IO-Link Safety – Test & Assessment

Specification

Related to
IO-Link Safety – System Extensions
Specification V1.1.3
and
IO-Link Test
Specification V1.1.3

Version 1.1.3
May 2023

Order No: 10.162

File name: IO-Link_Safety_Test-Spec_10162_V113_May23.docx

This version 1.1.3 of the IO-Link Safety – Test & Assessment specification has been prepared by the IO-Link Safety test team. It covers automated SCL test cases, functional test cases, change requests since V1.1, and requests from an assessment body.

Any comments, proposals, requests on this document are appreciated through the IO-Link CR database www.io-link-projects.com. Please provide name and email address.
Login: *IOLSafety-Test11*
Password: *Report*

Important notes:

NOTE 1 The IO-Link Community Rules shall be observed prior to the development and marketing of IO-Link products. The document can be downloaded from the www.io-link.com portal.

NOTE 2 Any IO-Link device shall provide an associated IODD file. Easy access to the file and potential updates shall be possible. It is the responsibility of the IO-Link device manufacturer to test the IODD file with the help of the IODD-Checker tool available per download from www.io-link.com.

NOTE 3 Any IO-Link device shall provide an associated manufacturer declaration on the conformity of the device. A corresponding form with references to relevant documents is available per download from www.io-link.com.

Disclaimer:

The attention of adopters is directed to the possibility that compliance with or adoption of IO-Link Community specifications may require use of an invention covered by patent rights. The IO-Link Community shall not be responsible for identifying patents for which a license may be required by any IO-Link Community specification, or for conducting legal inquiries into the legal validity or scope of those patents that are brought to its attention. IO-Link Community specifications are prospective and advisory only. Prospective users are responsible for protecting themselves against liability for infringement of patents.

The information contained in this document is subject to change without notice. The material in this document details an IO-Link Community specification in accordance with the license and notices set forth on this page. This document does not represent a commitment to implement any portion of this specification in any company's products.

WHILE THE INFORMATION IN THIS PUBLICATION IS BELIEVED TO BE ACCURATE, THE IO-LINK COMMUNITY MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS MATERIAL INCLUDING, BUT NOT LIMITED TO ANY WARRANTY OF TITLE OR OWNERSHIP, IMPLIED WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR USE.

In no event shall the IO-Link Community be liable for errors contained herein or for indirect, incidental, special, consequential, reliance or cover damages, including loss of profits, revenue, data, or use, incurred by any user or any third party. Compliance with this specification does not absolve manufacturers of IO-Link equipment, from the requirements of safety and regulatory agencies (TÜV, IFA, UL, CSA, etc.).

IO-Link ® is registered trademark. The use is restricted for members of the IO-Link Community. More detailed terms for the use can be found in the IO-Link Community Rules on www.io-link.com.

Conventions:

In this specification the following key words (in **bold** text) will be used:
shall: indicates a mandatory requirement. Designers **shall** implement such mandatory requirements to ensure interoperability and to claim conformity with this specification.
should: indicates flexibility of choice with a strongly preferred implementation.
can: indicates flexibility of choice with no implied preference (possibility and capability).
may: indicates a permission.

Publisher:
IO-Link Community
c/o PROFIBUS Nutzerorganisation e.V.
Haid-und-Neu-Str. 7
76131 Karlsruhe
Germany
Phone: +49 721 / 986 197 0
Fax: +49 721 / 986 197 11
E-mail: info@io-link.com
Web site: www.io-link.com

CONTENTS

0 Introduction

0.1 General

The single-drop digital communication interface (SDCI) technology described in part 9 of the IEC 61131 series focuses on small sensors and actuators in factory automation, which are nowadays using tiny little and cost-effective microcontrollers. With the help of the SDCI technology, the existing limitations of traditional signal connection technologies such as switching 0/24 V, analog 0 to 10 V, etc. can be turned into a smooth migration to pure digital communication. Classic sensors and actuators are usually connected to a fieldbus system via input/output modules in so-called remote I/O peripherals. The SDCI Master function enables these peripherals to map SDCI Devices onto a fieldbus system or build up direct gateways. Thus, parameter data can be transferred from the PLC level down to the sensor/actuator level and diagnosis data transferred back in turn by means of the SDCI communication. This is a contribution to consistent parameter storage and maintenance support within a distributed automation system. SDCI is compatible to classic signal switching technology according to part 2 of the IEC 61131 series.

The functional safety extensions for SDCI in [4] provide the necessary technology preconditions for Master and Devices to be turned into functional safety FS-Master and FS-Devices if they are developed according to safety standards such as IEC 61508/ISO13849.

This document specifies the test cases and associated test equipment for such FS-Master and FS-Devices. It provides the necessary preconditions for conformity testing to ensure inter-operability and allows manufacturers of FS-Master and FS-Devices to achieve a precondition of an assessment by a safety assessment body.

0.2 Patent declaration

There are no known patents for the technologies specified in this document. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The IO-Link Community shall not be held responsible for identifying any or all such patent rights.

The IO-Link Community maintains on-line data bases of patents relevant to their specifications. Users are encouraged to consult the databases for the most up to date information concerning patents.

IO-Link Safety – Test & Assessment

1 Scope

IEC 61131-9 specifies the Single-Drop digital Communication Interface (IO-Link™[1]) technology as a generic interface for connecting sensors and actuators (called Devices) to a Master unit, which may be combined with gateway capabilities to become a fieldbus remote I/O node (see [1]).

The SDCI physical interface is backward compatible with the usual 24 V I/O signalling specified in IEC 61131-2 and allows in addition digital point-to-point communication at transmission rates of 4,8 kbit/s, 38,4 kbit/s and 230,4 kbit/s.

The SDCI technology specifies parameterization, cyclic exchange of process data, and diagnosis as well as parameter Data Storage capabilities. It is also publicly available in [2].

The document "IO-Link Safety System Extensions" (see [4]) provides the necessary extensions to the basic IO-Link interface and system standard for functional safety communication including compatibility to OSSDe based sensors and the necessary configuration management. These extensions modify the architecture and behavior of Masters and thus turn them into FS-Masters. Devices are turned into FS-Devices.

This document specifies the test cases and associated test environments for FS-Master and FS-Devices designed and developped according to [1] or [2], [4], and relevant resolved Change Requests (CRs) within the Change Request Database described in [3]. It provides the necessary preconditions for conformity testing to ensure interoperability and enables manufacturers of FS-Master and FS-Devices to achieve conformity as a precondition of an assessment by a safety assessment body.

This document refers to [9] as the common basis for testing the non-safety-related parts of FS-Master and FS-Device. The common test cases are only referenced in this document. The current status of the Change-Request-Database shall be observed.

The structure of this document is described in clause 4.2.

In cases where conformance tests in accredited Test Centers unveil intentional implementation deviations or unintentional incorrect implementations that may have tremendous commercial effects, the rules in [10] apply.

Conformity with [4] cannot be claimed unless the requirements of this document are met.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60947-5-3, *Low-voltage switchgear and controlgear – Part 5-2: Control circuit devices and switching elements – Proximity switches*

IEC 61000-1-2, *Electromagnetic compatibility (EMC) - Part 1-2: General - Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena*

[1] IO-Link™ is a trade name of the "IO-Link Community". This information is given for the convenience of users of this specification and does not constitute an endorsement by the IO-Link Community of the trade name holder or any of its products. Compliance to this document does not require use of the registered logos for IO-Link™. Use of the registered logos for IO-Link™ requires permission of the "IO-Link Community".

IEC 61000-6-7, *Electromagnetic compatibility (EMC) - Part 6-7: Generic standards - Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations*

IEC 61131-2, *Programmable controllers – Part 2: Equipment requirements and tests*

IEC 61131-9, *Programmable controllers – Part 9: Single-drop digital communication interface for small sensors and actuators (SDCI)*

IEC 61496-1, *Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements and tests*

IEC 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*

IEC 61508-3:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 3: Software requirements*

IEC 61784-3:2016, *Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions*

IEC 62061, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*

IEC 62453, *Field device tool (FDT) interface specification*

ISO 12100:2010*, Safety of machinery – General principles for design – Risk assessment and risk reduction*

ISO 13849-1:2015, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

ISO 14119:2013, *Safety of machinery – Interlocking devices associated with guards – Principles for design and selection*

3 Terms, definitions, symbols, abbreviated terms and conventions

3.1 Common terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61131-1 and IEC 61131-2, as well as the following apply.

3.1.1
address
part of the M-sequence control to reference data within data categories of a communication channel

3.1.2
application layer
AL
<SDCI>[2] part of the protocol responsible for the transmission of Process Data objects and On-request Data objects

3.1.3
block parameter
consistent parameter access via multiple Indices or Subindices

[2] Angle brackets indicate validity of the definition for the SDCI (IO-Link) technology

113 **3.1.4**
114 **checksum**
115 <SDCI> complementary part of the overall data integrity measures in the data link layer in
116 addition to the UART parity bit

117 **3.1.5**
118 **CHKPDU**
119 integrity protection data within an ISDU communication channel generated through XOR
120 processing the octets of a request or response

121 **3.1.6**
122 **coded switching**
123 SDCI communication, based on the standard binary signal levels of IEC 61131-2

124 **3.1.7**
125 **COM1**
126 SDCI communication mode with transmission rate of 4,8 kbit/s

127 **3.1.8**
128 **COM2**
129 SDCI communication mode with transmission rate of 38,4 kbit/s

130 **3.1.9**
131 **COM3**
132 SDCI communication mode with transmission rate of 230,4 kbit/s

133 **3.1.10**
134 **COMx**
135 one out of three possible SDCI communication modes COM1, COM2, or COM3

136 **3.1.11**
137 **communication channel**
138 logical connection between Master and Device

139 Note 1 to entry: Four communication channels are defined: process channel, page and ISDU channel (for
140 parameters), and diagnosis channel.

141 **3.1.12**
142 **communication error**
143 unexpected disturbance of the SDCI transmission protocol

144 **3.1.13**
145 **cycle time**
146 time to transmit an M-sequence between a Master and its Device including the following idle
147 time

148 **3.1.14**
149 **Device**
150 single passive peer to a Master such as a sensor or actuator

151 Note 1 to entry: Uppercase "Device" is used for SDCI equipment, while lowercase "device" is used in a generic
152 manner.

153 **3.1.15**
154 **Direct Parameters**
155 directly (page) addressed parameters transferred acyclically via the page communication
156 channel without acknowledgement

157 **3.1.16**
158 **dynamic parameter**
159 part of a Device's parameter set defined by on-board user interfaces such as teach-in buttons
160 or control panels in addition to the static parameters

3.1.17
Event
instance of a change of conditions in a Device

Note 1 to entry: Uppercase "Event" is used for SDCI Events, while lowercase "event" is used in a generic manner.

Note 2 to entry: An Event is indicated via the Event flag within the Device's status cyclic information, then acyclic transfer of Event data (typically diagnosis information) is conveyed through the diagnosis communication channel.

3.1.18
fallback
transition of a port from coded switching to switching signal mode

3.1.19
inspection level
degree of verification for the Device identity

3.1.20
interleave
segmented cyclic data exchange for Process Data with more than 2 octets through subsequent cycles

3.1.21
ISDU
indexed service data unit used for acyclic acknowledged transmission of parameters that can be segmented in a number of M-sequences

3.1.22
M-sequence
sequence of two messages comprising a Master message and its subsequent Device message

3.1.23
M-sequence control
first octet in a Master message indicating the read/write operation, the type of the communication channel, and the address, for example offset or flow control

3.1.24
M-sequence error
unexpected or wrong message content, or no response

3.1.25
M-sequence type
one particular M-sequence format out of a set of specified M-sequence formats

3.1.26
Master
active peer connected through ports to one up to n Devices and which provides an interface to the gateway to the upper-level communication systems or PLCs

Note 1 to entry: Uppercase "Master" is used for SDCI equipment, while lowercase "master" is used in a generic manner.

3.1.27
message
<SDCI> sequence of UART frames transferred either from a Master to its Device or vice versa following the rules of the SDCI protocol

3.1.28
On-request Data
acyclically transmitted data upon request of the Master application consisting of parameters or Event data

208 **3.1.29**
209 **physical layer**
210 first layer of the ISO-OSI reference model, which provides the mechanical, electrical, functional
211 and procedural means to activate, maintain, and de-activate physical connections for bit
212 transmission between data-link entities

213 Note 1 to entry: Physical layer also provides means for wake-up and fallback procedures.

214 [SOURCE: ISO/IEC 7498-1, 7.7.2, modified – text extracted from subclause, note added]

215 **3.1.30**
216 **port**
217 communication medium interface of the Master to one Device

218 **3.1.31**
219 **port operating mode**
220 state of a Master's port that can be either INACTIVE, DO, DI, FIXEDMODE, or SCANMODE

221 **3.1.32**
222 **Process Data**
223 input or output values from or to a discrete or continuous automation process cyclically
224 transferred with high priority and in a configured schedule automatically after start-up of a
225 Master

226 **3.1.33**
227 **Process Data cycle**
228 complete transfer of all Process Data from or to an individual Device that may comprise several
229 cycles in case of segmentation (interleave)

230 **3.1.34**
231 **single parameter**
232 independent parameter access via one single Index or Subindex

233 **3.1.35**
234 **SIO**
235 port operation mode in accordance with digital input and output defined in IEC 61131-2 that is
236 established after power-up or fallback or unsuccessful communication attempts

237 **3.1.36**
238 **static parameter**
239 part of a Device's parameter set to be saved in a Master for the case of replacement without
240 engineering tools

241 **3.1.37**
242 **switching signal**
243 binary signal from or to a Device when in SIO mode (as opposed to the "coded switching" SDCI
244 communication)

245 **3.1.38**
246 **system management**
247 SM
248 <SDCI> means to control and coordinate the internal communication layers and the exceptions
249 within the Master and its ports, and within each Device

250 **3.1.39**
251 **UART frame**
252 <SDCI> bit sequence starting with a start bit, followed by eight bits carrying a data octet,
253 followed by an even parity bit and ending with one stop bit

254 **3.1.40**
255 **wake-up**
256 procedure for causing a Device to change its mode from SIO to SDCI

3.1.41
wake-up request
WURQ
physical layer service used by the Master to initiate wake-up of a Device, and put it in a receive ready state

3.2 IO-Link Safety: Additional terms and definitions

For the purposes of this document, the following additional terms and definitions apply.

3.2.1
error
discrepancy between a computed, observed, or measured value or condition and the true, specified or theoretically correct value or condition

Note 1 to entry: Errors may be due to design mistakes within hardware/software and/or corrupted information due to electromagnetic interference and/or other effects.

Note 2 to entry: Errors do not necessarily result in a *failure* or a *fault*.

SOURCE: [IEC 61508-4:2010], [IEC 61158]

3.2.2
failure
termination of the ability of a functional unit to perform a required function or operation of a functional unit in any way other than as required

Note 1 to entry: The definition in IEC 61508-4 is the same, with additional notes.

Note 2 to entry: Failure may be due to an error (for example, problem with hardware/software design or message disruption)

SOURCE: [IEC 61508-4:2010, modified], [ISO/IEC 2382-14.01.11, modified]

3.2.3
fault
abnormal condition that may cause a reduction in, or loss of, the capability of a functional unit to perform a required function

Note 1 to entry: IEV 191-05-01 defines “fault” as a state characterized by the inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources.

SOURCE: [IEC 61508-4:2010, modified], [ISO/IEC 2382-14.01.10, modified]

3.2.4
FS-Device
single passive peer such as a functional safety sensor or actuator to a Master with functional safety capabilities

3.2.5
FS-Master
active peer with functional safety capabilities connected through ports to one up to n Devices or FS-Devices and which provides an interface to the gateway to the upper-level communication systems (NSR or SR) or controllers with functional safety capabilities

3.2.6
FSP parameter
parameter set for the administration and operation of the IO-Link Safety protocol

3.2.7
FST parameter
parameter set for the safety-related technology of an FS-Device, for example light curtain

304 **3.2.8**
305 **Safety PDU**
306 Safety Protocol Data Unit
307 SPDU
308 PDU transferred through the safety communication channel

309 [SOURCE: IEC 61784-3:2021, 3.1.47, modified – Notes have been removed and admitted term
310 has been added.]

311 **3.2.9**
312 **SCL Tests**

313 safety-related communication protocol tests based on systematically developed and certified
314 test scripts whereat using protocol state machines, simulation, model checking, and automated
315 testcase generation, which are lock-sealed by signature (e.g. CRC) and which can only be
316 changed through an entire safety reassessment.

317 Note 1 to entry: Core part of both types of tests for FS-Device and FS-Master are the SCL test scripts in Clause
318 9 and Clause 12 in this document.

319 **3.2.10**
320 **Functional Tests**

321 non-safety-related visual, manual, or automated tests based on test-to-pass, test-to-fail, and
322 test coverage analysis of specified functions such as protocol environment, parameterization,
323 time conditions, and performance aspects, which can be updated according to approved change
324 requests without impacting the SCL tests in test systems.

325

326 ## 3.3 Symbols and abbreviated terms

AL	application layer	
BEP	bit error probability	
C/Q	connection for communication (C) or switching (Q) signal (SIO)	
CRC	cyclic redundancy check	
DDO	Device data object	
DI	digital input	
DL	data link layer	
DO	digital output	
DTI	Device Tool Interface	
FDI	Field Device Integration	[IEC 62769]
FDT	Field Device Tool	[IEC 62453]
FS	functional safety	
FSCP	functional safety communication profile (for example IEC 61784-3-x series)	
FSDT	FS-Device tester	
FS-AI	functional safety analog input	
FS-DI	functional safety digital input	
I/O	input / output	
IODD	IO Device Description	
IOPD	IO-Link Parameterization & Diagnostic tool	
IOL-S	IO-Link Safety	
L-	power supply (-)	
L+	power supply (+)	
SMTU	Safety Master Tester Unit	
SDTU	Safety Device Tester Unit	
N24	24 V extra power supply (-); Port class B	

NSR	non-safety-related	
OD	On-request Data	
OK	"OK", values or state correct	
OSSD	output signal switching device (self-testing electronic device with built-in OSSD)	[IEC 61496-1]
OSSDe	output signal switching device (self-testing electronic device with built-in OSSD)	[4]
OSSD1/2e	pin assigment of both OSSDe signals	[4]
OSSDm	output signal switching device (relay and solid state outputs)	[IEC 60947-5-5]
P24	24 V extra power supply (+); Port class B	
PD	Process Data	
PDin	functional safety input process data (from an FS-Master's view)	
PDout	functional safety output process data (from an FS-Master's view)	
PDCT	port and Device configuration tool	
PFH	(average) probability of a dangerous failure per hour	
PID	program interface description	
PL	physical layer	
PLC	programmable logic controller	
PS	power supply (measured in V)	
RIO	remote I/O	
SCL	safety communication layer	
SDCI	single-drop digital communication interface	[IEC 61131-9]
SIO	standard input output (digital switching mode)	[IEC 61131-2]
SM	system management	
SMTA	safety master tester application	
SDTA	safety device tester application	
SPDU	safety protocol data unit	
SR	safety-related	
SSI	synchronous serial interface (usually for encoders)	
TAF	temporary acknowledgment file	
TBF	temporary backchannel file	
TPF	temporary parameter file	
UART	universal asynchronous receiver transmitter	
UML 2	unified modeling language, edition 2	[ISO/IEC 19505-2]
WURQ	wake-up request pulse	
XML	extensible markup language	

3.4 Conventions

3.4.1 Test case template

This document uses a dedicated template as shown in Table 1 for the particular test cases. It contains explanations on how to use items in the left column.

332 **Table 1 – Test case template**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_nnnn (nnnn = 4-digit consecutive number starting with 0001)
Name	Characteristic name of the test case (see 0)
Purpose (short)	Short description of the purpose of the test case (one line maximum)
Equipment under test (EUT)	FS- Master, FS- Device, IODD, DedicatedTool, FS-MasterTool
Test case version	Starts with 1.0. Incremented first number indicates significant changes due to new functionality, the second one indicates changes within the test case
Category / type	See 3.4.3
Specification (clause)	[Bibliography, nn], clause or subclause, figure, table, chart, etc.
Configuration / setup	For example: Reference-FS-Master and EUT (FS-Device)

333

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Comprehensive description of the purpose of the test case (can be several lines). Shall not contain preconditions or instructions.
Precondition	Initial mode of the test set (both EUT and test environment) to be set prior to testing or ID of previous test. Examples: *Tester precondition/Measurement instrument pre-set* … *EUT precondition* …
Procedure	- Step by step description of the test, each step marked by characters a), b), c), etc. - Loops are possible (see [9]) - "Test step macros" are possible, shall be named "TS_<domain>_xxxx", and defined within the general clause. Examples: a) Test step macro α b) Evaluation 1) c) Single instruction d) Evaluation 2) …
Test parameter	- Shall be specified using definitions within [2] - Can be identified using A), B), C), etc. - Shall be linked to procedure steps, for example a), b), c), etc. - Test loops can be used as specified in 3.3.1.3 in [9]
Post condition	Final mode of the EUT and its test environment. It is possible to keep evaluation results as input for subsequent test cases if a certain test case gets too complex.

334

TEST CASE RESULTS	CHECK / REACTION
Evaluation	- A sequence of steps, where the status of the EUT is checked at each step - Each evaluation step is linked to a procedure step - Each evaluation step to be marked by a numeric character 1), 2), 3), etc. Example: 1) Parameter β, Parameter γ, … 2) Value λ …
Test passed	Test verdict if defined expectations are fulfilled, such as: - Approve reaction at each evaluation step whether it is correct ("and") - In case of alternate paths are defined, they shall be approved as defined ("or"). - Approve if deviations can be tolerated as exceptions (see [10]).
Test failed (examples)	Describe incorrect reaction and describe the reasons for failing
Report	Create brief data of test results such as measurement values, states, Events, implementation exceptions, test exceptions (see [10]), etc., and if test passed or not passed. Data shall be sufficient for a test certificate (option).

335

336 ### 3.4.2 Naming of test cases

337 Figure 1 shows the structure of the name of a test case.

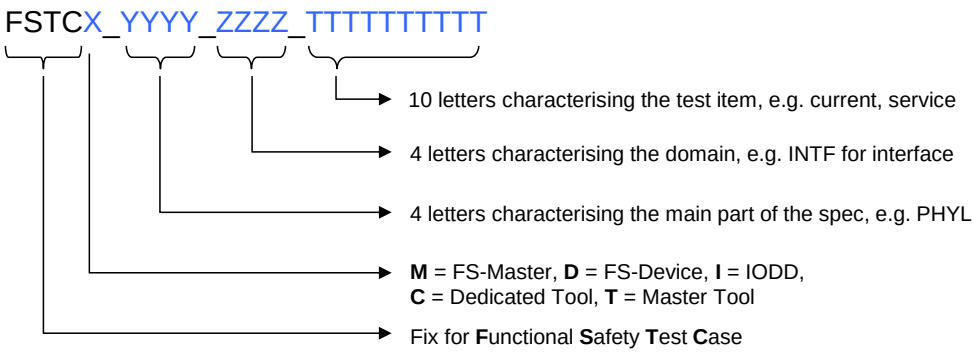


Figure 1 – Structure of the test case name

3.4.3 Categories and types of test cases

Table 2 shows the used test case categories within this document.

Table 2 – Test case categories

Category	Definition
Master Physical Layer test	Measure port voltages, currents, and timings
FS-Master OSSD test	Measure specific port voltages, currents, and timings
Device Physical Layer test	Measure Device voltages, currents, and timings
FS-Device OSSD test	Measure specific FS-Device voltages, currents, and timings
Master DL protocol test	Check Master protocol on DL level
FS-Master DL protocol test	Check FS-Master protocol specifics on DL level (e.g. READY pulse)
Device DL protocol test	Check Device protocol on DL level
FS-Device DL protocol test	Check FS-Device protocol specifics on DL level (e.g. READY pulse)
Master/Device protocol test	Master/Device interaction test on DL level
FS-Master/Device prot. test	FS-Master and FS-Device interaction test on DL level
Device PREOPERATE test	Device protocol test in PREOPERATE mode
FS-Device PREOPERATE test	FS-Device protocol test in PREOPERATE mode
Device OPERATE test	Device protocol test in OPERATE mode
FS-Device OPERATE test	FS-Device protocol test in OPERATE mode
Device ISDU test	Device ISDU protocol test
FS-Device ISDU test	FS-Device ISDU protocol test: FSP and FST parameterization
Device Event test	Test of Device Event handling
Device Direct Parameter test	Test of Device's Direct Parameter page handling
Device application test	Test of Device's application behavior
IODD safety test	Test whether IODD is conforming to IO-Link Safety Extensions spec.
IODD verification test	Test whether IODD and the actual FS-Device parameter are matching
IODD verify test (FSP)	Test whether IODD and the actual FS-Device parameter are matching
IODD verification test	Test whether IODD and the actual FS-Device parameter are matching
Master Data Storage test	Test of Master's Data Storage mechanisms

Table 3 shows the used test case types within this document.

Table 3 – Test case types

Category	Definition
Test-to-pass	Positive test. A function shall perform as specified. Usually, the tests of a domain are beginning with these tests, where no stress is applied.
Test-to-fail	Negative or stress test. A function shall react with a defined behavior, for example an error indication when boundary conditions are exceeded.

3.4.4 Naming of variables

Due to the possible implementation of the test cases in software, all used symbols and abbreviated terms in this document (see 3.3) are written in upper case letters without superscript or subscript.

3.4.5 Memory and transmission octet order

Figure 2 demonstrates the order that shall be used when transferring WORD based data types from memory to transmission and vice versa.

NOTE Existing microcontrollers can differ in the way WORD based data types are stored in memory: "big endian" and "little endian". If designs are not taking into account this fact, octets can be erroneously permuted for transmission.

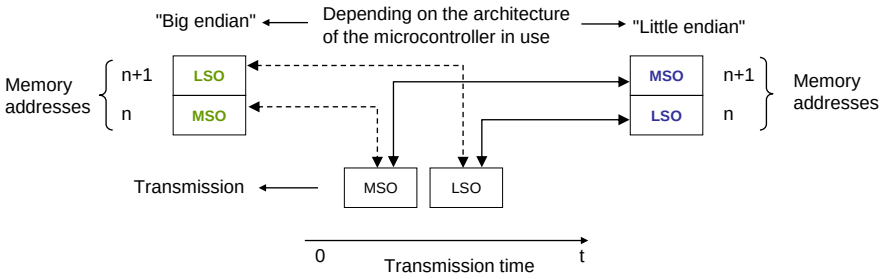


Figure 2 – Memory and transmission octet order

3.4.6 Behavioral descriptions

The notations of UML 2 are used, mainly timing diagrams [7].

4 Strategy for testing IO-Link Safety devices

4.1 Purpose of this test specification

This document specifies the test cases and the necessary test equipment for FS-Master and FS-Devices in conjunction with its parent documents [9] and [4]. It covers OSSDe feature tests as well as functional safety communication protocol tests. It covers also relevant test cases out of [9] via references since both FS-Master and FS-Device are based on IO-Link Technology as "black channel".

The functional safety communication protocol tests are derived from a UML state machine simulation engine and automated to a large extent.

This document provides the necessary information for the development of test instructions for a particular test set in test laboratories.

4.2 Structure of this document

Clause 5 specifies the test cases for the physical layer test of FS-Master and FS-Devices. They mainly require individual manual tests of both signal channels Pin4 and Pin2 (OSSDe) with variable power supplies, voltage and current meters as well as oscilloscopes.

Clause 6 specifies the XML schema and business rules tests for IODDs of FS-Devices using XML snippet files and the IO-Link Checker Tool. Additional test cases verify the consistency of the particular IODD and the actual FSP and FST parameters within the associated Device.

Clause 7 specifies additional test cases for FS-Devices verifying the consistency of the particular IODD and the actual FSP and FST parameters within the associated FS-Device and its operational modes.

Clause 8 specifies additional test cases for FS-Devices regarding safety measures such as the VerifyRecord and the protocol watchdog.

Clause 9 contains the automatically generated test cases via UML modelling, model checking and simulation for the safety communication layer (protocol) of the FS-Device.

Clause 10 specifies additional test cases for an FS-Device in a reference FS-Master system.

Clause 11 specifies the FS-Master Port operations test.

Clause 12 contains the automatically generated test cases via UML modelling, model checking and simulation for the safety communication layer (protocol) of the FS-Master.

Clause 13 specifies additional test cases for an FS-Master with reference FS-Devices.

Clause 14 specifies additional test cases for an FS-Master Tool regarding IODD and Dedicted Tool operations.

Clause 15 provides information on required environmental tests and relevant EMC standards as well as special approaches for functional safety.

Annex A describes the test tools, their requirements, and the test configurations. Annex B specifies requirements for safety assessments. Annex C provides information about support for conformance testing. Annex D refers to the Manufacturer Declaration for FS-Master and FS-Device. Annex E provides an index on all test cases in this document. Annexes A, B, and D are safety-related.

4.3 Conformity classes

4.3.1 Overview

All FS-Devices shall support ISDU and thus the rules in Clause 4.3.3 of [9] apply.

4.3.2 FS-Devices with OSSDe

Safety devices with a single stop function such as e-stop buttons, two-hands control, mats, light curtain, etc. are candidates to become an FS-Device with both OSSDe and digital safety communication and thus serving the markets for FS-DI modules in both the classic remote I/Os as well as the extended functionality with identification, parameterization, diagnosis, and Data Storage features to participate in modern automation concepts when connected to an FS-Master.

4.3.3 FS-Devices without OSSDe

Safety devices with measurement capabilities such as for temperature, strain, torque, pressure, object types, distance, position, rotation, or multi-sensing, or actuators such as motor starters, drives, and mechatronics containing sensors and actuators such as door locks, grippers, low voltage witch gears are candidates to become an FS-Device without OSSDe.

FS-Devices without OSSDe can benefit from extra 24 V power via class B.

4.3.4 FS-Master

FS-Master shall support all features specified in [4], which are not marked explicitly as optional. All Ports shall provide power supply ≥ 200 mA, at least one Port shall supply 1000 mA.

4.3.5 FS-Master with FS-DI/OSSDe support

FS-Master can provide FS-DI/OSSDe support to benefit from existing safety devices on the market as long as there are no versions available with SDCI-FS.

4.3.6 FS-Master with Port Class B

An FS-Master with Ports Class B is possible, however without FS-DI/OSSDe support. The rules in Clause 5.4.2 of [2] apply.

4.4 Test of FS-Devices

4.4.1 General

In general, the rules in Clause 5.1 of [9] apply.

4.4.2 Compatibility with non-safety Master (tester) Ports

4.4.2.1 Device properties for the analysis of the test behavior

It may happen that an FS-Device is connected to a Port in the non-safety mode of an FS-Master/Master or a USB-Master. Since some start-up features of the FS-Devices such as ready pulse and OSSDe are "unknown" to a non-safety Master Port, they may impair (test) functionality. It is not possible, to avoid completely all possible conflicts due to the huge number of deployments of Masters in the field and fortunately these cases do not occur very often.

However, this cannot be assumed for Device tester ("USB-Master") in general and therefore the possible conflicts have been analyzed with the help of a dummy representing a typical FS-Device and a tester representing a typical Master Port.

Table 4 shows the characteristics of the dummy FS-Device for the analysis.

Table 4 – Features of the dummy FS-Device

Feature	Characteristic/value	Remark
Self-testing time	3 s	–
Ready pulse	Implemented as specified	–
Switching to OSSDe mode	1.1 s after the Ready pulse as specified in [4]	After switching to OSSDe mode, the FS-Device shall not react on any wake-up or other disturbances.
No OSSDe mode	1. FS-Device is awaiting wake-up pulse 2. FS-Device reacts on "fallback" command	1. Regular behavior 2. FS-Device switches to SIO mode

Table 5 shows possible conflicts and references the remedies.

Table 5 – Possible conflicts

Tester (Master) behavior	FS-Device behavior	Remedy
Master Port starts wake-up after starting time of the FS-Device, which includes self-test and other waiting times (total > 4,2 s).	FS-Device switches automatically to OSSDe mode and does not react on wake-up	R1
Master Port does not send the VerifyRecord.	FS-Device sends Event 0xB00A	R2
Test of PDInvalid cannot be performed	FS-Device only provides PDInvalid information if SCL is in SPDU exchange mode	R3
Test of SystemComand "Application Reset"	FS-Device requires more unchanged parameters	R4
Test of other SystemCommands	FS-Device rejects them in armed mode	R5

Table 6 shows the requirements for retrofitting of Device testers. Those modified testers can be used to perform standard tests according to [9].

446 **Table 6 – Retrofitting of Device testers for IO-Link Safety**

Remedy	Requirements	Reference
R1	Device tester shall support the safety start-up: - Port Power Off/On ("Power cycle") - Await Ready pulse - Regular wake-up procedure - VerifyRecord not required	All TestCases requiring "Power cycle"
R2	Event 0xB00A shall be ignored	SDCI_TC_0072 (see Table 9)
R3	Device tester shall send VerifyRecord and start SCL	SDCI_TC_0312, SDCI_TC_0313 (see Table 9)
R4	"AuthenticityRecord" shall be treated in the same manner as "ApplicationSpecificTag" or "FunctionTag"	SDCI_TC_0317, SDCI_TC_0318 (see Table 9)
R5	The Device tester shall support the change to commissioning mode (see Clause G.1 in [4]) and perform the tests subsequently. The Device tester shall ensure the proper parameter set in the FS-Device after the test.	SDCI_TC_0317 (see Table 9)

447

448 ### 4.4.3 Physical Layer tests

449 Figure 3 shows the workflow for physical layer tests. They mainly comprise measurements of
450 the I/Q connection, which is necessary for OSSDe.

451 Table 7 lists the test cases to be performed during step 1. It contains the non-safety test cases
452 in its first part and the safety-specific test cases within its second part.

453 **Table 7 – Physical layer tests**

Major feature	Test cases	Remarks
Power and signal levels (C/Q)	See Clause 5.3 in [9]	–
Wake-up detection	See Clause 5.5 in [9]	–
Waveform and timings	See Clause 5.6 in [9]	–
Signal on I/Q	FSTC_0006 to _0007	Clause 5.3 in this document
Discrepancy, test pulses, Ready pulse	FSTC_0013 to _0017	Clause 5.5 in this document

454

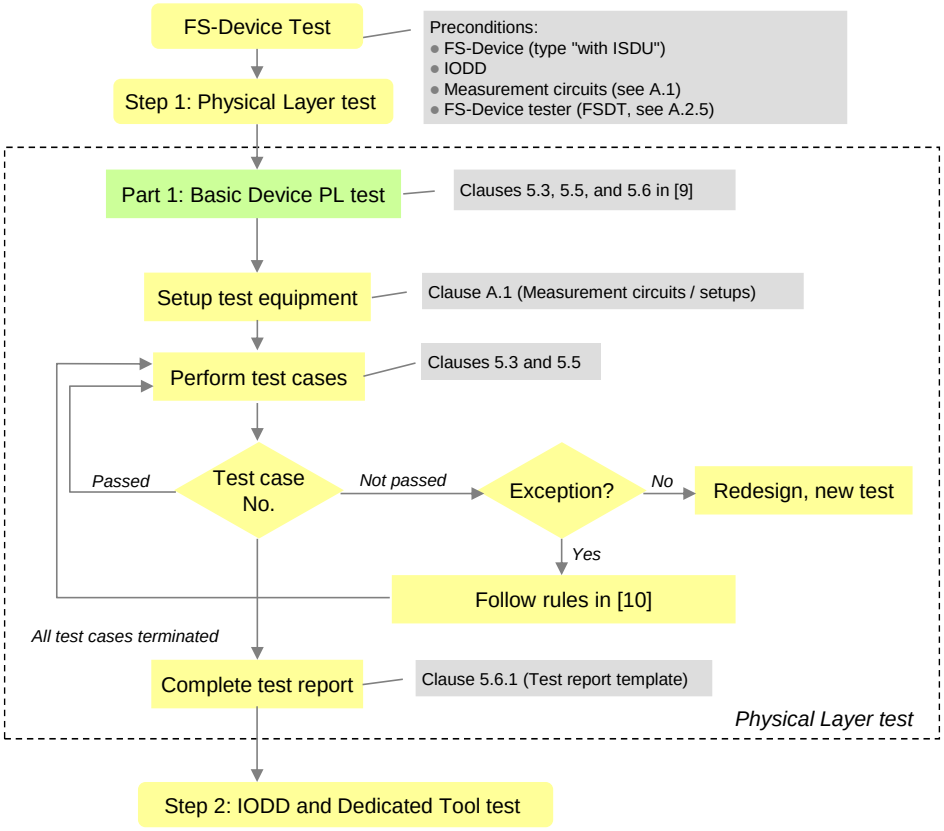


Figure 3 – Step 1 of the FS-Device test sequence (PL)

4.4.4 IODD and Dedicated Tool tests

The rules in Clause 7.1 of [9] apply. Figure 4 shows the workflow for IODD and Dedicated Tool tests of the FS-Device. Basic IODD tests are specified in [5].

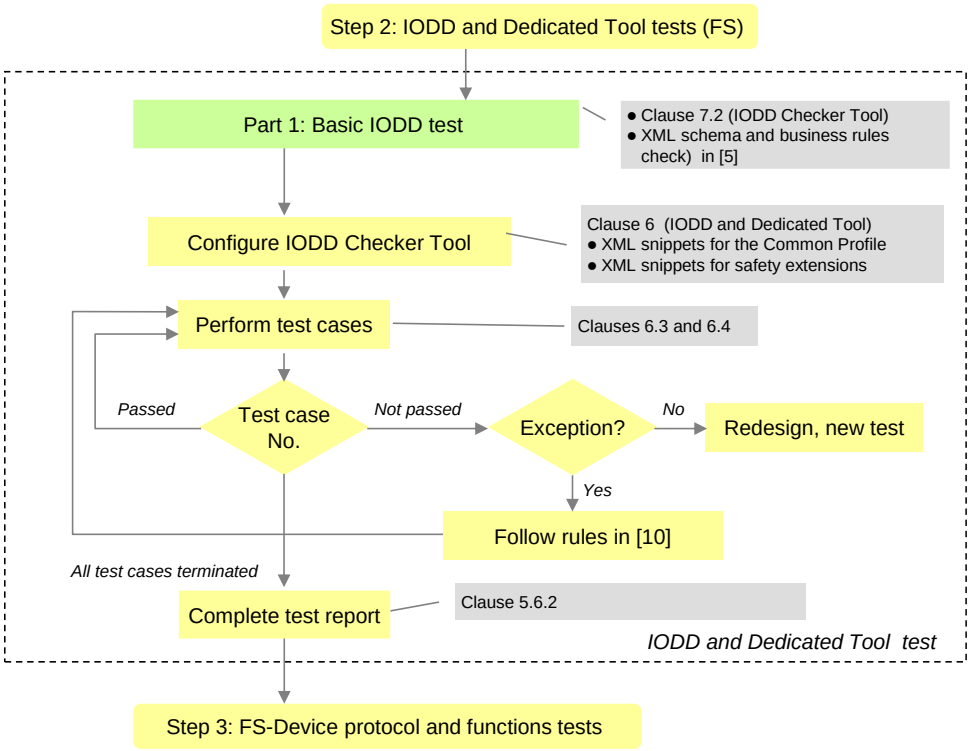


Figure 4 – Step 2 of the FS-Device test sequence (IODD + Dedicated Tool)

462 Table 8 lists the test cases to be performed during step 2. It contains the test cases for the non-
463 safety parameters within the first part and the safety-specific within the second part.

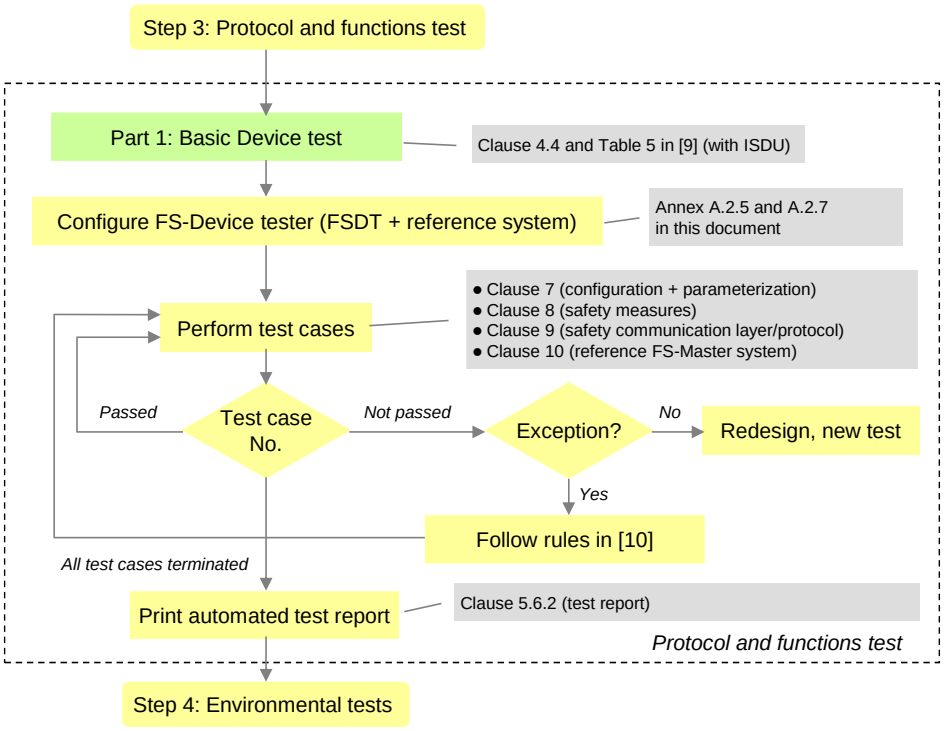
464 **Table 8 – IODD and Dedicated Tool of FS-Device**

Major feature	Test cases	Remarks
Basic IODD schema and business rules	See [5]	–
IODD (FS) + CRC	FSTC_0018	Clause 6.3 in this document
Dedicated Tool	FSTC_0019	Clause 6.4 in this document

465

466 ### 4.4.5 FS-Device protocol and functions tests

467 Figure 5 shows the workflow for protocol and functions testing. Tests are restricted to FS-
468 Devices with ISDU and Data Storage according to [2] and [3].



469

470 **Figure 5 – Step 3 of the FS-Device test sequence (protocol + functions)**

471 Table 9 lists the test cases to be performed during step 3. It contains the test cases for the
472 "black channel" operations of an FS-Device within the first part and the safety-specific within
473 the second part.

474 **Table 9 – Set of protocol test cases for FS-Devices**

Major feature	Test cases	Remarks
STARTUP	See 6.2 in [9]	–
PREOPERATE	See 6.3 in [9]	–
OPERATE	See 6.4 in [9]	For SDCI_TC_0312 and SDCI_TC_0313 see Table 6
ISDU	See 6.5 in [9]	–
Events	See 6.6 in [9]	For SDCI_TC_0072 see Table 6
Data Storage	See 6.7 in [9]	–
Direct Parameter page 1	See 6.9 in [9]	–

Major feature	Test cases	Remarks
Predefined parameters	See 6.10 in [9]	–
Block parameter	See 6.11 in [9]	–
IODD based parameter verification	See 7.3 in [9]	–
IODD based functional system tests	See 7.4 in [9]	For SDCI_TC_0317 and SDCI_TC_0318 see Table 6
Configuration + parameterization	FSTC_0020 to _0034	Clause 7 in this document
Safety measures	FSTC_0035 to _0051	Clause 8 in this document
Safety protocol (SCL)	FSTC_0052 to _0147	Clause 9 in this document
Dedicated Tool, replacement, Events	FSTC_0148 to _0154	Clause 10 in this document

4.4.6 Environment

Figure 6 shows step 4 of the FS-Device test. It contains references to the relevant clauses in this specification and consists of EMC tests according to generic or product-specific standards specified in 15.2. A successfully terminated FS-Device test can be completed by a manufacturer declaration as defined in Annex D.

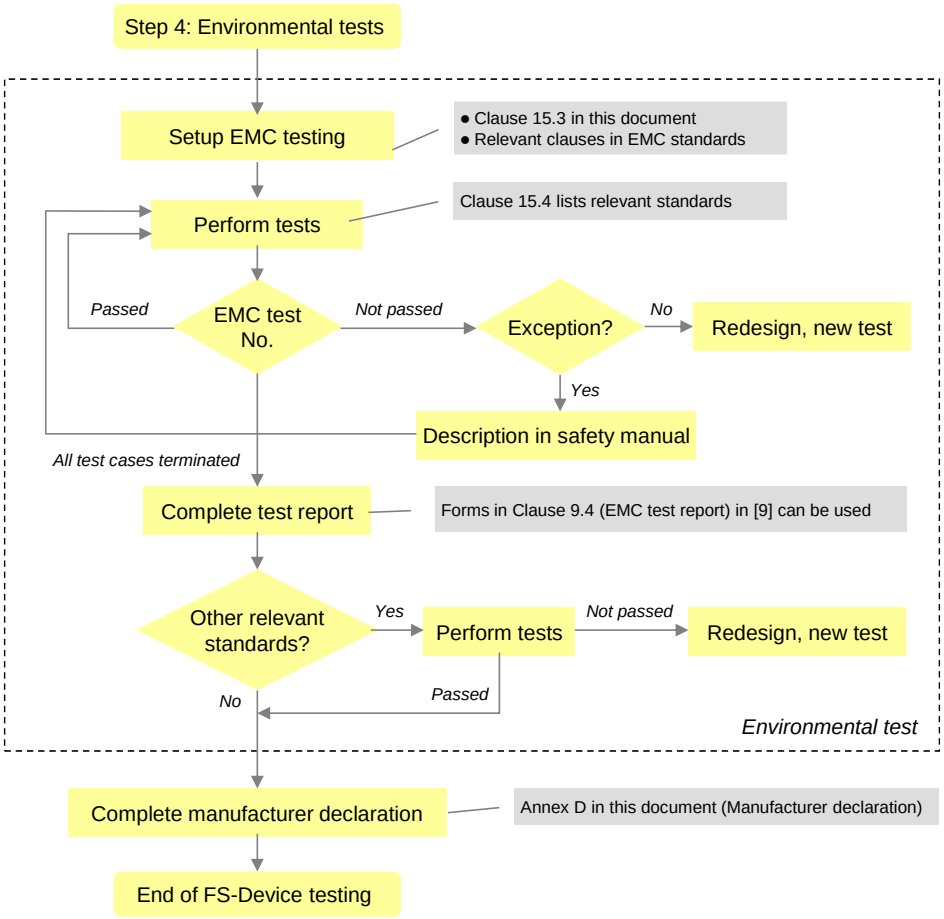


Figure 6 – Step 4 of the FS-Device test sequence (EMC)

4.5 Test of FS-Masters

4.5.1 General

The test of FS-Masters consists of four steps: Physical layer test, Port operations and protocol test, FS-Master Tool test, and environmental test. The requirements for FS-Master-Tester are specified in A.2.4 and A.4.

4.5.2 Physical Layer tests

Figure 7 illustrates step 1 of the FS-Master test sequence. It contains references to the relevant clauses in [9] and in this specification and consists of a visual check and manually performed measurements.

If the FS-Master shows specific connectors, cables, or color codings, these deviations shall be documented within the user manual with respect to the original definitions in [2] and [4].

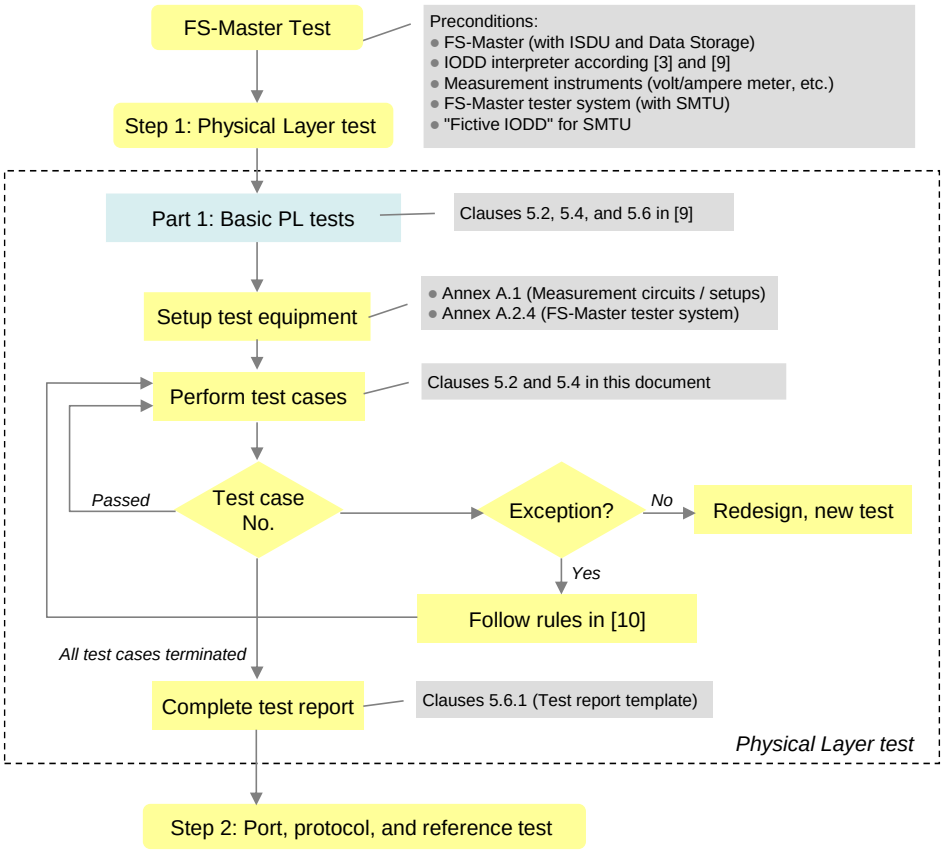


Figure 7 – Step 1 of the FS-Master test sequence (PL)

Table 10 lists the test cases to be performed during step 1. It contains the non-safety test cases in its first part and the safety-specific test cases within its second part.

Table 10 – Physical layer tests

Major feature	Test cases	Remarks
Power and signal levels	Clause 5.2 in [9]	–
Wake-up detection	Clause 5.4 in [9]	–
Waveform and timings	Clause 5.6 in [9]	–
Port Power OFF/ON and Signal on I/Q	FSTC_0001 to _0005	See 5.2 in this document
Discrepancy, test pulse resilience and Ready	FSTC_0008 to _0012	See 5.4 in this document

4.5.3 Port operations, protocol, and reference tests

Figure 8 illustrates step 2 of the FS-Master test.

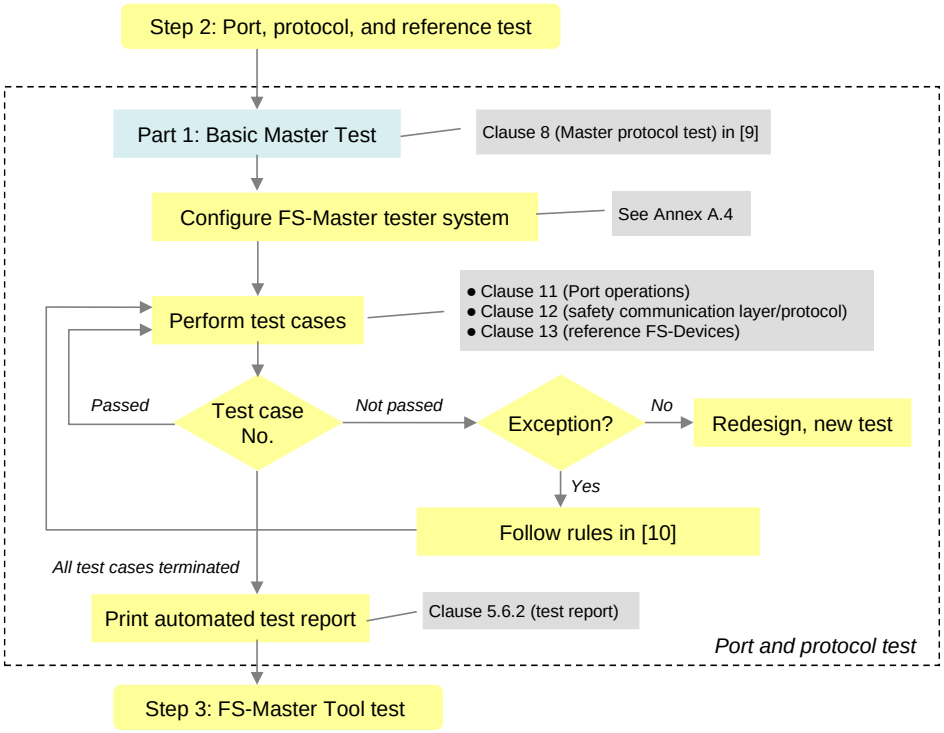


Figure 8 – Step 2 of the FS-Master test sequence (Protocol)

Table 11 lists the FS-Master Port operations and protocol tests. It contains the non-safety test cases in its first part and the safety-specific test cases within its second part.

Table 11 – FS-Master protocol tests

Major feature	Test cases	Remarks
Timings	Clause 8.2 in [9]	–
Process Data (PD)	Clause 8.3 in [9]	–
On-request Data (OD)	Clause 8.4 in [9]	–
STARTUP	Clause 8.5 in [9]	–
PREOPERATE	Clause 8.6 in [9]	–
OPERATE	Clause 8.7 in [9]	–
Fallback	Clause 8.8 in [9]	–
Retry	Clause 8.9 in [9]	–
ISDU (applic. errors)	Clause 8.10 in [9]	–
ISDU (derived errors)	Clause 8.11 in [9]	–
ISDU (limit checks)	Clause 8.12 in [9]	–
Events	Clause 8.13 in [9]	–
Data Storage	Clause 8.14 in [9]	–
Port operations	FSTC_0155 to _0163 FSTC_0196 to _0197	See 11 in this document
Safety protocol (SCL)	FSTC_0164 to _0176	See 12 in this document
Reference FS-Devices	FSTC_0177 to _0189	See 13 in this document

4.5.4 FS-Master Tool

Figure 9 illustrates step 3 of the FS-Master test. It contains references to the relevant clauses in [9] and in this specification and consists of tests regarding importability (CRC signature check) and display conventions (yellow color), as well as parameter access via DTI and DDO exchange.

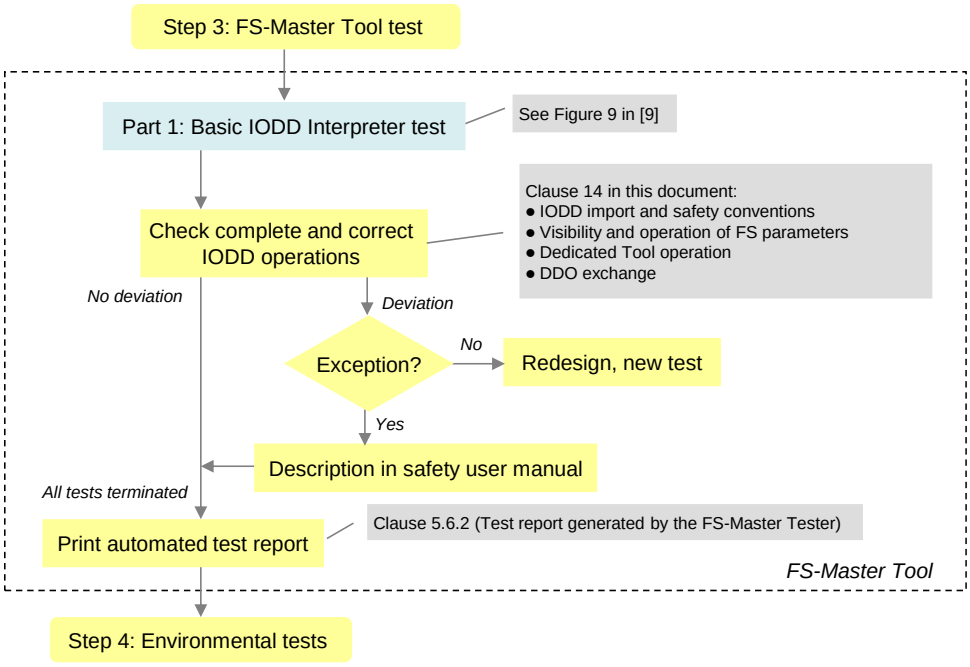


Figure 9 – Step 3 of the FS-Master test sequence (FS-Master Tool)

4.5.5 Environment

Figure 10 illustrates step 4 of the FS-Master test. It contains references to the relevant clauses in this specification and consists of EMC tests according to generic or product-specific standards specified in 15.2. A successfully terminated FS-Master test can be completed by a manufacturer declaration as defined in Annex D.

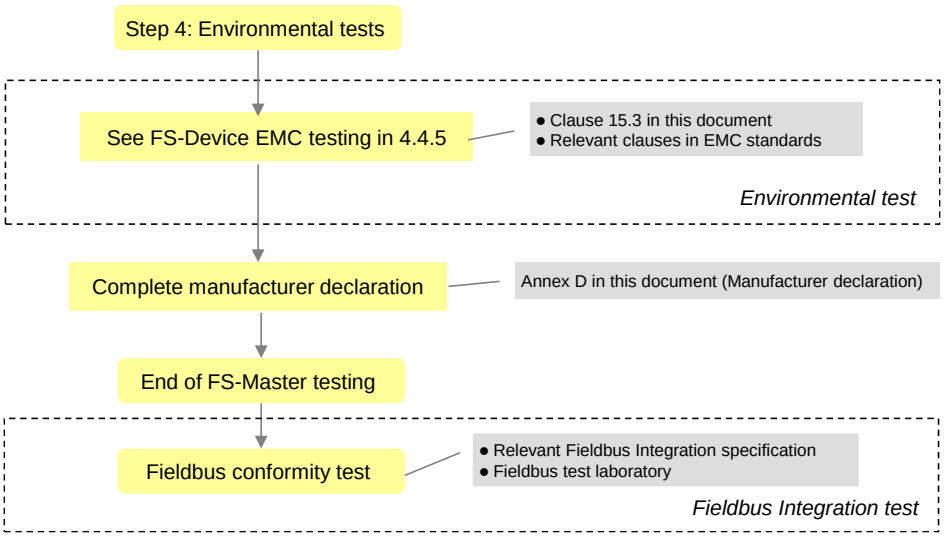


Figure 10 – Step 4 of the FS-Master test (EMC)

5 Physical Layer (PL) tests

5.1 General

The approach, nature and coverage of the FS-Device and FS-Master physical layer tests are described in 4.4.3 and 4.5.2. Figure 3 and Figure 7 illustrate the entire test procedure including the safety part.

The tests of static characteristics of FS-Master Ports comprise Power OFF/ON and the I/Q pin, which is required for OSSDe2 (FS-DI). The tests of dynamic characteristics of FS-Master Ports comprise Ready pulse, discrepancy of OSSDe signals, OSSDe test pulses, and Wake-up delay.

The tests of static characteristics of FS-Devices comprise power consumption and residual voltages at OSSDe2 (I/Q pin). The tests of dynamic characteristics of FS-Devices comprise discrepancy of OSSDe signals, OSSDe test pulses, Ready pulse duration, and delay to OSSDe operation.

5.2 Static characteristics of the FS-Master interface (FS-DI)

5.2.1 Power1 switchable OFF/ON

Table 12 defines the test conditions for this test case.

Table 12 – Power1 switchable OFF/ON

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0001
Name	FSTCM_PHYL_PWR1_SWITCHABLE
Purpose (short)	Power1 on any port can be switched OFF and ON
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master Physical Layer test, test-to-pass
Specification (clause)	[4] 4.1.4, 5.9
Configuration / setup	Variable Master input voltage PSM and variable current sink according to Figure A.1

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Measure voltage VSM at different loads while Power1 = OFF/ON
Precondition	Test setup: Current sink between L+ and L-, voltmeter in parallel. EUT: PORT_DI (see A.4.2 in [9])
Procedure	a) Identify current capability of tested port (1000 mA or 200 mA) and memorize as ISMmax value *;see field "Test parameter"* b) Select first PSM and ISM value *;see field "Test parameter"* c) Apply PSM value to Master *;see field "Test parameter"* d) Adjust current sink to ISM value *;see field "Test parameter"* e) Turn On Power1 f) Measure VSM in ON state g) Evaluation 1) h) Wait for 1 s i) Turn Off Power1 j) Measure VSM in OFF state k) Evaluation 2) l) Repeat from d) with next ISM value m) Repeat from c) with next PSM value.
Test parameter	PSM = {PSMmin, PSMmax} *;according to user manual* ISM = {ISMmax, 0 mA} *;ISMmax according to user manual*
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Determine maximum VSM (ON state) compared with value of previous loop 2) Determine minimum VSM (OFF state) compared with value of previous loop
Test passed	Maximum value of VSM ≤ 1 V in OFF state, and *;1 V is reasonable practical value* Minimum value of VSM ≥ 20 V in ON state
Test failed	Maximum value of VSM > 1 V in OFF state, or *;1 V is reasonable practical value* Minimum value of VSM < 20 V in ON state
Report	Maximum VSM (ON state): <value> <ok |nok> Minimum VSM (OFF state): <value> <ok |nok>

5.2.2 High-level input threshold voltage at I/Q

Table 13 defines the test conditions for this test case.

Table 13 – High-level input threshold voltage at I/Q

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0002
Name	FSTCM_PHYL_OSSD_HIGHVIMIQ
Purpose (short)	Test of static input high-level threshold at I/Q
Equipment under test (EUT)	FS-Master with I/Q support
Test case version	1.0
Category / type	FS-Master PL test, test-to-pass
Specification (clause)	[4] 5.3.4, Table 6; [2] 11.2.20, Figure 113
Configuration / setup	The digital input signal for a rising edge of the I/Q input is being monitored (see Figure A.1)
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Measurement of the high-level threshold at I/Q
Precondition	Test setup: Voltage source with value VIMIQ between I/Q and L- EUT: PORT_DI (see A.4.2 in [9])
Procedure	a) Set supply voltage of Master to first PSM value ;see field Test parameter b) Sweep voltage VIMIQ at I/Q from 5 V to 15 V in steps of maximum 0,1 V c) Exemplary: Repeat SMI_PDInIQ until DI_I/Q = 1 d) Measure VIMIQ Transition e) Evaluation 1) f) Repeat from b) with next PSM value
Test parameter	PSM = {PSMmin, PSMmax} ;according to user manual
Post condition	Memorize VIMIQ at DI transition 0→1 (all PSM)
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check voltage VIMIQ at DI transition "low" to "high"
Test passed	All checks: 10,5 V < VIMIQ < 13 V (range of VTHHM)
Test failed (examples)	Any of the checks failed
Report	VIMIQ @ Transition 0→1 (PSMmin): <value> <ok | nok> VIMIQ @ Transition 0→1 (PSMmax): <value> <ok | nok>

5.2.3 Low-level input threshold voltage at I/Q

Table 14 defines the test conditions for this test case.

Table 14 – Low-level input threshold voltage at I/Q

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0003
Name	FSTCM_PHYL_OSSD_LOWVIMIQ
Purpose (short)	Test of static input low-level threshold at I/Q
Equipment under test (EUT)	FS-Master with I/Q support
Test case version	1.0
Category / type	FS-Master PL test, test-to-pass
Specification (clause)	[4] 5.3.4, Table 6; [2] 11.2.20, Figure 113
Configuration / setup	The digital input signal for a falling edge of the I/Q input is being monitored (see Figure A.1)
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Measurement of the low-level threshold at I/Q
Precondition	Test setup: Voltage source with value VIMIQ between I/Q and L- EUT: PORT_DI (see A.4.2 in [9])
Procedure	a) Set supply voltage of Master to first PSM value *;see field Test parameter* b) Sweep voltage VIMIQ at I/Q from 15 V to 5 V in steps of maximum 0,1 V c) Exemplary: Repeat SMI_PDInIQ until DI_I/Q = 0 d) Measure VIMIQ Transition e) Evaluation 1) f) Repeat from b) with next PSM value
Test parameter	PSM = {PSMmin, PSMmax} *;according to user manual*
Post condition	Memorize VIMIQ at DI transition 1→0 (all PSM)
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check voltage VIMIQ at DI transition "high" to "low"
Test passed	All checks: 8,0 V < VIMIQ < 11,5 V (range of VTHLM)
Test failed (examples)	Any of the checks failed
Report	VIMIQ @ Transition 1→0 (PSMmin): <value> <ok | nok> VIMIQ @ Transition 1→0 (PSMmax): <value> <ok | nok>

5.2.4 Input hysteresis voltage at I/Q

Table 15 defines the test conditions for this test case.

Table 15 – Input hysteresis voltage at I/Q

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0004
Name	FSTCM_PHYL_OSSD_VHYSMCI
Purpose (short)	Calculation of input hysteresis at I/Q
Equipment under test (EUT)	FS-Master with I/Q support
Test case version	1.0
Category / type	FS-Master PL test, test-to-pass
Specification (clause)	[4] 5.3.4, Table 6
Configuration / setup	See FSTC_0002 and FSTC_0003
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Calculation of the hysteresis voltage at I/Q
Precondition	Value VIMIQ from FSTC_0002 is available for all PSM values Value VIMIQ from FSTC_0003 is available for all PSM values
Procedure	–
Test parameter	–
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	For all PSM values: VHYSMCI = Value VIMIQ(FSTC_0002) – Value VIMIQ(FSTC_0003)
Test passed	For all PSM values: Voltage VHYSMCI is ≥ 0 V
Test failed (examples)	For any PSM value: Voltage VHYSMCI is < 0 V
Report	VHYSMCI (PSMmin): <value> <ok | nok> VHYSMCI (PSMmax): <value> <ok | nok>

559 ### 5.2.5 Load current at I/Q

560 Table 16 defines the test conditions for this test case.

561 **Table 16 – Load current at I/Q**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0005
Name	FSTCM_PHYL_OSSD_LOADIQ
Purpose (short)	Load current at I/Q of FS-Master Port
Equipment under test (EUT)	FS-Master with I/Q support
Test case version	1.0
Category / type	FS-Master PL test, test-to-pass
Specification (clause)	[4] 5.5, Table 8
Configuration / setup	The input current at I/Q of the FS-Master Port is being monitored (see Figure A.1).

562

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Quiescent current at FS-Master Port I/Q in input mode. Monitor current flowing into I/Q.
Precondition	Test setup: Voltage source with value VIMIQ between L- and I/Q EUT: PORT_DI (see A.4.2 in [9])
Procedure	a) Set supply voltage of Master to first PSM value ;Test parameter b) Measure VSM c) Set voltage VIMIQ = 5V d) Measure current ILLM into I/Q e) Evaluation 1) f) Set voltage VIMIQ = 5,1 V g) Measure current ILLM into I/Q h) Evaluation 2) i) Set voltage VIMIQ = 15V j) Measure current ILLM into I/Q k) Evaluation 3) l) Set voltage VIMIQ = measured value of VSM in b) m) Measure current ILLM into I/Q n) Evaluation 4) o) Repeat from b) with next PSM value
Test parameter	PSM = {PSMmin, PSMmax} (according to user manual)
Post condition	–

563

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check ILLM < 15 mA 2) Check 2 mA < ILLM < 15 mA 3) Check 2 mA < ILLM < 15 mA 4) Check 2 mA < ILLM < 15 mA
Test passed	All checks OK
Test not passed (examples)	Any of the checks above failed
Report	ILLM (VIMIQ = 5 V, PSMmin): <value> <ok | nok> ILLM (VIMIQ = 5,1 V, PSMmin): <value> <ok | nok> ILLM (VIMIQ = 15 V, PSMmin): <value> <ok | nok> ILLM (VIMIQ = measured value of VSM, PSMmin): <value> <ok | nok> ILLM (VIMIQ = 5 V, PSMmax): <value> <ok | nok> ILLM (VIMIQ = 5,1 V, PSMmax): <value> <ok | nok> ILLM (VIMIQ = 15 V, PSMmax): <value> <ok | nok> ILLM (VIMIQ = measured value of VSM, PSMmax): <value> <ok | nok>

564

5.3 Static characteristics of the FS-Device interface

5.3.1 General

Power consumption of an FS-Device is already tested via NSR tests according to [9]. Warnings in case of current limits > 200 mA are checked via user manual in 7.2.3.

This clause focuses on tests of signal behavior on I/Q pin of an FS-Device.

5.3.2 High-side residual voltage at FS-Device OSSD2

Table 17 defines the test conditions for this test case. It is only applicable for Devices with OSSD.

Table 17 – High-side residual voltage at FS-Device OSSD2

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0006
Name	FSTCD_PHYL_OSSD_HSRESVOLT
Purpose (short)	Static high-side driver capability
Equipment under test (EUT)	FS-Device with OSSD output
Test case version	1.0
Category / type	FS-Device PL test, test-to-pass
Specification (clause)	[4] 5.4, Table 7
Configuration / setup	The high-side output level of the FS-Device OSSD2 output is measured while connected to a current sink (see Figure A.2, method ①)

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Driver capability of the FS-Device high-side driver. Measurement of the voltage drop VIQ between L+ and I/Q (OSSD2) under load condition of 50 mA.
Precondition	PL-Tester: Voltage source with value VSD between L+ and L- EUT: FS-Device in OSSD mode with signals in high state
Procedure	a) Apply first supply voltage VSD to the Device ;Test parameter b) Apply current sink with 50 mA from I/Q (OSSD2) to L- c) Measure voltage VIQ between L+ and I/Q (OSSD2) d) Evaluation 1) e) Repeat from b) with next VSD value
Test parameter	VSD = {18 V, 30 V}
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check VIQ
Test passed	For all VSD values: VIQ ≤ 3,0 V
Test not passed (examples)	For any VSD value: VIQ > 3,0 V
Report	VIQ (VSD = 18 V): <value> <ok | nok> VIQ (VSD = 30 V): <value> <ok | nok>

5.3.3 Low-side residual voltage at FS-Device OSSD2

Table 18 defines the test conditions for this test case. It is only applicable for Devices with OSSD.

Table 18 – Low-side residual voltage at FS-Device OSSD2

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0007
Name	FSTCD_PHYL_OSSD_LSRESVOLT
Purpose (short)	Static low-side driver capability
Equipment under test (EUT)	FS-Device with OSSD output
Test case version	1.0
Category / type	FS-Device PL test, test-to-pass
Specification (clause)	[4] 5.4, Table 7
Configuration / setup	The low-side output level of the FS-Device OSSD2 output is measured while connected to a current source (see Figure A.2, method ②)

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Driver capability of the FS-Device low-side driver. Measurement of the voltage drop between negative supply L- and I/Q (OSSD2) output at source current of 50 mA
Precondition	Test setup: Voltage source with value VSD between L+ and L- EUT: FS-Device in OSSD mode with signals in low state
Procedure	a) Apply first supply voltage VSD to the FS-Device ;Test parameter b) Apply current source with 50 mA from I/Q (OSSD2) to L+ c) Measure voltage VIQ between I/Q (OSSD2) and L- d) Evaluation 1) e) Repeat from b) with next VSD value
Test parameter	VSD = {18 V, 30 V}
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check VIQ
Test passed	For all VSD values: VIQ ≤ 3,0 V
Test not passed (examples)	For any VSD value: VIQ > 3,0 V
Report	VIQ (VSD = 18 V): <value> <ok | nok> VIQ (VSD = 30 V): <value> <ok | nok>

5.4 Dynamic characteristics of the FS-Master interface

5.4.1 FS-DI and OSSD sensor with and without READY pulse

Table 19 defines the test conditions for this test case.

Table 19 – FS-DI and OSSD sensor with and without READY pulse

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE	
Identification (ID)	SDCI_FSTC_0008	
Name	FSTCM_PHYL_INTF_OSSDSENS	
Purpose (short)	Start-up of FS-Master Port with OSSD sensor with and without READY pulse	
Equipment under test (EUT)	FS-Master	
Test case version	1.0	
Category / type	FS-Master Physical Layer test, test-to-pass	
Specification (clause)	[4] 5.3.3, Figure 20, Figure 21; 5.4, Table 7	
Configuration / setup	OSSD signal generator (see A.2.2) connected to EUT	
TEST CASE	**CONDITIONS / PERFORMANCE**	
Purpose (detailed)	Test of FS-Master Port start-up when connected to FS-Devices with different OSSD behavior, e.g. without READY pulse, with READY pulse, or antivalent switching.	
Precondition	Test setup: OSSD signal generator EUT: Configured to "OSSDe" Port mode, FS-Master Tool with SMI_PortPowerOffOn and SMI_SPDUIn services	
Procedure	a) Select first OSSD-sequence b) Apply first signal slot of OSSD-sequence c) Perform power cycle of FS-Master Port d) Read Process Data via SMI_SPDUIn service e) Apply next signal slot(s) of OSSD-sequence f) Read SR Process Data via SMI_FSPDInOut service g) If OSSD sequence > OS 3: Wait on SMI_PortEvent h) Evaluation 1) i) Repeat from b) with next OSSD-sequence	;Test parameter ;returns ArgBlock "FSPDInOut" ;returns ArgBlock "PortEvent" ;Test parameter
Test parameter	OSSD-sequences: OS 1 = {HH, LL}, OS 2 = {LL, HH}, OS 3 = {LL, HL(1 ms), LL(1 s), HH},	OS 4 = {LH, LH}, OS 5 = {HL, HL}, OS 6 = {LL, HL}, OS 7 = {HH, LH}.
Post condition	–	
TEST CASE RESULTS	**CHECK / REACTION**	
Evaluation	1) Check Argblock "FSPDInOut.SPDUIn0" 2) Check ArgBlock "PortEvent"	
Test passed	OS1: "Low" detected after transition to signal slot 2 <LL>. OS2: "High" detected after transition to slot 2 <HH>. OS3: "High" detected after transition to slot 4 <HH>. OS4: "Low" detected instantly and Port Event = 0x20F0 OS5: "Low" detected instantly and Port Event = 0x20F0 OS6: "Low" detected after transition to slot 2 (HL) and Port Event = 0x20F0 OS7: "Low" detected after transition to slot 2 (LH) and Port Event = 0x20F0	
Test failed (examples)	Any incorrect detection(s) during evaluation	
Report	"Low" (Demand) detected: <yes/no> "High" (Activation) detected: <yes/no> "Low" (Antivalent) detected: <yes/no> Correct Port Event detected: <yes/no>	<ok | nok> <ok | nok> <ok | nok> <ok | nok>

5.4.2 FS-DI and discrepancy evaluation

Table 20 defines the test conditions for this test case.

Table 20 – FS-DI and discrepancy evaluation

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0009
Name	FSTCM_PHYL_INTF_DISCREPANCY
Purpose (short)	Behavior of Port at tolerable and intolerable discrepancy times (see Figure 11)
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master Physical Layer test, test-to-pass
Specification (clause)	[4] clause 5.5, Table 8
Configuration / setup	OSSD signal generator (see A.2.2) connected to EUT

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Behavior of Port at tolerable and intolerable discrepancy times
Precondition	Test setup: OSSD signal generator EUT: Configured to "OSSDE" Port mode, FS-Master Tool with SMI_PortPowerOffOn and SMI_SPDUIn services
Procedure	a) Select first value of tdis b) Power cycle of Master Port c) Run "OSSD startup sequence" *;Test parameter* d) Run first "OSSD test sequence" *;Test parameter* e) Read SR Process Data via SMI_FSPDInOut service *;returns ArgBlock "FSPDInOut"* f) If tdis = 10 ms Wait on SMI_PortEvent service *;returns ArgBlock "PortEvent"* g) Evaluation 1) h) Repeat from b) with next OSSD test sequence i) Repeat all OSSD test sequences from b) with next value of tdis
Test parameter	OSSD startup sequence: {LL(2 s), HL(1 ms), LL(1 s)} *;Startup* OSSD test sequences 1: {LL(2 s), HL(tdis), HH *;Low–High Transition* 2: {LL(2 s), LH(tdis), HH *;Low–High Transition* 3: {HH(2 s) HL(tdis), LL *;High–Low Transition* 4: {HH(2 s) LH(tdis), LL *;High–Low Transition* tdis = {3 ms,10 ms}
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Argblock OSSDIN=FSPDInOut.SPDUIn0 2) Check ArgBlock "PortEvent"
Test passed	No Port Event 0x20F0, and *;tdis = 3 ms* OSSDIN = “Low” and Port Event 0x20F0 *;tdis = 10 ms*
Test failed (examples)	Any incorrect detection(s) during evaluation
Report	No Port Event detected at tdis = 3 <yes/no> <ok | nok> "Low" detected at tdis =10 ms <yes/no> <ok | nok> Correct Port Event at tdis = 10 ms detected: <yes/no> <ok | nok>

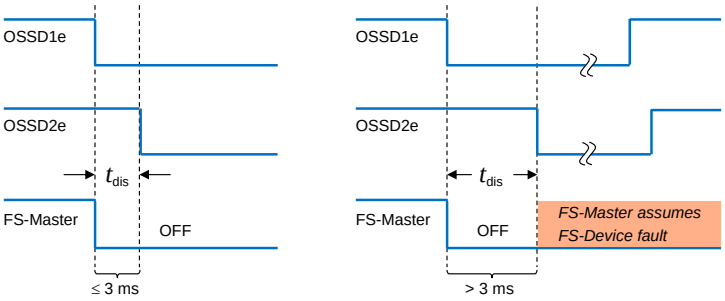


Figure 11 – Discrepancy behavior

The discrepancy time given in [4] specifies the max. discrepancy time, a Device may generate. The discrepance time in Figure 11 specifies the min. discrepancy time, a Master shall tolerate without generating a safety relevant reaction.

600 ### 5.4.3 Test pulse resilience

601 Table 21 defines the test conditions for this test case.

602 **Table 21 – Test pulse resilience**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0010
Name	FSTCM_PHYL_INTF_TESTPULSERES
Purpose (short)	Behavior of Port at test pulse skews (time-shift)
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master Physical Layer test, test-to-pass
Specification (clause)	[4] 5.3.2.2, 5.3.2.3, 5.5, Table 8
Configuration / setup	OSSD signal generator (see A.2.2) connected to EUT

603

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Behavior of Port at test pulse skews (time-shift)
Precondition	Test setup: OSSD signal generator EUT: Configured to "OSSDE" Port mode, FS-Master Tool with SMI_SPDUIn services
Procedure	a) Choose first value of tc *;Test parameter* b) Start test pulse sequence {<p(Tp, ti) >,<p(Tp, ti, tc)>} *;at OSSD signal "high"* c) Read 10 times SR PD via SMI_FSPDInOut service *;returns ArgBlock "FSPDInOut"* d) Evaluation 1) e) Repeat from b) with next value of tc *;Test parameter*
Test parameter	Tp = 10 ms, ti = 1 ms, tc = {0 ms, 1 ms, -1 ms, 5 ms, -5 ms}
Post condition	–

604

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Argblock "FSPDInOut.SPDUIn0"
Test passed	For all repetitions and loops: No "Low" and no Port Events
Test failed (examples)	Any "Low" or Events
Report	No "Low" and no Events: <yes/no> <ok | nok>

605

606 ### 5.4.4 READY pulse detection

607 Table 22 defines the test conditions for this test case.

608 **Table 22 – Ready pulse detection**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0011
Name	FSTCM_PHYL_INTF_READYDETECT
Purpose (short)	Behavior of Port on READY pulse; limits of detection
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master Physical Layer test, test-to-pass
Specification (clause)	[4] 5.3.3, Figure 21; 5.4, Table 7; 5.7, Figure 27
Configuration / setup	FS-Master Tester system

609

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	FS-Master Port behavior upon variable time-to-Ready-pulse t2R and Ready pulse duration tRP
Precondition	SMTU: SMTU_STANDARD_STATE_32 EUT: PORT_MIXFSCOM
Procedure	a) Choose first values of t2R and tRP ;Test parameter b) Perform SMTU_Ready_Wait(t2R, tRP) ;see A.4.7 c) Power ON cycle of FS-Device d) TM_AWAIT (t2R) ;before and beyond Ready pulse e) Read SR Process Data via SMI_FSPDInOut service ;returns ArgBlock "FSPDInOut" f) Evaluation 1) g) Repeat from b) with next t2R h) Repeat from b) with next tRP
Test parameter	t2R = {5 s, (5+1) s}, ;optional: value from IODD instead of default = 5 s tRP = {0,5 ms, 1 ms}
Post condition	–

610

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Argblock "FSPDInOut.SPDUIn0"
Test passed	Safety communication started, and *;t2R = 5 s* Safety communication did not start (timeout) *;t2R = (5+1) s*
Test failed (examples)	Safety communication did not start, and/or *;t2R = 5 s* Safety communication started *;t2R = (5+1) s*
Report	Safety communication: <yes/no> <ok | nok>

611

612 ### 5.4.5 Wake-up delay after Ready pulse

613 Table 22 defines the test conditions for this test case

614 **Table 23 – Wake-up delay after Ready pulse**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0012
Name	FSTCM_PHYL_INTF_WAKEUPTOREADYDELAY
Purpose (short)	After Ready pulse, FS-Master waits tRW before Wake-up
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master Physical Layer test, test-to-pass
Specification (clause)	[4] 5.3.3, Figure 21; 5.4, Table 7; 5.7, Figure 27
Configuration / setup	FS-Master Tester system

615

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	After Ready pulse, FS-Master waits a time tRW before Wake-up sequence
Precondition	SMTU: SMTU_STANDARD_STATE_32 EUT: PORT_MIXFSCOM
Procedure	a) Choose first value of tRP *;Test parameter* b) Perform SMTU_Ready_Wait(2 s, tRP) *;see A.4.7* c) Power ON cycle of "FS-Device" d) Measure time tRW from falling edge of READY-pulse to rising edge of WURQ e) Repeat from b) with next tRP
Test parameter	tRP = {0,5 ms, 1 ms}
Post condition	–

616

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check measurement value
Test passed	tRW ≥ 50 µs
Test failed (examples)	tRW < 50 µs
Report	tRW ≥ 50 µs: <yes/no> <ok | nok>

617

618 ## 5.5 Dynamic characteristics of the FS-Device interface

619 ### 5.5.1 Equivalent switching and discrepancy time

620 Table 24 defines the test conditions for this test case.

621 **Table 24 – Equivalent switching and discrepancy time**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0013
Name	FSTCD_PHYL_OSSD_DISCREP
Purpose (short)	Equivalent switching and discrepancy time limits
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device Physical Layer test, test-to-pass
Specification (clause)	[4] 5.3.2.2, 5.3.2.3, 5.4, Table 7, [8]
Configuration / setup	Measurement circuit of Figure A.4

622

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Measurement of an FS-Device's equivalent switching and discrepancy times and conformity check with [4] and [8]
Precondition	EUT: in OSSDe mode (OFF state)
Procedure	a) Trigger FS-Device to toggle it´s outputs from low to high *;Test parameter* b) Measure time between rising edges of both OSSD signals c) Evaluation 1) d) Trigger FS-Device to toggle it´s outputs from high to low *;Test parameter* e) Measure time between falling edges of both OSSD signals f) Evaluation 2) g) Repeat from a) 100 times
Test parameter	Information on how to change FS-Device's OSSD states (OFF/ON)
Post condition	–

623

TEST CASE RESULTS	CHECK / REACTION	
Evaluation	1) Check discrepancy times of rising edges and memorize maximum absolute value 2) Check discrepancy times of falling edges and memorize maximum absolute value	
Test passed	Absolute value of maximum discrepancy time ≤ 2 ms	NOTE
Test failed (examples)	Absolute value of maximum discrepancy time > 2 ms	
Report	Maximum discrepancy time low to high: <value> Maximum discrepancy time high to low: <value>	<ok | nok> <ok | nok>
NOTE Maximum discrepancy time = maximum t_{disD} + maximum t_i (possible adjacent test pulse)		

624

625 ### 5.5.2 Test pulse duration

626 Table 25 defines the test conditions for this test case.

627 **Table 25 – Test pulse duration**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0015
Name	FSTCD_PHYL_INTF_TESTPULSDURATION
Purpose (short)	FS-Device's test pulses duration
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device Physical Layer test, test-to-pass
Specification (clause)	[4] 5.3.2.2, 5.3.2.3, Figure 19; 5.4, Table 7
Configuration / setup	Measurement circuit of Figure A.4

628

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Measurement of an FS-Device's test pulse duration and conformity check
Precondition	EUT: in OSSDe mode (ON state) Measurement circuit: load = Type 1 input acc. IEC 61131-2
Procedure	a) Apply first PSD value ;Test parameter b) Measure time between falling and rising edge of a test pulse on OSSDe1 c) Evaluation 1) d) Measure time between falling and rising edge of a test pulse on OSSDe2 e) Evaluation 2) f) Repeat from b) 100 times g) Repeat from b) with next PSD value
Test parameter	PSD = {18 V, 30 V}
Post condition	–

629

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check duration of test pulse and memorize maximum value Ti1max 2) Check duration of test pulse and memorize maximum value Ti2max
Test passed	Ti1max ≤ 1 ms, and Ti2max ≤ 1 ms
Test failed (examples)	Ti1max > 1 ms, or Ti2max > 1 ms
Report	Maximum duration of test pulses at OSSDe1: <value> <ok | nok> Maximum duration of test pulses at OSSDe2: <value> <ok | nok>

630

631 ### 5.5.3 Ready pulse duration

632 Table 26 defines the test conditions for this test case.

633 **Table 26 – Ready pulse duration**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0016
Name	FSTCD_PHYL_INTF_READYPULSDUR
Purpose (short)	FS-Device's Ready pulse duration
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device Physical Layer test, test-to-pass
Specification (clause)	[4] 5.3.3, Figure 21; 5.4, Table 7; 5.7, Figure 27
Configuration / setup	Measurement circuit of Figure A.4

634

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Measurement of an FS-Device's Ready pulse duration and conformity check
Precondition	EUT: Power off
Procedure	a) Apply first PSD value *;Test parameter* b) Measure time tRP between rising and falling edge of Ready pulse on OSSDe1 c) Evaluation 1) d) Repeat from b) with next PSD value
Test parameter	PSD = {18 V, 30 V}
Post condition	–

635

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check and memorize tRP @ PSD = 18 V and 30 V
Test passed	For both supply voltages: 500 µs ≤ tRP ≤ 1000 µs
Test failed (examples)	Any of the values of tRP < 500 µs or > 1000 µs
Report	tRP @ 18V: <value> <ok | nok> tRP @ 30V: <value> <ok | nok>

636

5.5.4 End of Ready pulse to OSSD

Table 27 defines the test conditions for this test case.

Table 27 – End of Ready pulse to OSSD

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0017
Name	FSTCD_PHYL_INTF_READY2OSSD
Purpose (short)	FS-Device's end of Ready pulse to OSSDe operation
Equipment under test (EUT)	FS-Device with OSSDe capability
Test case version	1.0
Category / type	FS-Device Physical Layer test, test-to-pass
Specification (clause)	[4] clause 5.3.3, Figure 21; clause 5.4, Table 7; clause 5.7, Figure 27
Configuration / setup	Measurement circuit of Figure A.4
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Measurement of an FS-Device's end of READY pulse to OSSDe operation time and conformity check
Precondition	EUT: Power OFF (preset to ON state)
Procedure	a) Prepare FS-Device for outputs "high" immediately after OSSDe start b) Apply PSD = 24 V to EUT c) Wait until end of Ready pulse d) Measure time t1 e) Wait until OSSDe1 or OSSDe2 change to ON state ("high") f) Measure time t2 g) Evaluation 1)
Test parameter	–
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Determine tRO = t2 – t1
Test passed	tRO ≥ 1,1 s
Test failed (examples)	tRO < 1,1 s
Report	tRO: <value> <ok | nok>

643 ## 5.6 Test report templates

644 ### 5.6.1 Template for the test report of PL tests

645 Table 28 shows the template for the test reports of PL tests.

646 **Table 28 – Template for the test report of PL tests**

Test Case ID	Test report	ok/ nok	Statement/ Exception
SDCI_FSTC_0001	Maximum VSM (ON state): <value> Minimum VSM (OFF state): <value>		
SDCI_FSTC_0002	VIMIQ @ Transition 0→1 (PSMmin): <value> VIMIQ @ Transition 0→1 (PSMmax): <value>		
SDCI_FSTC_0003	VIMIQ @ Transition 1→0 (PSMmin): <value> VIMIQ @ Transition 1→0 (PSMmax): <value>		
SDCI_FSTC_0004	VHYSMCI (PSMmin): <value> VHYSMCI (PSMmax): <value>		
SDCI_FSTC_0005	ILLM (VIMIQ = 5 V, PSMmin): <value> ILLM (VIMIQ = 5,1 V, PSMmin): <value> ILLM (VIMIQ = 15 V, PSMmin): <value> ILLM (VIMIQ = measured value of VSM, PSMmin): <value> ILLM (VIMIQ = 5 V, PSMmax): <value> ILLM (VIMIQ = 5,1 V, PSMmax): <value> ILLM (VIMIQ = 15 V, PSMmax): <value> ILLM (VIMIQ = measured value of VSM, PSMmax): <value>		
SDCI_FSTC_0006	VIQ (VSD = 18 V): <value> VIQ (VSD = 30 V): <value>		
SDCI_FSTC_0007	VIQ (VSD = 18 V): <value> VIQ (VSD = 30 V): <value>		
SDCI_FSTC_0008	"Low" (Demand) detected: <yes/no> "High" (Activation) detected: <yes/no> "Low" (Antivalent) detected: <yes/no> Correct Port Event detected: <yes/no>		
SDCI_FSTC_0009	"Low" detected: <yes/no> "Low" detected: <yes/no> Correct Port Event detected: <yes/no>		
SDCI_FSTC_0010	No "Low" and no Events: <yes/no>		
SDCI_FSTC_0011	Safety communication: <yes/no>		
SDCI_FSTC_0012	tRW ≥ 50 µs: <yes/no>		
SDCI_FSTC_0013	Maximum discrepancy time low to high: <value> Maximum discrepancy time high to low: <value>		
SDCI_FSTC_0015	Maximum duration of test pulses at OSSDe1: <value> Maximum duration of test pulses at OSSDe2: <value>		
SDCI_FSTC_0016	tRP @ 18V: <value> tRP @ 30V: <value>		
SDCI_FSTC_0017	tRO: <value>		

647

648 ### 5.6.2 Test report summaries of automated test cases

649 Templates are defined by the particular tester equipments. The complete test reports shall
650 present at least the information of the report fields of the test cases.

6 IODD and Dedicated Tool tests

6.1 Overview

Any FS-Device comes with an IODD including FSP parameters for functional safe communication and usually FST parameters for the possibility of adjusting the particular technology (e.g. optical sensor) to user automation applications and optionally a Dedicated Tool.

Tests of an IODD shall be performed using the IODD Checker Tool, which can be downloaded from the website indicated in Annex C. The extra requirements for the IODD Checker Tool due to the safety extensions are specified in 6.2. These requirements include XML-Snippets for the Common Profile and for IO-Link Safety. XML-Snippets support the presentation of user interfaces and the automated IODD testing.

IODD test cases are specified in 6.3.

For FS-Devices without parameters for their individual technology (so-called FST parameter) no other tool is required besides the IODD. FS-Devices with FST parameter also come with a Dedicated Tool at least for the calculation of the TechParCRC value to be transfered into the FSP_TechParCRC field of the FS-Master Tool.

Dedicated Tool test cases are specified in 10.2.

6.2 Requirements for the IODD Checker (expanded schema test for safety)

6.2.1 Basic requirements and business rules for FS-Devices

Basically, the requirements defined in [5] apply. Additional business rules for IODDs of FS-Devices to be checked are defined in 6.3.

6.2.2 XML snippets for the Common Profile

The XML snippets for the Common Profile are contained in its .zip file downloadable from the website indicated in Annex C. The name of the corresponding draft XML file is *IODD-CommonProfile_Snippets_V1.1.0.xml*.

6.2.3 XML snippets for safety extensions

The XML snippets for safety extensions are specified in [4] and contained in an extra file named *IODD-SafetyProfile_Snippets1.1.3.xml*. Both can be downloaded in a .zip file from the website indicated in Annex C.

680 ## 6.3 IODD test via Checker Tool (conformity and CRC signatures)

681 Table 29 defines the test conditions for this test case.

682 **Table 29 – IODD test via Checker Tool (conformity and CRC signatures)**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0018
Name	FSTCI_IODD_FSPD_IODDPARAMDESCCRC
Purpose (short)	Conformity of IODD of FS-Device and correct CRC signatures
Equipment under test (EUT)	IODD of FS-Device
Test case version	1.0
Category / type	IODD verify test
Specification (clause)	[4] clause A.1, E.5.6; [6]
Configuration / setup	IODD Checker Tool + XML snippets

683

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check conformity of IODD of FS-Device with the help of the Checker Tool downloadable from the official IO-Link website. Base checks are supplemented by extensions from Common Profile specification and IO-Link Safety specification (XML snippets). CRC signature across the entire IODD is checked as well as the CRC signature "FSP_ParamDescCRC". The IODD Checker Tool provides correct CRC signature values if found values have been identified as incorrect.
Precondition	Up to date IODD Checker Tool downloaded from the Internet and XML snippet files
Procedure	a) Perform conformance testing with the help of standard IODD Checker Tool using IODD XML schema based on IODD specification V1.1.3 b) Evaluation 1) c) Perform test on Common Profile parameters using the file "*IODD-CommonProfile_Snippets_V1.1.0.xml*" d) Evaluation 2) e) Perform test on Safety parameters using the file "*IODD-SafetyProfile-Snippets1.1.3.xml*" f) Evaluation 3) g) Perform test on Protocol Mode "Input/Output length" using ProcessData Collection (see [5]) h) Evaluation 4) i) Replace CRC signature value of FSP_ParamDescCRC in IODD with suggested value of the Tool if value was incorrect j) Perform IODD check again k) Evaluation 5)
Test parameter	–
Post condition	Value of FSP_ParamDescCRC

684

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Tool report 2) Check report on Common Profile parameters 3) Check report on Safety parameters 4) Check report on Protocol Mode 5) Check Tool report and value of "FSP_ParamDescCRC"
Test passed	All reports OK and value correct
Test failed (examples)	Any report NOK and/or value incorrect
Report	IODD with correct "FSP_ParamDescCRC" parameter: <yes/no> <ok | nok>

685

686 ## 6.4 Availability of the Dedicated Tool

687 Table 30 defines the test conditions for this test case.

688 **Table 30 – Availability of the Dedicated Tool**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0019
Name	FSTCI_IODD_FSPD_DEDICTOOL
Purpose (short)	Availability of Dedicated Tool or adequate means for TechParCRC determination
Equipment under test (EUT)	FS-Device with FST parameter
Test case version	1.0
Category / type	IODD verify test: Dedicated Tool
Specification (clause)	[4] clause A.1, E.5.6
Configuration / setup	IODD Finder, user manual

689

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	An FS-Device with FST parameters shall provide either a Dedicated Tool for the calculation of the TechParCRC value corresponding to the parameter setting or other adequate means such as a table within the user manual.
Precondition	–
Procedure	a) User manual: Dedicated Tool suitable for FS-Device? - .exe program - designation, - version, - relation to FS-Device b) Evaluation 1) c) If no Dedicated Tool: Adequate means available d) Evaluation 2)
Test parameter	–
Post condition	Usable Dedicated Tool or adequate means available

690

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check items 2) Optional: adequate means sufficient and mentioned in assessment report
Test passed	All checks correct
Test failed (examples)	Any check incorrect
Report	Dedicated Tool OK: <yes/no> <ok | nok>

691

692

693 # 7 FS-Device configuration and parameterization tests

694 ## 7.1 Overview

695 The FS-Device configuration and parameterization tests comprise the necessary information
696 about the product to test, the FSP protocol parameter availability and limits including securing
697 via CRC signature, the FST technology parameter availability and limits including securing via
698 CRC signature, and setup of operational modes such as "Commissioning" and "Armed".

699 ## 7.2 FS-Device meta data

700 ### 7.2.1 Manuals and safety assessment certificate

701 Table 31 defines the test conditions for this test case.

702 **Table 31 – Manuals and safety assessment certificate**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0020
Name	FSTCD_CONF_INFO_DOCUMENTS
Purpose (short)	Check user/safety manuals for exceptions, properties, and certificates
Equipment under test (EUT)	User/safety manual of FS-Device and Dedicated Tool
Test case version	1.0
Category / type	FS-Device test
Specification (clause)	[4] "highly recommended" feature status, Table 8, Annex H.6, [6] p2 (conventions)
Configuration / setup	–

703

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Manufacturers/vendors are obliged to inform in a user manual about not implemented "highly recommended" features, and to provide a "Safety Manual" as well as a safety assessment certificate.
Precondition	–
Procedure	a) Identify in user manual not implemented "highly recommended" features b) Identify information in safety manual according to Annex H.6 in [4] c) Identify functional safety assessment report (certificate)
Test parameter	–
Post condition	–

704

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check exceptions in user manual 2) Check required parameters in safety manual 3) Check statements for relevant aspects of the particular standard (IEC 61508 /ISO13849), the assessment body, and the certificate number
Test passed	Exceptions permitted, and Safety Manual correct (at least WCDT, OFDT), and Certicate accepted and noted in test report
Test failed (examples)	Any check incorrect
Report	Documents OK: <yes/no> <ok | nok>

705

706 ### 7.2.2 Connector and cable information

707 Table 32 defines the test conditions for this test case.

708 **Table 32 – Connector and cable information**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0021
Name	FSTCD_CONF_INFO_CONNECTCABLE
Purpose (short)	Check user/safety manuals for connector and cable information (OSSDe)
Equipment under test (EUT)	User/safety manual of FS-Device and Dedicated Tool
Test case version	1.0
Category / type	FS-Device test
Specification (clause)	[4] 4.1.4, Figure 9
Configuration / setup	–

709

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check user/safety manuals for connector and cable information for OSSDe operation.
Precondition	–
Procedure	a) Identify in user manual connector Pin layout in case of M type connector b) Identify cable recommendations with respect to robustness and loop resistence
Test parameter	–
Post condition	–

710

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Pin layout 2) Check recommendations on robustness and loop resistence
Test passed	Pin layouts are correct, and Robustness recommendations for cable coating such as "tear proof" and "cut resistant" as well as for loop resistance such that minimum supply voltages are guaranteed at maximum supply current are available
Test failed (examples)	Any check incorrect
Report	Documents OK: <yes/no> <ok | nok>

711

712 ### 7.2.3 FS-Device default behavior

713 Table 33 defines the test conditions for this test case.

714 **Table 33 – FS-Device default behavior**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0022
Name	FSTCD_CONF_INFO_DEFAULTBEHAVIOR
Purpose (short)	FS-Device information: Consumption, Ready pulse, test pulses, watchdog
Equipment under test (EUT)	User manual of FS-Device
Test case version	1.0
Category / type	FS-Device test
Specification (clause)	[4] Table 7, Table 8
Configuration / setup	–

715

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	FS-Device information: Power consumption, Ready pulse, test pulses, watchdog
Precondition	–
Procedure	a) Identify parameter "Power consumption" in safety/user manual b) Identify parameter "Time delay before availability" in safety/user manual c) Identify parameter "Test pulse duration (t_i)" in safety/user manual d) Identify parameter "Period of test pulses (T_P)" in safety/user manual e) Identify "Watchdog" value recommendations
Test parameter	–
Post condition	Memorize power consumption, Ready pulse, test pulses, watchdog

716

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check "Power consumption" information 2) Check parameter "Time delay before availability" and "FSP_Time2Ready" in IODD 3) Check parameter "Test pulse duration (t_i)" 4) Check parameter "Period of test pulses (T_P)" 5) Check values of "Watchdog" and default "FSP_Watchdog" in IODD
Test passed	Values and recommendations are indicated if > 200 mA and ≤ 1000 mA, and Parameter value corresponds to value of FSP_Time2Ready in IODD, and Parameter value within specified borders, and Parameter value within specified borders, and Parameter value corresponds to value of "FSP_Watchdog" in IODD
Test failed (examples)	Values are not indicated in case of > 200 mA or > 1000 mA, or any other check incorrect
Report	Documents OK: <yes/no> <ok | nok>

717

718 ## 7.3 FSP parameter range limits and invalid values

719 ### 7.3.1 Invalid value of parameter "FSP_Port"

720 Table 34 defines the test conditions for this test case.

721 **Table 34 – Invalid value of parameter "FSP_Port"**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0023
Name	FSTCD_CONF_FSPD_PORTINVAL
Purpose (short)	Detection of invalid value of parameter "FSP_Port"
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test: test-to-fail
Specification (clause)	[4] Annex A
Configuration / setup	FS-Device-Tester-Unit

722

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Detection of invalid value of parameter "FSP_Port" (outside specified range)
Precondition	EUT in OPERATE (configured for commissioning operation) FSDT in OPERATE (configured for commissioning operation)
Procedure	a) Write FSP authenticity parameter record (0x4200), e.g. via SMI_DeviceWrite *;see field test parameter* b) Evaluation 1) c) Evaluation 2)
Test parameter	FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 0, FSP_AuthentCRC = 25195
Post condition	–

723

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Write response 2) Check Events
Test passed	Negative Write response with one of (0x8030, 0x8032, 0x8040 or 0x8041), and No Events
Test failed (examples)	Incorrect Write response, and/or Unexpected Events
Report	Correct negative Write response: <yes/no> <ok | nok> No Events received: <yes/no> <ok | nok>

724

7.3.2 Invalid value of signature "FSP_AuthentCRC"

Table 35 defines the test conditions for this test case.

Table 35 – Invalid value of signature "FSP_AuthentCRC"

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0024
Name	FSTCD_CONF_FSPD_AUTHENTCRCINVAL
Purpose (short)	Detection of invalid value of signature "FSP_AuthentCRC"
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test: test-to-fail
Specification (clause)	[4] Annex A
Configuration / setup	FS-Device-Tester-Unit

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Detection of invalid value of signature "FSP_AuthentCRC" (outside specified range)
Precondition	EUT in OPERATE (commissioning operation, FSP_TechParCRC = 0) FSDT in OPERATE (commissioning operation)
Procedure	a) Write FSP authenticity parameter record (0x4200), e.g. via SMI_DeviceWrite *;see field test parameter* b) Evaluation 1) c) Evaluation 2)
Test parameter	FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11457
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Write response 2) Check Events
Test passed	Negative Write response with one of 0x8040, 0x8041 and No Events
Test failed (examples)	Incorrect Write response, and/or Unexpected Events
Report	Correct negative Write response: <yes/no> <ok | nok> No Events received: <yes/no> <ok | nok>

731 ### 7.3.3 Invalid value of parameter "FSP_ProtVersion"

732 Table 36 defines the test conditions for this test case.

733 **Table 36 – Invalid value of parameter "FSP_ProtVersion"**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0025
Name	FSTCD_CONF_FSPD_PROTVINVAL
Purpose (short)	Detection of invalid value of parameter "FSP ProtVersion"
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test: test-to-fail
Specification (clause)	[4] Annex A
Configuration / setup	FS-Device-Tester-Unit

734

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Detection of invalid value of parameter "FSP_ProtVersion" (outside IODD)
Precondition	EUT in OPERATE (commissioning operation, FSP_TechParCRC = 0) FSDT in OPERATE (commissioning operation)
Procedure	a) Write FSP protocol parameter record (0x4201), e.g. via SMI_DeviceWrite *;see field test parameter with A)* b) Evaluation 1) c) Write FSP protocol parameter record (0x4201), e.g. via SMI_DeviceWrite *;see field test parameter with B)* d) Evaluation 2)
Test parameter	FSP protocol parameter record for cases A) and B): FSP_ProtVersion = A) or B), *;see values at the end of field* FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = 0, FSP_ProtParCRC = valid CRC *;values for case A) or B)* A) FSP_ProtVersion = defaultValue in IODD - 1 B) FSP_ProtVersion = defaultValue in IODD + 1
Post condition	–

735

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Write response 2) Check Write response
Test passed	Negative Write responses for Write attempts: In case of 1): 0x8030 (out of range) In case of 2): 0x8030 (out of range)
Test failed (examples)	Incorrect or no negative Write responses
Report	Correct negative Write responses: <yes/no> <ok | nok>

736

7.3.4 Invalid value of parameter "FSP_ProtMode"

Table 37 defines the test conditions for this test case.

Table 37 – Invalid value of parameter "FSP_ProtMode"

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0026
Name	FSTCD_CONF_FSPD_PMODEINVAL
Purpose (short)	Detection of invalid value of parameter "FSP_ProtMode"
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test: test-to-fail
Specification (clause)	[4] Annex A
Configuration / setup	FS-Device-Tester-Unit

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Detection of invalid value of parameter "FSP_ProtMode" (outside specified range and IODD). This test also proves that test parameter values are not accepted by FS Device.
Precondition	EUT in OPERATE (commissioning operation, FSP_TechParCRC = 0) FSDT in OPERATE (commissioning operation)
Procedure	a) Write FSP protocol parameter record (0x4201), e.g. via SMI_DeviceWrite *;see field test parameter with A)* b) Evaluation 1) c) Write FSP protocol parameter record (0x4201), e.g. via SMI_DeviceWrite *;see field test parameter with B)* d) Evaluation 2) e) Write FSP protocol parameter record (0x4201), e.g. via SMI_DeviceWrite *;see field test parameter with C)* f) Evaluation 3) g) Write FSP protocol parameter record (0x4201), e.g. via SMI_DeviceWrite *;see field test parameter with D)* h) Evaluation 4)
Test parameter	FSP protocol parameter record for cases A), B), C). and D): FSP_ProtVersion = defaultValue in IODD; FSP_ProtMode = A), B), C), or D), *;see values at the end of field* FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = 0, FSP_ProtParCRC = valid CRC *;values for case A), B), C) or D)* A) FSP_ProtMode = defaultValue in IODD - 1 B) FSP_ProtMode = defaultValue in IODD + 1 C) FSP_ProtMode = 0xF9 D) FSP_ProtMode = 0xFA
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Write response 2) Check Write response 3) Check Write response 4) Check Write response
Test passed	Negative Write responses for Write attempts: In case of 1): 0x8030 (out of range) In case of 2): 0x8030 (out of range) In case of 3): 0x8030 (out of range) In case of 4): 0x8030 (out of range)
Test failed (examples)	Incorrect or no negative Write responses
Report	Correct negative Write responses: <yes/no> <ok | nok>

7.3.5 Invalid range of parameter "FSP_Watchdog"

Table 38 defines the test conditions for this test case.

Table 38 – Invalid range of parameter "FSP_Watchdog"

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0027
Name	FSTCD_CONF_FSPD_WDOGRANGE
Purpose (short)	Detection of invalid range of parameter "FSP Watchdog"
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test: test-to-fail
Specification (clause)	[4] Annex A
Configuration / setup	FS-Device-Tester-Unit

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Detection of invalid value of parameter "FSP_Watchdog" (outside specified range and IODD). FSP parameter range value test based on IODD/specification
Precondition	EUT in OPERATE (commissioning operation, FSP_TechParCRC = 0) FSDT in OPERATE (commissioning operation)
Procedure	a) Write FSP protocol parameter record (0x4201), e.g. via SMI_DeviceWrite *;see field test parameter with A)* b) Evaluation 1) c) Write FSP protocol parameter record (0x4201), e.g. via SMI_DeviceWrite *;see field test parameter with B)* d) Evaluation 2) e) Write FSP protocol parameter record (0x4201), e.g. via SMI_DeviceWrite *;see field test parameter with C)* f) Evaluation 3)
Test parameter	FSP protocol parameter record for cases A), B), and optionally C): FSP_ProtVersion = defaultValue in IODD; FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = A), B), or C), *;see values at the end of field* FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = 0, FSP_ProtParCRC = valid CRC *;values for case A), B), C) or D)* A) FSP_Watchdog = 0 B) FSP_Watchdog = lowerValue in IODD - 1 C) FSP_Watchdog = upperValue in IODD +1 *;only if upperValue in IODD < 65535*
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Write response and Event 2) Check Write response and Event 3) Check Write response and Event
Test passed	Negative Write responses for Write attempts: In case of 1): 0x8032 (below limit) In case of 2): 0x8032 (below limit) In case of 3): 0x8031 (above limit)
Test failed (examples)	Incorrect or no negative Write responses
Report	Correct negative Write responses: <yes/no> <ok | nok>

7.3.6 Invalid value of signature "FSP_ProtParCRC"

Table 39 defines the test conditions for this test case.

Table 39 – Invalid value of signature "FSP_ProtParCRC"

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0028
Name	FSTCD_CONF_FSPD_PRCRCINVAL
Purpose (short)	Detection of invalid value of signature "FSP_ProtParCRC"
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test: test-to-fail
Specification (clause)	[4] Annex A
Configuration / setup	FS-Device-Tester-Unit
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Detection of invalid value of signature "FSP_ProtParCRC" based on calculation
Precondition	EUT in OPERATE (commissioning operation, FSP_TechParCRC = 0) FSDT in OPERATE (commissioning operation)
Procedure	a) Write FSP protocol parameter record (0x4201), e.g. via SMI_DeviceWrite *;see field test parameter* b) Evaluation 1) c) Evaluation 2)
Test parameter	FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD; FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = 0, FSP_ProtParCRC = invalid CRC *;e.g. decrement calculated value*
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check Write response 2) Check Events
Test passed	Negative Write response with one of 0x8040, 0x8041, and No Events
Test failed (examples)	Incorrect Write response, and/or Unexpected Events
Report	Correct negative Write response: <yes/no> <ok | nok> No Events received: <yes/no> <ok | nok>

7.4 FST parameterization

7.4.1 Default FST parameter (for OSSDe operation)

Table 40 defines the test conditions for this test case.

Table 40 – Default FST parameter (for OSSDe operation)

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0029
Name	FSTCD_CONF_DEFAULTFST
Purpose (short)	FST parameter of FS-Device in delivery state retrieved as indicated in IODD
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test: test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Device-Tester-Unit

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	FST parameter of FS-Device in delivery state retrieved as indicated in IODD. FSP_TechParCRC from FS-Device matches calculation performed by Test Tool.
Precondition	EUT in delivery state
Procedure	a) Read parameter in fst_param (start with first value) *;see IODD* b) Evaluation 1) c) Repeat with next parameter from a) *;see field test parameter* d) Calculate FSP_TechParCRC for all fst_param using Dedicated Tool / User manual e) Read parameter FSP_TechParCRC f) Evaluation 2)
Test parameter	fst_param = {all FST parameter in IODD}
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Compare value "defaultValue" of FST parameter in IODD with read parameter from EUT 2) Compare calculated FSP_TechParCRC with FSP_TechParCRC read from EUT
Test passed	All comparisons show equal values
Test failed (examples)	Any comparison is showing not equal values
Report	Comparison equal: <yes/no> <ok | nok>

762 ### 7.4.2 IODD versus FST parameters in FS-Device

763 Table 41 defines the test conditions for this test case.

764 **Table 41 – IODD versus FST parameters in FS-Device**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0030
Name	FSTCD_CONF_IODDFSTPAR
Purpose (short)	FST parameter in IODD accessible in FS-Device as indicated
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test: test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Device-Tester-Unit

765

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	FST parameter in IODD accessible in FS-Device as indicated
Precondition	EUT in OPERATE (commissioning operation, FSP_TechParCRC = 0) FSDT in OPERATE (commissioning operation)
Procedure	a) Get Index/Subindex of parameter in fst_param (start with first) b) Read parameter if read access allowed c) Evaluation 1) d) Write parameter with read value if write access allowed e) Evaluation 2) f) Repeat from a)
Test parameter	fst_param = {all FST parameter in IODD}
Post condition	–

766

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Read response 2) Check Write response
Test passed	All responses positive
Test failed (examples)	Any response negative
Report	Responses positive: <yes/no> <ok | nok>

767

768 ### 7.4.3 TechParCRC via Dedicated Tool

769 Table 42 defines the test conditions for this test case.

770 **Table 42 – TechParCRC via Dedicated Tool**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0031
Name	FSTCD_CONF_CRCDEDTOOL
Purpose (short)	CRC signature calculation of "Dedicated Tool" fits to calculation of FS-Device
Equipment under test (EUT)	FS-Device and Dedicated Tool or alternative method
Test case version	1.1
Category / type	FS-Device test: test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Device-Tester

771

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	TechParCRC signature calculation of "Dedicated Tool" fits to calculation of FS-Device (FSP_TechParCRC)
Precondition	EUT in delivery state
Procedure	a) Set some FST parameter of EUT and retrieve FSP_TechParCRC ;see user manual for method b) Write FST parameter to EUT c) Evaluation 1) d) Write valid FSP_AuthRecord and FSP_ProtocolRecord to EUT e) Evaluation 2) f) Set valid Set PortConfig with FSP_VerifyRecord ; e.g. via SMI_PortConfiguration using ArgBlock 0x8100 g) Wait for Port state "SPDU_EXCHANGE" ; e.g. via ArgBlock FSPortStatusList h) Evaluation 3)
Test parameter	–
Post condition	–

772

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Write responses 2) Check Write responses 3) Check Port state
Test passed	All checks correct
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

773

7.4.4 Switch to OSSDe operation after parameterization

Table 43 defines the test conditions for this test case.

Table 43 – Switch to OSSDe operation after parameterization

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0032
Name	FSTCD_CONF_SWTOOSSD
Purpose (short)	FST parameterization cycle: COM → OSSDe → COM
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test: test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE	
Purpose (detailed)	FST parameterization cycle: COM → OSSDe → COM	
Precondition	EUT: in out-of-box configuration	
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of A) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for port state OPERATE c) Write FSP protocol parameter record (0x4201) *;see A)* d) Evaluation 1) e) Write FSP authenticity parameter record (0x4200) *;see B)* f) Evaluation 2) g) Port power Off/On e.g. via SMI_PortPowerOffOn h) Wait for Port state "SCL_ENABLED" e.g. via ArgBlock FSPortStatusList i) Evaluation 3) j) Set PortConfig to OSSDE k) Port power Off/On e.g. via SMI_PortPowerOffOn l) Wait FSP_TimeToReady m) Get PDin e.g. via SMI_FSPDInOut service *;return ArgBlock "FSPDInOut"* m) Evaluation 4) n) Set PortConfig with FSP_VerifyRecord with values of A) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see test parameter* o) Port power Off/On p) Wait for Port state "SCL_ENABLED" q) Evaluation 5)	
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature, FSP_ProtParCRC = valid CRC signature	B) FSP authenticity parameter: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 *;CRC: Responsibility of tester*
Post condition	–	

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Write response 2) Check Write response 3) Check Port state 4) Check OSSDe input (e.g. via ArgBlock FSPDInOut.SPDUIn0) 5) Check Port state
Test passed	All checks correct
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

780 ## 7.5 Setup operational modes (Annex G)

781 ### 7.5.1 Setup "commissioning test"

782 Table 45 defines the test conditions for this test case.

783 **Table 44 – Setup "commissioning test"**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0033
Name	FSTCD_CONF_SETUPCOMMI
Purpose (short)	Setup "commissioning test" as specified
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test, test-to-pass
Specification (clause)	[4] Annex G
Configuration / setup	FS-Device-Tester (FSDT)

784

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Setup "commissioning test" as specified.
Precondition	EUT: in out-of-box configuration
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of A) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for port state OPERATE c) Write FSP protocol parameter record (0x4201) *;see A)* d) Evaluation 1) e) Write FSP authenticity parameter record (0x4200) *;see B)* f) Evaluation 2) g) Port power Off/On e.g. via SMI_PortPowerOffOn h) Wait for Port state "SCL_ENABLED" e.g. via ArgBlock FSPortStatusList i) Evaluation 3)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = 0, FSP_ProtParCRC = valid CRC signature ;responsibility of tester B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456
Post condition	–

785

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Write response 2) Check Write response 3) Check Port state
Test passed	All checks correct
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

786

787 ### 7.5.2 Setup "armed"

788 Table 45 defines the test conditions for this test case.

789 **Table 45 – Setup "armed"**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0034
Name	FSTCD_CONF_SETUPARMED
Purpose (short)	Setup "armed" as specified
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test: test-to-pass
Specification (clause)	[4] Annex G
Configuration / setup	FS-Device-Tester-Unit

790

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Setup "armed" as described
Precondition	EUT in OPERATE (commissioning operation, FSP_TechParCRC = 0) FSDT in OPERATE (commissioning operation)
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of A) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "SCL_ENABLED" e.g. via ArgBlock FSPortStatusList c) Write FSP protocol parameter record (0x4201) *;see A)* d) Evaluation 1) e) Write FSP authenticity parameter record (0x4200) *;see B)* f) Evaluation 2) g) Port power Off/On e.g. via SMI_PortPowerOffOn h) Wait for Port state "SCL_ENABLED" e.g. via ArgBlock FSPortStatusList i) Evaluation 3)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature *;responsibility of tester* B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456
Post condition	–

791

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Write response 2) Check Write response 3) Check Port state
Test passed	All checks correct
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

792

8 FS-Device safety measure tests

8.1 Overview

The FS-Device protocol tests comprise the various constellations of the VerifyRecord prior to start of the Safety Communication Layer (SCL). It also comprises special tests such as the protocol watchdog timer and evidence of correct implementation of the watchdog trigger as well as the exceptional handling whenever a CRC signature calculation results in "0".

8.2 Verification (VerifyRecord)

8.2.1 Correct VerifyRecord and FSP_TechParCRC ("armed")

Table 46 defines the test conditions for this test case. It checks whether an FS-Device starts SCL communication in "armed" mode (operation not monitored) after reception of a valid VerifyRecord and FSP_TechParCRC ≠ 0.

Table 46 – Correct VerifyRecord and FSP_TechParCRC ("armed")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0035
Name	FSTCD_PARM_VRFY_ARMED
Purpose (short)	Correct VerifyRecord and FSP_TechParCRC ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-pass
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1
Configuration / setup	FS-Device-Tester
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Make sure that an FS Device is going to start SCL communication (“armed”) after reception of a valid VerifyRecord with FSP_TechParCRC ≠ 0.
Precondition	EUT: Configured for armed operation *;see field test parameter* FSDT: Port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of A) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "SCL_ENABLED" e.g. via ArgBlock FSPortStatusList c) Repeat SMI_FSPDInOut until change (observe <timeout>) *;ArgBlock FSPDInOut* d) Evaluation 1)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature *;responsibility of tester* B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 <timeout> = 1s
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check change
Test passed	No <timeout> occured
Test failed (examples)	<timeout>
Report	SPDU exchange: <negative/positive> <ok | nok>

807

8.2.2 Correct VerifyRecord and FSP_TechParCRC ("commissioning")

Table 47 defines the test conditions for this test case. It checks whether an FS-Device starts SCL communication in "commissioning - test" mode (operation monitored by personel) after receiving a valid VerifyRecord and FSP_TechParCRC =0.

Table 47 – Correct VerifyRecord and FSP_TechParCRC ("commissioning")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0036
Name	FSTCD_PARM_VRFY_COMMISTEST
Purpose (short)	Correct VerifyRecord and FSP_TechParCRC ("commissioning test")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-pass
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is going to start SCL communication (“commissioning test”) when receiving a valid VerifyRecord with FSP_TechParCRC = 0.
Precondition	EUT configured for commissioning operation *;see field test parameter* FSDT Port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of A) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "SCL_ENABLED" e.g. via ArgBlock FSPortStatusList c) Repeat SMI_FSPDInOut until change (observe <timeout>) *;ArgBlock FSPDInOut* d) Evaluation 1)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = 0, FSP_ProtParCRC = valid CRC signature *;responsibility of tester* B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check change
Test passed	No <timeout>
Test failed (examples)	<timeout>
Report	SPDU exchange: <negative/positive> <ok | nok>

8.2.3 Missing VerifyRecord at start-up ("armed")

Table 48 defines the test conditions for this test case. It checks whether an FS-Device refuses to start SCL communication when VerifyRecord is missing in "armed" mode (operation not monitored).

Table 48 – Missing VerifyRecord at start-up ("armed")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0037
Name	FSTCD_PARM_VRFY_ARMEDNOVFY
Purpose (short)	Missing VerifyRecord at start-up ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS-Device is not going to start SCL communication without receiving a valid and matching VerifyRecord within twice the time required for regular start-up.
Precondition	EUT configured for armed operation *;see field test parameter* FSDT Port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of A) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* FSDT: Do NOT send FSP_VerifyRecord b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1) d) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature *;responsibility of tester* B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state 2) Check Events
Test passed	Port state is “OPERATE”, and Event 0xB00A received
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok> Event 0xB00A received: <yes/no> <ok | nok>

8.2.4 Missing VerifyRecord at start-up ("commissioning")

Table 49 defines the test conditions for this test case. It checks whether an FS-Device refuses to start SCL communication when VerifyRecord is missing in "commissioning – test" mode (monitored operation).

Table 49 – Missing VerifyRecord at start-up ("commissioning")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0038
Name	FSTCD_PARM_VRFY_TESTNOVFY
Purpose (short)	Missing VerifyRecord at start-up ("commissioning test")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1
Configuration / setup	FS-Device-Tester
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication ("commissioning test") without receiving a valid VerifyRecord within twice the time required for regular start-up.
Precondition	EUT configured for commissioning operation *;see field test parameter* FSDT Port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of A) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* FSDT: Do NOT send FSP_VerifyRecord b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1) d) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = 0, FSP_ProtParCRC = valid CRC signature *;responsibility of tester* B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check Port state 2) Check Events
Test passed	Port state is "OPERATE", and Event 0xB00A received
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok> Event 0xB00A received: <yes/no> <ok | nok>

8.2.5 Incorrect FSP_TechParCRC ("commissioning")

Table 50 defines the test conditions for this test case. It checks whether an FS-Device refuses to start SCL communication when FSP_TechParCRC ≠ 0 in "commissioning – test" mode (monitored operation). An Event shall be raised.

Table 50 – Incorrect FSP_TechParCRC ("commissioning")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0039
Name	FSTCD_PARM_VRFY_TECHPARN0
Purpose (short)	Incorrect FSP_TechParCRC when "commissioning test"
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication ("commissioning test") without receiving a valid VerifyRecord with FSP_TechParCRC = 0.
Precondition	EUT configured for commissioning operation *;see A) and B)* FSDT port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of C) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1) d) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = 0, FSP_ProtParCRC = valid CRC signature *;responsibility of tester* B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 C) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature *;responsibility of tester*
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state 2) Check Events
Test passed	Port state is "OPERATE", and Event 0xB007 received
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok> Event 0xB007 received: <yes/no> <ok | nok>

8.2.6 Incorrect FSP_TechParCRC ("armed")

Table 51 defines the test conditions for this test case. It checks whether an FS-Device refuses to start SCL communication when FSP_TechParCRC = 0 in "armed" mode (operation not monitored). An Event shall be raised.

Table 51 – Incorrect FSP_TechParCRC ("armed")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0040
Name	FSTCD_PARM_VRFY_TECHPAR0
Purpose (short)	Incorrect FSP_TechParCRC ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication (“armed”) without receiving a valid VerifyRecord with FSP_TechParCRC ≠ 0.
Precondition	EUT configured for armed operation *;see A) and B)* FSDT port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of C) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1) d) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 C) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, *;responsibility of tester* FSP_TechParCRC = valid CRC signature + 1, FSP_ProtParCRC = valid CRC signature *;responsibility of tester*
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state 2) Check Events
Test passed	Port state is “OPERATE”, and Event 0xB007 received
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok> Event 0xB007 received: <yes/no> <ok | nok>

8.2.7 Unexpected authenticity 1 ("armed")

Table 52 defines the test conditions for this test case. It checks whether an FS-Device refuses to start SCL communication in case of VerifyRecord with unexpected authenticity 1 in "armed" mode (operation not monitored). This corresponds to the use case of a misconnected FS-Device to a correct Port but to an incorrect FS-Master. In this case an Event shall be raised.

Table 52 – Unexpected authenticity 1 ("armed")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0041
Name	FSTCD_PARM_VRFY_AUTH1WRONG
Purpose (short)	Unexpected authenticity 1 ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1, clause B.1
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication (“armed”) when receiving VerifyRecord with unexpected AUTH1 parameter.
Precondition	EUT configured for armed operation *;see A) and B)* FSDT Port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of A) and C) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1) d) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 C) FSP authenticity parameter record: FSCP_Authenticity_1 = 2, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 26664
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state 2) Check Events
Test passed	Port state is “OPERATE”, and Event 0xB003 received
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok> Event 0xB003 received: <yes/no> <ok | nok>

8.2.8 Unexpected authenticity 2 ("armed")

Table 53 defines the test conditions for this test case. It checks whether an FS-Device refuses to start SCL communication in case of VerifyRecord with unexpected authenticity 2 in "armed" mode (operation not monitored). This corresponds to the use case of a misconnected FS-Device to a correct Port but to an incorrect FS-Master. In this case an Event shall be raised.

Table 53 – Unexpected authenticity 2 ("armed")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0042
Name	FSTCD_PARM_VRFY_AUTH2WRONG
Purpose (short)	Unexpected authenticity 2 ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1, clause B.1
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication (“armed”) when receiving VerifyRecord with unexpected AUTH2 parameter.
Precondition	EUT configured for armed operation *;see A) and B)* FSDT port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of A) and C) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1) d) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 C) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 3, FSP_Port = 1, FSP_AuthentCRC = 24853
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state 2) Check Events
Test passed	Port state is “OPERATE”, and Event 0xB003 received
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok> Event 0xB003 received: <yes/no> <ok | nok>

8.2.9 Unexpected Port ("armed")

Table 54 defines the test conditions for this test case. It checks whether an FS-Device refuses to start SCL communication in case of VerifyRecord with unexpected Port in "armed" mode (operation not monitored). This corresponds to the use case of a misconnected FS-Device to an incorrect Port but to a correct FS-Master. In this case an Event shall be raised.

Table 54 – Unexpected Port ("armed")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0043
Name	FSTCD_PARM_VRFY_PORTWRONG
Purpose (short)	Unexpected Port ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1, clause B.1
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication (“armed”) when receiving VerifyRecord with unexpected authentication port parameter.
Precondition	EUT configured for armed operation *;see A) and B)* FSDT port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of A) and C) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1) d) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 C) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 2, FSP_AuthentCRC = 65341
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state 2) Check Events
Test passed	Port state is “OPERATE”, and Event 0xB004 received
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok> Event 0xB004 received: <yes/no> <ok | nok>

878 ### 8.2.10 Incorrect authenticity CRC signature ("armed")

879 Table 55 defines the test conditions for this test case. It checks whether an FS-Device refuses
880 to start SCL communication in case of VerifyRecord with incorrect authenticity CRC signature
881 in "armed" mode (operation not monitored). In this case an Event shall be raised.

882 **Table 55 – Incorrect authenticity CRC signature ("armed")**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0044
Name	FSTCD_PARM_VRFY_AUTHCRCWRG
Purpose (short)	Incorrect authenticity CRC signature ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1, clause B.1
Configuration / setup	FS-Device-Tester

883

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication (“armed”) when receiving VerifyRecord with incorrect FSP_AuthentCRC parameter.
Precondition	EUT configured for armed operation *;see A) and B)* FSDT Port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of A) and C) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1) d) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 C) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11457
Post condition	–

884

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state 2) Check Events
Test passed	Port state is “OPERATE”, and Event 0xB005 received
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok> Event 0xB005 received: <yes/no> <ok | nok>

885

8.2.11 Incorrect protocol parameter CRC signature ("armed")

Table 55 defines the test conditions for this test case. It checks whether an FS-Device refuses to start SCL communication in case of VerifyRecord with incorrect protocol parameter CRC signature in "armed" mode (operation not monitored). In this case an Event shall be raised.

Table 56 – Incorrect protocol parameter CRC signature ("armed")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0045
Name	FSTCD_PARM_VRFY_PPARCRCWRG
Purpose (short)	Incorrect protocol parameter CRC signature ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1, clause B.1
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication (“armed”) when receiving VerifyRecord with incorrect FSP_ProtParCRC parameter.
Precondition	EUT configured for armed operation *;see A) and B)* FSDT Port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of C) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1) d) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 C) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, *;responsibility of tester* FSP_TechParCRC = valid CRC signature, FSP_ProtParCRC = valid CRC signature + 1 *;responsibility of tester*
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state 2) Check Events
Test passed	Port state is “OPERATE”, and Event 0xB006 received
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok> Event 0xB006 received: <yes/no> <ok | nok>

8.2.12 Incorrect technology parameter CRC signature ("armed")

Table 55 defines the test conditions for this test case. It checks whether an FS-Device refuses to start SCL communication in case of VerifyRecord with incorrect technology parameter CRC signature in "armed" mode (operation not monitored). In this case an Event shall be raised.

Table 57 – Incorrect technology parameter CRC signature ("armed")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0046
Name	FSTCD_PARM_VRFY_TPARCRCWRG
Purpose (short)	Incorrect technology parameter CRC signature ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1, clause B.1
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication (“armed”) when receiving VerifyRecord with incorrect FSP_TechParCRC parameter.
Precondition	EUT configured for armed operation *;see A) and B)* FSDT Port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of C) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1) d) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 C) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, *;responsibility of tester* FSP_TechParCRC = 0, FSP_ProtParCRC = valid CRC signature *;responsibility of tester*
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state 2) Check Events
Test passed	Port state is “OPERATE”, and Event 0xB007 received
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok> Event 0xB007 received: <yes/no> <ok | nok>

902 ### 8.2.13 Incorrect IO structure CRC signature ("armed")

903 Table 58 defines the test conditions for this test case. It checks whether an FS-Device refuses
904 to start SCL communication in case of VerifyRecord with incorrect technology parameter CRC
905 signature in "armed" mode (operation not monitored). In this case an Event shall be raised.

906 **Table 58 – Incorrect IO structure CRC signature ("armed")**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0047
Name	FSTCD_PARM_VRFY_IOSTCRCWRG
Purpose (short)	Incorrect IO structure CRC signature ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1, clause B.1
Configuration / setup	FS-Device-Tester

907

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication (“armed”) when receiving VerifyRecord with incorrect FSP_IO_StructCRC parameter.
Precondition	EUT configured for armed operation *;see A) and B)* FSDT Port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of C) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1) d) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature, *;responsibility of tester* FSP_ProtParCRC = valid CRC signature B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 C) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD + 1, *;responsibility of tester* FSP_TechParCRC = valid CRC signature, FSP_ProtParCRC = valid CRC signature *;responsibility of tester*
Post condition	–

908

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state 2) Check Events
Test passed	Port state is “OPERATE”, and Event 0xB008 received
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok> Event 0xB008 received: <yes/no> <ok | nok>

909

8.2.14 Invalid watchdog time ("armed")

Table 59 defines the test conditions for this test case. It checks whether an FS-Device refuses to start SCL communication in case of VerifyRecord with invalid watchdog time in "armed" mode (operation not monitored). In this case an Event shall be raised.

Table 59 – Invalid watchdog time ("armed")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0048
Name	FSTCD_PARM_VRFY_WDTIMEINVL
Purpose (short)	Invaild watchdog time ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1, clause B.1, A.2.6
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication (“armed”) when receiving VerifyRecord with invalid "WD timeout" value.
Precondition	EUT configured for armed operation *;see A) and B)* FSDT Port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of C) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1) d) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 C) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = 0, FSP_IOStructCRC = defaultValue in IODD, *;responsibility of tester* FSP_TechParCRC = valid CRC signature, FSP_ProtParCRC = valid CRC signature *;responsibility of tester*
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state 2) Check Events
Test passed	Port state is “OPERATE”, and Event 0xB009 received
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok> Event 0xB009 received: <yes/no> <ok | nok>

8.2.15 Invalid protocol version ("armed")

Table 60 defines the test conditions for this test case. It checks whether an FS-Device refuses to start SCL communication in case of VerifyRecord with incorrect protocol version in "armed" mode (operation not monitored). In this case no Event shall be raised.

Table 60 – Invalid protocol version ("armed")

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0049
Name	FSTCD_PARM_VRFY_PVERSINVL
Purpose (short)	Invalid protocol version ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication (“armed”) when receiving VerifyRecord with invalid protocol version parameter.
Precondition	EUT configured for armed operation *;see A) and B)* FSDT Port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of C) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 C) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD + 1, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, *;responsibility of tester* FSP_TechParCRC = valid CRC signature, FSP_ProtParCRC = valid CRC signature *;responsibility of tester*
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state
Test passed	Port state is “OPERATE”
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok>

926 ### 8.2.16 Invalid protocol mode ("armed")

927 Table 61 defines the test conditions for this test case. It checks whether an FS-Device refuses
928 to start SCL communication in case of VerifyRecord with incorrect protocol mode in "armed"
929 mode (operation not monitored). In this case no Event shall be raised.

930 **Table 61 – Invalid protocol mode ("armed")**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0050
Name	FSTCD_PARM_VRFY_PMODEINVL
Purpose (short)	Invalid protocol mode ("armed")
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device PREOPERATE test: test-to-fail
Specification (clause)	[4] clause 10.4.1, clause 10.4.3.1, clause 11.7.6, clause G.1
Configuration / setup	FS-Device-Tester

931

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Make sure that an FS Device is not going to start SCL communication (“armed”) when receiving VerifyRecord with invalid protocol mode parameter.
Precondition	EUT configured for armed operation *;see A) and B)* FSDT Port config DEACTIVATED
Procedure	a) Set PortConfig with FSP_VerifyRecord with values of C) and B) e.g. via SMI_PortConfiguration using ArgBlock 0x8100 *;see field test parameter* b) Wait for Port state "OPERATE" e.g. via ArgBlock FSPortStatusList c) Evaluation 1)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_2 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456 C) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD + 1, FSP_ProtMode = 10, FSP_Watchdog = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, *;responsibility of tester* FSP_TechParCRC = valid CRC signature, FSP_ProtParCRC = valid CRC signature *;responsibility of tester*
Post condition	–

932

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Port state
Test passed	Port state is “OPERATE”
Test failed (examples)	Any check incorrect
Report	Port state OPERATE: <negative/positive> <ok | nok>

933

8.3 Special SCL tests

8.3.1 Principle of FS-Device watchdog timer test

In 13.6.1, the general concepts on worst-case delay times (WCDT) and one fault delay times (OFDT) as well as watchdog timer testing for FS-Master are explained. The test case for FS-Devices follows a similar concept.

Figure 12 illustrates, how the watchdog timer of an FS-Device is tested. The FS-Device Tester controls the FS-Device in such a way that the FS-Master SPDU ("MCount = 4") is delayed through artificial repetitions. For details see 8.3.2.

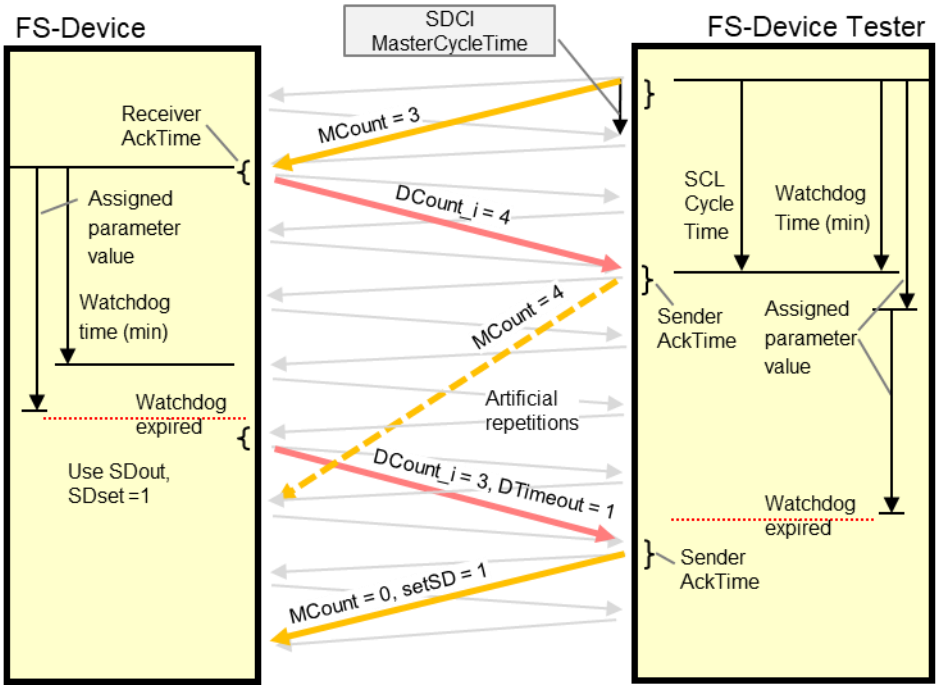


Figure 12 – Principle of FS-Device watchdog timer test

Usually, the SCL software is triggered by the IO-Link communication, which is determined by the Master cycle time. Thus, the reaction of the SCL on expiration of the watchdog depends on how the SCL software samples the IO-Link messages with SPDU as shown in Figure 13.

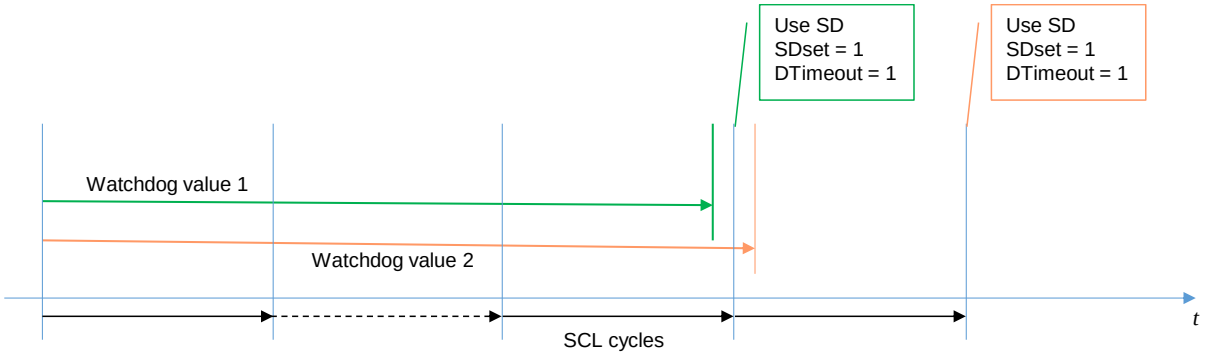


Figure 13 – Influence of SCL sampling effects

In best case, the expiration of the watchdog coincides with the sampling. In worst case, the expiration is just behind sampling and the safety reaction is delayed correspondingly.

It is highly recommended for the designer of an FS-Device to choose the default value of the parameter FSP_Watchdog in IODD such that one extra SCL cycle time is included.

954 ### 8.3.2 FS-Device watchdog timer test

955 Table 62 defines the test conditions for this test case. The base protocol watchdog function of
956 the SCL is tested in 9.2.

957 **Table 62 – FS-Device watchdog timer test**

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0051
Name	FSTCD_SCLD_WATCHDOGANDIODD
Purpose (short)	Check whether FS-Device watchdog timeout coincides with IODD value
Equipment under test (EUT)	FS-Device and IODD
Test case version	1.1
Category / type	FS-Device test, test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Device-Tester

958

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check whether FS-Device's safety reaction time upon watchdog timeout coincides with the FSP_Watchdog value in the IODD (see also 13.6.2).
Precondition	EUT: Configured for armed operation ;*see field test parameter* FSDT: Port config DEACTIVATED FS Device SCL cycle time t_scl,d, SCL cycle time of Master = t_scl,m = 0
Procedure	a) Set PortConfig with FSP_VerifyRecord values of A) and B) ;*see field test parameter* b) Wait for Port state "OPERATE" c) delay the generation of SPDU in the FSDTU with the maximum number of cycles not exceeding the time t_lp ;*see field test parameter* d) Line monitor to measure timeouts for 1 min (Status Bit0 = 0, DTimeout) e) Evaluation 1) f) delay the generation of SPDU in the FSDTU with the minimum number of cycles exceeding the time t_sf. ;*see field test parameter* g) Line monitor to measure timeouts for 1 min (Status Bit0 = 0, DTimeout), break if a timeout has occurred h) Evaluation 2)
Test parameter	A) FSP protocol parameter record: FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_Watchdog (t_wd) = min cycle time from IODD * 100 t_ct = Master cycle time which is used during test $t_{lp} = 0.9\, t_{wd} - 2t_{ct} - t_{scl,d}$ $t_{sf} = 1.1 + 2t_{ct} + t_{scl,d}$ FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature ;*responsibility of tester* FSP_ProtParCRC = valid CRC signature ;*responsibility of tester* B) FSP authenticity parameter record: FSCP_Authenticity_1 = 1, FSCP_Authenticity_1 = 2, FSP_Port = 1, FSP_AuthentCRC = 11456
Post condition	–

959

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check timeouts 2) Check timeouts
Test passed	No timeout occured in 1) At least 1 timeout occurred in 2)
Test failed (examples)	If a timeout occurred in 1) or no timeout occurred in 2)
Report	Watchdog within limits <ok | not ok>

8.3.3 Watchdog retrigger and CRC exception (0 → 1)

8.3.1 defines the conditions for this test case. Some critical safety features cannot be tested by IO-Link on-board equipment and shall be assessed during the development process via verification and validation activities according to appropriate clauses in IEC 61508-3 as also mentioned in 13.6.1.

Manufacturer to prove that the SCL watchdog timer is only retriggered when MCount has been incremented and a calculated SPDU CRC signature of "0" will be changed to "1".

9 FS-Device safety communication layer tests

9.1 Interface for the FS-Device SCL test scripts

The test scripts for the automated safety layer test are encoded as XML files. Each and every test script ("FSDeviceSclTestCaseSteps") consists of test step instructions as described in Table 63. The XML Schema of the interface parameters for the FS-Device automated safety layer test is illustrated in Figure 14. It is similar to the XML format of the message types for the FS-Master (see 12.1).

However, the test scripts for the FS-Device do not contain test data for the "technology" interface. An upper tester is not intended for the FS-Device test. During the execution of the test scripts, the "technology" data has always its configured initial value.

NOTE The general concept of SCL protocol conformance testing is described in A.2.3. The automated safety layer tester for FS-Devices is described in A.2.5.

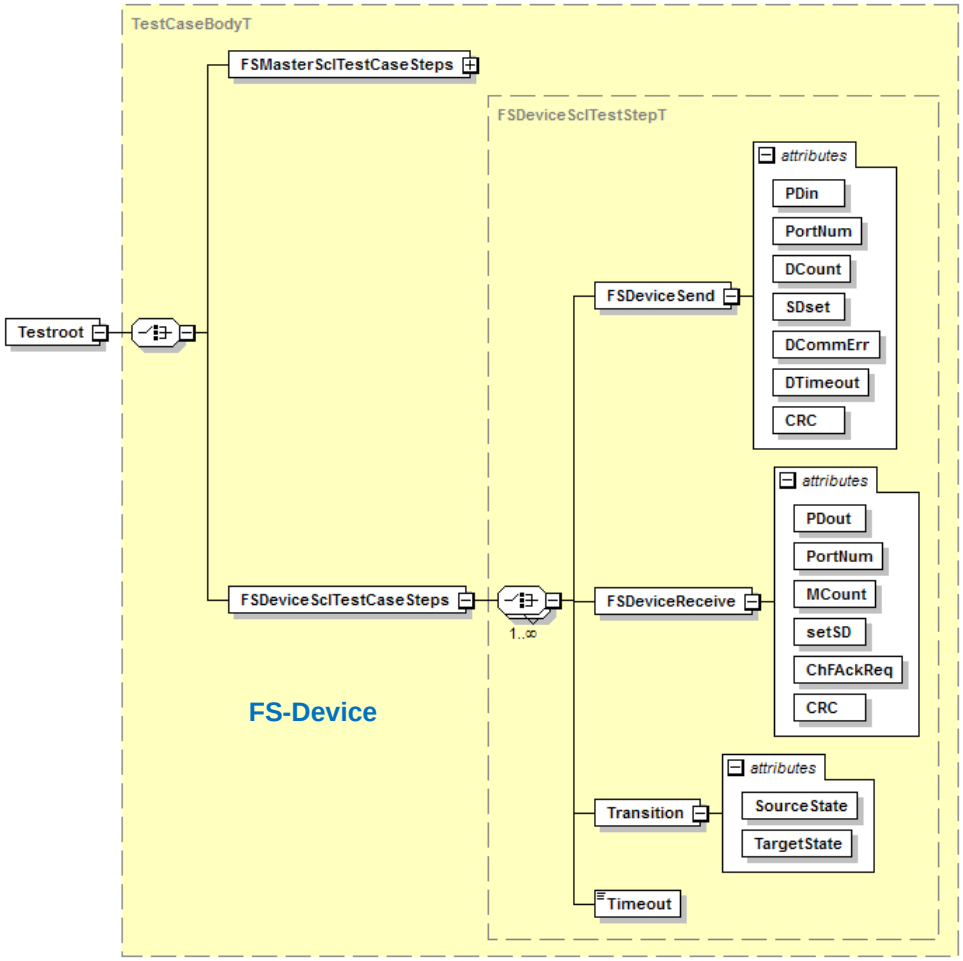


Figure 14 – Schema of steps and parameters/attributes

Table 63 defines the FS-Device interface parameters.

Table 63 – FS-Device interface parameters

Test step instructions	Parameter	Value range
FSDeviceSend (FS-Device → Test System)	PDin	SD –Test System expects SD values (= 0) PD – Test System expects PD values (> 0)
	PortNum	valid –Test System expects configured port number
	DCount	0 to 7
	SDset	0, 1

Test step instructions	Parameter	Value range
	DCommErr	0, 1
	DTimeout	0, 1
	CRC	valid – Test System expects correct CRC-Signature
FSDeviceReceive (Test System → FS-Device)	PDout	PD – Test System sends PD values (> 0)
	PortNum	valid – Test System sends configured port number invalid – Test System sends not configured port number
	MCount	0 to 7
	setSD	0, 1
	ChFAckReq	0, 1
	CRC	valid – Test System sends correct CRC-Signature invalid – Test System sends incorrect CRC-Signature
Timeout (Test System → FS-Device)		Test System sends no new message within a time delay ≥ DTime. See for example 9.2.3.
Transition (Tag)	SourceState	This parameter is informative and will be inserted only in test logging from test system
	TargetState	This parameter is informative and will be inserted only in test logging from test system

The test step instructions comprise test messages from and to the FS-Device, Timeout, and Transition tags.

Test messages sent by the FS-Device test object (EUT) are specified with the message type "FSDeviceSend". The test message type "FSDeviceReceive" describes test messages that are received by the FS-Device in a test scenario. Both messages are defining test data that are received from or sent to the IO-Link communication Port.

The test step instruction "Timeout" specifies for how long the test system shall not send a response. This time shall be greater than the watchdog time of the EUT (DTime).

The XML tag "Transition" is used for traceability of test messages with respect to the expected transition of the state machine specified in [4]. This information is only descriptive and has no impact on the test flow of the test tool.

9.2 FS-Device SCL test suite

9.2.1 Test script 1

Table 64 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 1, and Timeout.

Table 64 – FS-Device test script 1

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0052
Name	FSTCD_SCLD_FLOW_NOERRMC1TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 46 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_1.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_1.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_1" date="20.11.2018: 14:01:13.942">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
```

```
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.2 Test script 2

Table 65 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error and MCount = 0.

Table 65 – FS-Device test script 2

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0053
Name	FSTCD_SCLD_FLOW_SETSD1MC0
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_2.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_2.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_2" date="20.11.2018: 14:01:13.942">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
1087        <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
1088        <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
1089        <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
1090        <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
1091        <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
1092        <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
1093        <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
1094        <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
1095        <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
1096        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
1097        <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
1098      </FSDeviceSclTestCaseSteps>
1099    </Testroot>
1100
```

9.2.3 Test script 3

Table 66 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 5, and Timeout.

Table 66 – FS-Device test script 3

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0054
Name	FSTCD_SCLD_FLOW_ SETSD0MC5TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_3.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_3.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_3" date="20.11.2018: 14:01:13.942">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <Timeout/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="0" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
```

```
1139      </FSDeviceSclTestCaseSteps>
1140    </Testroot>
1141
```

1142

9.2.4 Test script 4

Table 67 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 1, and Timeout.

Table 67 – FS-Device test script 4

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0055
Name	FSTCD_SCLD_FLOW_SETSD0MC1TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_4.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_4.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_4" date="20.11.2018: 14:01:13.942">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
```

```
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.5 Test script 5

Table 68 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error and MCount = 0.

Table 68 – FS-Device test script 5

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0056
Name	FSTCD_SCLD_FLOW_SETSD1MC0
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_5.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_5.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_5" date="20.11.2018: 14:01:13.943">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.6 Test script 6

Table 69 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 2, and Timeout.

Table 69 – FS-Device test script 6

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0057
Name	FSTCD_SCLD_FLOW_SETSD0MC2TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_6.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_6.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_6" date="20.11.2018: 14:01:13.943">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
```

```
1254      <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
1255      <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
1256      <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
1257      <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="1" ChFAckReq="0" CRC="valid"/>
1258      <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
1259      <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
1260      <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
1261      <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
1262      <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
1263      <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
1264      <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
1265      <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
1266      <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
1267    </FSDeviceSclTestCaseSteps>
1268  </Testroot>
1269
```

9.2.7 Test script 7

Table 70 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 1, and Timeout.

Table 70 – FS-Device test script 7

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0058
Name	FSTCD_SCLD_FLOW_SETSD0MC1TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_7.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_7.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_7" date="20.11.2018: 14:01:13.943">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.8 Test script 8

Table 71 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 7, and Timeout.

Table 71 – FS-Device test script 8

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0059
Name	FSTCD_SCLD_FLOW_SETSD0MC7TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_8.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_8.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_8" date="20.11.2018: 14:01:13.943">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.9 Test script 9

Table 72 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a CRC error and MCount = 0, and Timeout.

Table 72 – FS-Device test script 9

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0060
Name	FSTCD_SCLD_FLOW_CRC1MC0TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_9.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_9.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_9" date="20.11.2018: 14:01:13.943">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <Timeout/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.10 Test script 10

Table 73 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and Timeout.

Table 73 – FS-Device test script 10

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0061
Name	FSTCD_SCLD_FLOW_SETSD1MC0TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_10.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_10.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_10" date="20.11.2018: 14:01:13.943">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <Timeout/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
```

```
1407        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
1408        <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
1409      </FSDeviceSclTestCaseSteps>
1410    </Testroot>
1411
```

9.2.11 Test script 11

Table 74 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error and MCount = 0.

Table 74 – FS-Device test script 11

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0062
Name	FSTCD_SCLD_FLOW_SETSD1MC0
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_11.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_11.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_11" date="20.11.2018: 14:01:13.944">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.12 Test script 12

Table 75 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 75 – FS-Device test script 12

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0063
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_12.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_12.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_12" date="20.11.2018: 14:01:13.944">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.13 Test script 13

Table 76 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 76 – FS-Device test script 13

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0064
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_13.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_13.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_13" date="20.11.2018: 14:01:13.944">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.14 Test script 14

Table 77 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 2, and DCommErr.

Table 77 – FS-Device test script 14

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0065
Name	FSTCD_SCLD_FLOW_SETSD0MC2DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_14.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_14.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_14" date="20.11.2018: 14:01:13.944">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.15 Test script 15

Table 78 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 78 – FS-Device test script 15

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0066
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_15.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_15.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_15" date="20.11.2018: 14:01:13.944">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
```

```
1596        <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
1597        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
1598        <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
1599      </FSDeviceSclTestCaseSteps>
1600    </Testroot>
1601
```

9.2.16 Test script 16

Table 79 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 79 – FS-Device test script 16

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0067
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_16.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_16.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_16" date="20.11.2018: 14:01:13.944">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
```

```
1639      <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
1640      <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
1641      <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
1642      <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
1643      <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
1644      <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
1645      <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
1646      <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
1647    </FSDeviceSclTestCaseSteps>
1648  </Testroot>
```

9.2.17 Test script 17

Table 80 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a PortNum error and MCount = 0.

Table 80 – FS-Device test script 17

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0068
Name	FSTCD_SCLD_FLOW_PNERRMC0
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_17.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_17.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_17" date="20.11.2018: 14:01:13.944">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.18 Test script 18

Table 81 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 2, and Timeout.

Table 81 – FS-Device test script 18

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0069
Name	FSTCD_SCLD_FLOW_SETSD0MC2TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_18.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_18.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_18" date="20.11.2018: 14:01:13.944">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.19 Test script 19

Table 82 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 82 – FS-Device test script 19

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0070
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_19.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_19.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_19" date="20.11.2018: 14:01:13.944">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.20 Test script 20

Table 83 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 83 – FS-Device test script 20

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0071
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_20.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_20.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_20" date="20.11.2018: 14:01:13.944">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.21 Test script 21

Table 84 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 84 – FS-Device test script 21

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0072
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_21.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_21.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_21" date="20.11.2018: 14:01:13.944">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.22 Test script 22

Table 85 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 85 – FS-Device test script 22

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0073
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_22.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_22.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_22" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.23 Test script 23

Table 86 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 1, and DCommErr.

Table 86 – FS-Device test script 23

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0074
Name	FSTCD_SCLD_FLOW_SETSD1MC1DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_23.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_23.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_23" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="WaitOnSPDU_26"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.24 Test script 24

Table 87 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 1, and DCommErr.

Table 87 – FS-Device test script 24

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0075
Name	FSTCD_SCLD_FLOW_SETSD1MC1DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_24.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_24.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_24" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.25 Test script 25

Table 88 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 1, and Timeout.

Table 88 – FS-Device test script 25

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0076
Name	FSTCD_SCLD_FLOW_SETSD0MC1TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_25.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_25.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_25" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="WaitOnSPDU_26"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.26 Test script 26

Table 89 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 1, and Timeout.

Table 89 – FS-Device test script 26

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0077
Name	FSTCD_SCLD_FLOW_SETSD0MC1TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_26.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_26.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_26" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.27 Test script 27

Table 90 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 1, and Timeout.

Table 90 – FS-Device test script 27

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0078
Name	FSTCD_SCLD_FLOW_SETSD0MC1TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_27.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_27.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_27" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.28 Test script 28

Table 91 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 2, and Timeout.

Table 91 – FS-Device test script 28

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0079
Name	FSTCD_SCLD_FLOW_SETSD0MC2TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_28.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_28.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_28" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="WaitOnSPDU_26"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.29 Test script 29

Table 92 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 2, and Timeout.

Table 92 – FS-Device test script 29

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0080
Name	FSTCD_SCLD_FLOW_SETSD0MC2TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_29.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_29.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_29" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.30 Test script 30

Table 92 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 2, and Timeout.

Table 93 – FS-Device test script 30

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0081
Name	FSTCD_SCLD_FLOW_SETSD0MC2TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_30.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_30.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_30" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.31 Test script 31

Table 94 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 3, and Timeout.

Table 94 – FS-Device test script 31

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0082
Name	FSTCD_SCLD_FLOW_SETSD0MC3TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_31.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_31.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_31" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="WaitOnSPDU_26"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.32 Test script 32

Table 95 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 3, and Timeout.

Table 95 – FS-Device test script 32

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0083
Name	FSTCD_SCLD_FLOW_SETSD0MC3TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_32.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_32.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_32" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.33 Test script 33

Table 96 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 3, and Timeout.

Table 96 – FS-Device test script 33

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0084
Name	FSTCD_SCLD_FLOW_SETSD0MC3TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_33.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_33.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_33" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.34 Test script 34

Table 97 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 4, and Timeout.

Table 97 – FS-Device test script 34

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0085
Name	FSTCD_SCLD_FLOW_SETSD0MC4TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_34.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_34.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_34" date="20.11.2018: 14:01:13.945">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="WaitOnSPDU_26"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.35 Test script 35

Table 98 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 4, and Timeout.

Table 98 – FS-Device test script 35

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0086
Name	FSTCD_SCLD_FLOW_SETSD0MC4TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_35.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_35.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_35" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.36 Test script 36

Table 99 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 4, and Timeout.

Table 99 – FS-Device test script 36

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0087
Name	FSTCD_SCLD_FLOW_SETSD0MC4TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_36.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_36.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_36" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.37 Test script 37

Table 100 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 5, and Timeout.

Table 100 – FS-Device test script 37

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0088
Name	FSTCD_SCLD_FLOW_SETSD0MC5TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_37.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_37.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_37" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="WaitOnSPDU_26"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.38 Test script 38

Table 101 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 5, and Timeout.

Table 101 – FS-Device test script 38

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0089
Name	FSTCD_SCLD_FLOW_SETSD0MC5TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_38.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_38.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_38" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.39 Test script 39

Table 102 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 5, and Timeout.

Table 102 – FS-Device test script 39

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0090
Name	FSTCD_SCLD_FLOW_SETSD0MC5TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_39.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_39.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_39" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.40 Test script 40

Table 103 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 6, and Timeout.

Table 103 – FS-Device test script 40

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0091
Name	FSTCD_SCLD_FLOW_SETSD0MC6TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_40.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_40.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_40" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="WaitOnSPDU_26"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.41 Test script 41

Table 104 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 6, and Timeout.

Table 104 – FS-Device test script 41

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0092
Name	FSTCD_SCLD_FLOW_SETSD0MC6TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_41.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_41.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_41" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.42 Test script 42

Table 105 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 7, and Timeout.

Table 105 – FS-Device test script 42

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0093
Name	FSTCD_SCLD_FLOW_SETSD0MC7TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_42.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_42.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_42" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="WaitOnSPDU_26"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.43 Test script 43

Table 106 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 7, and Timeout.

Table 106 – FS-Device test script 43

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0094
Name	FSTCD_SCLD_FLOW_SETSD0MC7TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_43.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_43.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_43" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.44 Test script 44

Table 107 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 7, and Timeout.

Table 107 – FS-Device test script 44

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0095
Name	FSTCD_SCLD_FLOW_SETSD0MC7TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_44.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_44.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_44" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.45 Test script 45

Table 108 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 108 – FS-Device test script 45

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0096
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_45.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_45.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_45" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.46 Test script 46

Table 109 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 109 – FS-Device test script 46

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0097
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_46.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_46.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_46" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.47 Test script 47

Table 110 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 110 – FS-Device test script 47

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0098
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_47.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_47.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_47" date="20.11.2018: 14:01:13.946">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.48 Test script 48

Table 111 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 111 – FS-Device test script 48

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0099
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_48.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_48.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_48" date="20.11.2018: 14:01:13.947">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.49 Test script 49

Table 112 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 112 – FS-Device test script 49

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0100
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_49.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_49.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_49" date="20.11.2018: 14:01:13.947">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.50 Test script 50

Table 113 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 2, and Timeout.

Table 113 – FS-Device test script 50

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0101
Name	FSTCD_SCLD_FLOW_SETSD0MC2TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_50.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_50.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_50" date="20.11.2018: 14:01:13.947">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.51 Test script 51

Table 114 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 2, and DCommErr.

Table 114 – FS-Device test script 51

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0102
Name	FSTCD_SCLD_FLOW_SETSD0MC2DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_51.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_51.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_51" date="20.11.2018: 14:01:13.947">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.52 Test script 52

Table 115 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 3, and Timeout.

Table 115 – FS-Device test script 52

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0103
Name	FSTCD_SCLD_FLOW_SETSD0MC3TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_52.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_52.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_52" date="20.11.2018: 14:01:13.947">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.53 Test script 53

Table 116 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 3, and Timeout.

Table 116 – FS-Device test script 53

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0104
Name	FSTCD_SCLD_FLOW_SETSD0MC3TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_53.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_53.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_53" date="20.11.2018: 14:01:13.947">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.54 Test script 54

Table 117 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 4, and Timeout.

Table 117 – FS-Device test script 54

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0105
Name	FSTCD_SCLD_FLOW_SETSD0MC4TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_54.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_54.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_54" date="20.11.2018: 14:01:13.947">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.55 Test script 55

Table 118 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 118 – FS-Device test script 55

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0106
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_55.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_55.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_55" date="20.11.2018: 14:01:13.947">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.56 Test script 56

Table 119 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error and MCount = 0.

Table 119 – FS-Device test script 56

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0107
Name	FSTCD_SCLD_FLOW_SETSD1MC0
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_56.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_56.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_56" date="20.11.2018: 14:01:13.947">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="WaitOnSPDU_24"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.57 Test script 57

Table 120 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 120 – FS-Device test script 57

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0108
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_57.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_57.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_57" date="20.11.2018: 14:01:13.947">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.58 Test script 58

Table 121 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 121 – FS-Device test script 58

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0109
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_58.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_58.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_58" date="20.11.2018: 14:01:13.947">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.59 Test script 59

Table 122 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 122 – FS-Device test script 59

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0110
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_59.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_59.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_59" date="20.11.2018: 14:01:13.947">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.60 Test script 60

Table 123 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 123 – FS-Device test script 60

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0111
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_60.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_60.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_60" date="20.11.2018: 14:01:13.948">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.61 Test script 61

Table 124 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error and MCount = 0.

Table 124 – FS-Device test script 61

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0112
Name	FSTCD_SCLD_FLOW_SETSD1MC0
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_61.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_61.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_61" date="20.11.2018: 14:01:13.948">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="WaitOnSPDU_24"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.62 Test script 62

Table 124 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 125 – FS-Device test script 62

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0113
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_62.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_62.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_62" date="20.11.2018: 14:01:13.948">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.63 Test script 63

Table 126 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 126 – FS-Device test script 63

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0114
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_63.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_63.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_63" date="20.11.2018: 14:01:13.948">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.64 Test script 64

Table 127 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 127 – FS-Device test script 64

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0115
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_64.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_64.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_64" date="20.11.2018: 14:01:13.948">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.65 Test script 65

Table 128 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error and MCount = 0.

Table 128 – FS-Device test script 65

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0116
Name	FSTCD_SCLD_FLOW_SETSD1MC0
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_65.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_65.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_65" date="20.11.2018: 14:01:13.948">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="WaitOnSPDU_24"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.66 Test script 66

Table 129 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error and MCount = 0.

Table 129 – FS-Device test script 66

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0117
Name	FSTCD_SCLD_FLOW_SETSD1MC0
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_66.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_66.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_66" date="20.11.2018: 14:01:13.948">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
```

```
3279      </FSDeviceSclTestCaseSteps>
3280    </Testroot>
3281
```

9.2.67 Test script 67

Table 130 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 130 – FS-Device test script 67

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0118
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_67.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_67.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_67" date="20.11.2018: 14:01:13.948">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
```

```
3319        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3320        <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3321      </FSDeviceSclTestCaseSteps>
3322    </Testroot>
3323
```

9.2.68 Test script 68

Table 131 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error and MCount = 0.

Table 131 – FS-Device test script 68

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0119
Name	FSTCD_SCLD_FLOW_SETSD1MC0
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_68.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_68.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_68" date="20.11.2018: 14:01:13.948">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="WaitOnSPDU_24"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.69 Test script 69

Table 132 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 132 – FS-Device test script 69

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0120
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_69.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_69.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_69" date="20.11.2018: 14:01:13.948">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
```

```
3399        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3400        <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3401      </FSDeviceSclTestCaseSteps>
3402    </Testroot>
3403
```

9.2.70 Test script 70

Table 133 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 133 – FS-Device test script 70

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0121
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_70.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_70.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_70" date="20.11.2018: 14:01:13.949">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
```

```
3441        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3442        <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3443      </FSDeviceSclTestCaseSteps>
3444    </Testroot>
3445
```

9.2.71 Test script 71

Table 134 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 134 – FS-Device test script 71

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0122
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_71.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_71.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_71" date="20.11.2018: 14:01:13.949">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
```

```
3483        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3484        <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3485      </FSDeviceSclTestCaseSteps>
3486    </Testroot>
3487
```

9.2.72 Test script 72

Table 135 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 135 – FS-Device test script 72

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0123
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_72.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_72.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_72" date="20.11.2018: 14:01:13.949">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
```

```
3525        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3526        <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3527      </FSDeviceSclTestCaseSteps>
3528    </Testroot>
3529
```

9.2.73 Test script 73

Table 136 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 136 – FS-Device test script 73

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0124
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_73.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_73.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_73" date="20.11.2018: 14:01:13.949">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
```

```
3567        <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
3568        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3569        <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3570      </FSDeviceSclTestCaseSteps>
3571    </Testroot>
3572
```

9.2.74 Test script 74

Table 137 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 137 – FS-Device test script 74

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0125
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_74.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_74.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_73" date="20.11.2018: 14:01:13.949">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
```

```
3610        <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
3611        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3612        <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3613      </FSDeviceSclTestCaseSteps>
3614    </Testroot>
3615
```

3616

9.2.75 Test script 75

Table 138 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 138 – FS-Device test script 75

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0126
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_75.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_75.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_75" date="20.11.2018: 14:01:13.950">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="invalid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
```

```
3654        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3655        <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3656      </FSDeviceSclTestCaseSteps>
3657    </Testroot>
3658
```

3659

9.2.76 Test script 76

Table 139 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error and MCount = 0.

Table 139 – FS-Device test script 76

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0127
Name	FSTCD_SCLD_FLOW_SETSD1MC0
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_76.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_76.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_76" date="20.11.2018: 14:01:13.950">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
3698      <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
3699      <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
3700      <Transition SourceState="WaitOnSPDU_24" TargetState="WaitOnSPDU_24"/>
3701    </FSDeviceSclTestCaseSteps>
3702  </Testroot>
3703
```

3704

9.2.77 Test script 77

Table 140 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 140 – FS-Device test script 77

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0128
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_77.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_77.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_77" date="20.11.2018: 14:01:13.950">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
```

```
3742      <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
3743      <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
3744      <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
3745      <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
3746      <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
3747      <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3748      <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3749    </FSDeviceSclTestCaseSteps>
3750  </Testroot>
3751
```

3752

9.2.78 Test script 78

Table 141 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 141 – FS-Device test script 78

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0129
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_78.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_78.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_78" date="20.11.2018: 14:01:13.950">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
```

```
3790      <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
3791      <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
3792      <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
3793      <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
3794      <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
3795      <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3796      <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3797    </FSDeviceSclTestCaseSteps>
3798  </Testroot>
3799
3800
```

9.2.79 Test script 79

Table 142 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 142 – FS-Device test script 79

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0130
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_79.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_79.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_79" date="20.11.2018: 14:01:13.951">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
```

```
3838      <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
3839      <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
3840      <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
3841      <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
3842      <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
3843      <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3844      <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3845    </FSDeviceSclTestCaseSteps>
3846  </Testroot>
3847
```

3848

9.2.80 Test script 80

Table 143 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 143 – FS-Device test script 80

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0131
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_80.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_80.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_80" date="20.11.2018: 14:01:13.951">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
```

```
3886        <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
3887        <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
3888        <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
3889        <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="invalid"/>
3890        <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
3891        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3892        <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3893      </FSDeviceSclTestCaseSteps>
3894    </Testroot>
3895
```

3896

9.2.81 Test script 81

Table 144 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 1, and Timeout.

Table 144 – FS-Device test script 81

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0132
Name	FSTCD_SCLD_FLOW_SETSD0MC1TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_81.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_81.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_81" date="20.11.2018: 14:01:13.951">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
3935      <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
3936      <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
3937      <Transition SourceState="WaitOnSPDU_24" TargetState="WaitOnSPDU_24"/>
3938    </FSDeviceSclTestCaseSteps>
3939  </Testroot>
3940
```

3941

9.2.82 Test script 82

Table 145 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 1, and Timeout.

Table 145 – FS-Device test script 82

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0133
Name	FSTCD_SCLD_FLOW_SETSD0MC1TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_82.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_82.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_82" date="20.11.2018: 14:01:13.951">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
3980        <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
3981        <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
3982        <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
3983        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
3984        <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
3985      </FSDeviceSclTestCaseSteps>
3986    </Testroot>
3987
```

3988

9.2.83 Test script 83

Table 146 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 1, and Timeout.

Table 146 – FS-Device test script 83

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0134
Name	FSTCD_SCLD_FLOW_SETSD0MC1TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_83.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_83.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_83" date="20.11.2018: 14:01:13.952">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
4027        <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4028        <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
4029        <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
4030        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
4031        <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
4032      </FSDeviceSclTestCaseSteps>
4033    </Testroot>
4034
```

4035

9.2.84 Test script 84

Table 147 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 2, and Timeout.

Table 147 – FS-Device test script 84

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0135
Name	FSTCD_SCLD_FLOW_SETSD0MC2TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_84.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_84.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_84" date="20.11.2018: 14:01:13.952">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="WaitOnSPDU_24"/>
  </FSDeviceSclTestCaseSteps>
</Testroot>
```

9.2.85 Test script 85

Table 148 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 2, and Timeout.

Table 148 – FS-Device test script 85

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0136
Name	FSTCD_SCLD_FLOW_SETSD0MC2TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_85.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_85.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_85" date="20.11.2018: 14:01:13.952">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
4119        <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4120        <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
4121        <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
4122        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
4123        <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
4124      </FSDeviceSclTestCaseSteps>
4125    </Testroot>
4126
```

4127

9.2.86 Test script 86

Table 149 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 2, and Timeout.

Table 149 – FS-Device test script 86

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0137
Name	FSTCD_SCLD_FLOW_SETSD0MC2TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_86.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_86.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_86" date="20.11.2018: 14:01:13.952">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
4166        <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4167        <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
4168        <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
4169        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
4170        <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
4171      </FSDeviceSclTestCaseSteps>
4172    </Testroot>
4173
```

4174

9.2.87 Test script 87

Table 150 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 3, and Timeout.

Table 150 – FS-Device test script 87

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0138
Name	FSTCD_SCLD_FLOW_SETSD0MC3TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_87.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_87.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_87" date="20.11.2018: 14:01:13.952">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
4213        <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4214        <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
4215        <Transition SourceState="WaitOnSPDU_24" TargetState="WaitOnSPDU_24"/>
4216      </FSDeviceSclTestCaseSteps>
4217    </Testroot>
4218
```

4219

9.2.88 Test script 88

Table 151 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 3, and Timeout.

Table 151 – FS-Device test script 88

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0139
Name	FSTCD_SCLD_FLOW_SETSD0MC3TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_88.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_88.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_88" date="20.11.2018: 14:01:13.953">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
4258      <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4259      <FSDeviceReceive PDout="PD" PortNum="invalid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
4260      <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
4261      <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
4262      <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
4263    </FSDeviceSclTestCaseSteps>
4264  </Testroot>
4265
```

4266

9.2.89 Test script 89

Table 152 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 152 – FS-Device test script 89

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0140
Name	FSTCD_SCLD_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_89.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_89.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_89" date="20.11.2018: 14:01:13.953">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
```

```
4304      <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
4305      <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
4306      <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4307      <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
4308      <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
4309      <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
4310      <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
4311      <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
4312    </FSDeviceSclTestCaseSteps>
4313  </Testroot>
4314
4315
```

9.2.90 Test script 90

Table 153 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 2, and Timeout.

Table 153 – FS-Device test script 90

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0141
Name	FSTCD_SCLD_FLOW_SETSD0MC2TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_90.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_90.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_90" date="20.11.2018: 14:01:13.953">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
4354        <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4355        <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
4356        <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
4357        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
4358        <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
4359      </FSDeviceSclTestCaseSteps>
4360    </Testroot>
4361
```

4362

9.2.91 Test script 91

Table 154 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 1, and Timeout.

Table 154 – FS-Device test script 91

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0142
Name	FSTCD_SCLD_FLOW_SETSD0MC1TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_91.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_91.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_91" date="20.11.2018: 14:01:13.954">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
4401        <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4402        <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
4403        <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
4404        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
4405        <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
4406      </FSDeviceSclTestCaseSteps>
4407    </Testroot>
4408
```

4409

9.2.92 Test script 92

Table 155 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 1, and Timeout.

Table 155 – FS-Device test script 92

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0143
Name	FSTCD_SCLD_FLOW_SETSD0MC1TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_92.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_92.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_92" date="20.11.2018: 14:01:13.954">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
4448        <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4449        <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="invalid"/>
4450        <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
4451        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
4452        <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
4453      </FSDeviceSclTestCaseSteps>
4454    </Testroot>
4455
```

4456

9.2.93 Test script 93

Table 156 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 3, and Timeout.

Table 156 – FS-Device test script 93

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0144
Name	FSTCD_SCLD_FLOW_SETSD0MC3
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_93.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_93.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_93" date="20.11.2018: 14:01:13.954">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
4495        <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4496        <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
4497        <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
4498        <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_23"/>
4499        <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
4500        <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4501      </FSDeviceSclTestCaseSteps>
4502    </Testroot>
4503
```

4504

9.2.94 Test script 94

Table 157 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 1, and Timeout.

Table 157 – FS-Device test script 94

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0145
Name	FSTCD_SCLD_FLOW_SETSD0MC1TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_94.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_94.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_94" date="20.11.2018: 14:01:13.954">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
4543        <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4544        <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
4545        <Transition SourceState="WaitOnSPDU_24" TargetState="CheckSPDU_22"/>
4546        <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
4547        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
4548        <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
4549      </FSDeviceSclTestCaseSteps>
4550    </Testroot>
4551
```

4552

9.2.95 Test script 95

Table 158 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 3, and Timeout.

Table 158 – FS-Device test script 95

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0146
Name	FSTCD_SCLD_FLOW_SETSD0MC3TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_95.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_95.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_95" date="20.11.2018: 14:01:13.954">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
4591        <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4592        <FSDeviceReceive PDout="PD" PortNum="valid" MCount="0" setSD="0" ChFAckReq="0" CRC="invalid"/>
4593        <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
4594        <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
4595        <FSDeviceSend PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
4596      </FSDeviceSclTestCaseSteps>
4597    </Testroot>
4598
```

4599

9.2.96 Test script 96

Table 159 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of no error, MCount = 2, and Timeout.

Table 159 – FS-Device test script 96

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0147
Name	FSTCD_SCLD_FLOW_SETSD0MC2TO
Purpose (short)	
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device automated SCL protocol test
Specification (clause)	[4] clause 11.3.3, Figure 42 (services); clause 11.5.3, Figure 47 (state chart)
Configuration / setup	See Table 63

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Device waiting for the first message
Procedure	See XML file "IO-Link-Safety_spec_device_final_testsuite_testcase_96.xml"
Test parameter	See Table 63 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_device_final_testsuite_testcase_96.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_96" date="20.11.2018: 14:01:13.955">
  <FSDeviceSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="SystemStart_20"/>
    <Transition SourceState="SystemStart_20" TargetState="WaitOnSPDU_21"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_21" TargetState="CheckSPDU_22"/>
    <Transition SourceState="CheckSPDU_22" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="5" SDset="1" DCommErr="1" DTimeout="1" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="4" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="3" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_25"/>
    <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
    <FSDeviceSend PDin="PD" PortNum="valid" DCount="2" SDset="1" DCommErr="0" DTimeout="0" CRC="valid"/>
    <FSDeviceReceive PDout="PD" PortNum="valid" MCount="6" setSD="0" ChFAckReq="0" CRC="valid"/>
    <Transition SourceState="WaitOnSPDU_26" TargetState="CheckSPDU_27"/>
    <Transition SourceState="CheckSPDU_27" TargetState="PrepareResponse_23"/>
    <Transition SourceState="PrepareResponse_23" TargetState="WaitOnSPDU_24"/>
```

```
4638      <FSDeviceSend PDin="PD" PortNum="valid" DCount="1" SDset="0" DCommErr="0" DTimeout="0" CRC="valid"/>
4639      <FSDeviceReceive PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="invalid"/>
4640      <Transition SourceState="WaitOnSPDU_24" TargetState="PrepareResponse_25"/>
4641      <Transition SourceState="PrepareResponse_25" TargetState="WaitOnSPDU_26"/>
4642      <FSDeviceSend PDin="PD" PortNum="valid" DCount="0" SDset="1" DCommErr="1" DTimeout="0" CRC="valid"/>
4643    </FSDeviceSclTestCaseSteps>
4644  </Testroot>
4645
```

4646

10 FS-Device in reference system tests

10.1 Overview and reference systems

The FS-Device in reference system tests comprise tests, where a complete (DTI) and approved FS-Master reference system including FS-Master Tool is available. Rules for reference systems are defined in A.2.7.

IODD testing is specified in Clause 6 and therefore interoperability of the particular IODD of an FS-Device with the reference FS-Master system can be assumed. In case, an IODD tested with the help of the Checker Tool cannot be imported, the testing of the FS-Device shall be continued as far as possible, and in parallel, the manufacturer of the reference system shall be contacted for clarification.

The availability of the Dedicated Tool has been checked in Clause 6.4. It is not necessary,

- if an FS-Device has no parameters for its particular technology (no FST parameter), or
- if the manufacturer of an FS-Device provides CRC signature values (TechParCRC) for any FST parameter combination (e.g. via user manual), which can be entered into the FSP_TechParCRC field of the FS-Master Tool.

The FS-Device in reference system tests comprise tests of the Dedicated Tool, behavior of the FS-Device in case of correct or incorrect FSP protocol parameter, and test of Events that are not covered by other test cases anyway.

10.2 Dedicated Tool

10.2.1 Invokability via registry

Table 160 defines the test conditions for this test case.

Table 160 – Invokability via registry

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0148
Name	FSTCD_REFT_INVOKEDEDITOOL
Purpose (short)	"Dedicated Tool" of the FS-Device can be launched/invoked
Equipment under test (EUT)	Dedicated Tool of FS-Device
Test case version	1.0
Category / type	DTI test, test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Device-Reference-System and user manual
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	"Dedicated Tool" is dedicated to the FS-Device and can be launched/invoked
Precondition	–
Procedure	a) Install Dedicated Tool according to user manual b) Evaluation 1) c) Launch/invoke Dedicated Tool d) Evaluation 2)
Test parameter	–
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check registry: UUID, AppPath, PID-File, VendorID, and DeviceID 2) Check display
Test passed	Registry values OK and match information in user manual, and FST parameters are visible according to user manual
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

10.2.2 Calculation of TechParCRC

Table 161 defines the test conditions for this test case.

Table 161 – Calculation of TechParCRC

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0149
Name	FSTCD_REFT_CALCDEDITOOL
Purpose (short)	Dedicated Tool presents FST parameter, calculates and displays TechParCRC value
Equipment under test (EUT)	Dedicated Tool of FS-Device (no back channel in DTI communication)
Test case version	1.0
Category / type	DTI test, test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Device-Reference-System

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Dedicated Tool presents FST parameter, recalculates TechParCRC upon parameter changes, and displays the TechParCRC signature value in decimal form.
Precondition	–
Procedure	a) Launch/invoke Dedicated Tool b) Evaluation 1) c) Modify FST parameter values d) Evaluation 2) e) Copy & Paste TechParCRC signature to FS-Master Tool f) Evaluation 3) g) Perform commissioning of FS-Device (EUT) h) Evaluation 4)
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check availability of TechParCRC display (decimal value) 2) Check changes in TechParCRC display 3) Check reaction of FS-Master Tool (FSP_TechParCRC field) 4) Check behavior of reference system with connected FS-Device
Test passed	All checks correct
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

10.2.3 DTI communication/Back Channel

Table 162 defines the test conditions for this test case. This test is optional.

Table 162 – DTI communication/Back Channel

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0150
Name	FSTCD_REFT_BACKDEDITOOL
Purpose (short)	Dedicated Tool presents FST parameter, calculates and displays TechParCRC value
Equipment under test (EUT)	Dedicated Tool of FS-Device (with back channel in DTI communication)
Test case version	1.0
Category / type	DTI test, test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Device-Reference-System

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	FS-Master Tool invokes Dedicated Tool and passes over FST parameter via TPF. Subsequently, calculation of TechParCRC upon parameter changes takes place. Parameter values and TechParCRC are returned to FS-Master Tool via TBF ("Back Channel"). After parameter changes in FS-Master Tool, an update of the parameter values in the Dedicated Tool shall not occur automatically but only upon invocation of the Dedicated Tool.
Precondition	–
Procedure	a) Launch/invoke Dedicated Tool b) Evaluation 1) c) Try changing parameter values in FS-Master Tool d) Evaluation 2) e) Close Dedicated Tool f) Evaluation 3) g) Modify FST parameter values in FS-Master Tool h) Relaunch Dedicated Tool i) Evaluation 4) j) Evaluation 5) k) Perform commissioning of FS-Device (EUT) l) Evaluation 6)
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check availability of TechParCRC display (decimal value) in Dedicated Tool (memorize CRC value) 2) Editing of values in FS-Master Tool shall be blocked 3) Check identical TechParCRC display (decimal value) in FS-Master Tool (see 1)) 4) Compare parameter values in displays of Dedicated Tool and FS-Master Tool (parameter values shall match) 5) Compare FST_TechParCRC on FS-Master Tool with TechParCRC of Dedicated Tool (CRC values should differ due to parameter changes) 6) Check behavior of reference system with connected FS-Device
Test passed	All checks correct
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

10.2.4 DTI communication to FS-Device

Table 163 defines the test conditions for this test case. This test is optional.

Table 163 – DTI communication to FS-Device

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0151
Name	FSTCD_REFT_COMMDEDITOOL
Purpose (short)	DTI communication from Dedicated Tool to FS-Device
Equipment under test (EUT)	Dedicated Tool of FS-Device (with DTI communication and online access)
Test case version	1.0
Category / type	DTI test, test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Device-Reference-System
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	DTI communication from Dedicated Tool to FS-Device
Precondition	User manual
Procedure	a) Launch/invoke Dedicated Tool b) Evaluation 1) c) Get access to FS-Device d) Evaluation 2)
Test parameter	–
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check availability of connection display 2) Check connection to FS-Device
Test passed	All checks correct
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

10.3 FS-Device replacement

10.3.1 Correct FSP parameter values (Out-of-box)

Table 164 defines the test conditions for this test case.

Table 164 – Correct FSP parameter values

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0152
Name	FSTCD_REFT_CORRECTFSTVALUES
Purpose (short)	Replace configured FS-Device by same FS-Device with out-of-box parameters
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test, test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Replace configured FS-Device by same FS-Device with out-of-box parameters
Precondition	EUT in armed mode, FSP_TechParCRC valid) FSDT in OPERATE (armed operation)
Procedure	a) Set FSDT Validation&Backup to 3: Backup + Restore e.g. via SMI_PortConfig b) Wait for Event 0xFF27 c) Set FSDT Validation&Backup to 4: Restore e.g. SMI_PortConfig d) Write System Command 131 "Back-to-box" e.g. SMI_DeviceWrite e) Evaluation 1) f) Port power Off/On e.g. via SMI_PortPowerOffOn g) Wait for Port state "SCL_ENABLED" e.g. via ArgBlock FSPortStatusList h) Evaluation 2)
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Write response 2) Check Port state
Test passed	All checks correct
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

10.3.2 Incorrect FSP parameter values

Table 165 defines the test conditions for this test case.

Table 165 – Incorrect FSP parameter values

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0153
Name	FSTCD_REFT_INCORRECTFSPVALUES
Purpose (short)	Replace configured FS-Device by same FS-Device with different parameters
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test, test-to-fail
Specification (clause)	[4] Figure 56, Table A.1
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Replace configured FS-Device by same FS-Device with different parameters
Precondition	EUT in armed mode, FSP_TechParCRC valid) FSDT in OPERATE (armed operation)
Procedure	a) Read FSP protocol parameter record (0x4201) e.g. SMI_DeviceRead b) Evaluation 1) c) Change parameter in WDTime and set FSP_TechParCRC = 0 *;prepare values* d) Write changed FSP protocol parameter record (0x4201) e.g. SMI_DeviceWrie e) Evaluation 2) f) Set FSP_TechParCRC to valid value *;prepare values* g) Write changed FSP protocol parameter record (0x4201) e.g. SMI_DeviceWrie h) Evaluation 3) f) Port power Off/On e.g. via SMI_PortPowerOffOn g) Wait for Port state "OPERATE" e.g. ArgBlock PortStatusList h) Evaluation 4)
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Read response 2) Check Write response 3) Check Write response 4) Check Event
Test passed	All ISDU responses OK, and Event 0xB009 received
Test failed (examples)	Any check incorrect and/or Event 0xB009 not received
Report	Values OK: <yes/no> <ok | nok>

10.4 Events

10.4.1 Overview

Most of the FS-Device Events are already covered within the context of other test cases. Table 166 contains a list of Clauses and the concerned EventCodes.

Table 166 – List of FS-Device Events in other test cases

Clause	EventCode	Description
8.2.7, 8.2.8, 11.3.4, 13.5.2	0xB003	Unexpected authentication code
8.2.10	0xB005	Incorrect FSP_AuthentCRC
10.3.2, 8.2.14	0xB009	Watchdog time out of specification (e.g. "0")
8.2.11	0xB006	Incorrect FSP_ProtParCRC
8.2.3, 8.2.4	0xB00A	No FSP_VerifyRecord received
8.2.5, 8.2.6, 8.2.12	0xB007	Incorrect FSP_TechtParCRC
8.2.9	0xB004	Unexpected authentication Port
8.2.13	0xB008	Incorrect FSP_IO_StructCRC

Remaining Events are tested in 10.4.2.

10.4.2 Events@communication

Table 167 defines the test conditions for this test case.

Table 167 – Events@communication

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0154
Name	FSTCD_REFT_COMMINTERRUPT
Purpose (short)	Events when communication is interrupted due to errors at SPDU exchange
Equipment under test (EUT)	FS-Device
Test case version	1.0
Category / type	FS-Device test, test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Device-Tester

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Events when communication is interrupted due to errors at SPDU exchange
Precondition	EUT: in armed mode FSDT: in OPERATE (armed operation)
Procedure	a) FSDT send SPDU with wrong CRC b) Evaluation 1) c) FSDT send SPDU with correct CRC d) FSDT send SPDU with incorrect Counter e) Evaluation 2) f) FSDT send SPDU with correct Counter g) FSDT stop sending SPDUs h) Evaluation 3)
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check for Event 0xB000 *;Transmission error (CRC signature)* 2) Check for Event 0xB001 *;Transmission error (Counter)* 3) Check for Event 0xB002 *;Transmission error (Timeout)*
Test passed	All Events received correctly
Test failed (examples)	Any Event incorrect or missing
Report	Event 0xB000 received: <yes/no> <ok | nok> Event 0xB001 received: <yes/no> <ok | nok> Event 0xB002 received: <yes/no> <ok | nok>

10.5 Test with reference FS-Master

10.5.1 Test in regular automation environment

Table 168 defines the test conditions for this test case.

Table 168 – Test of FS-Device with Reference FS-Master

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0198
Name	FSTCD_REFT_RM
Purpose (short)	Basic test of FS_Device with Reference FS-Master
Equipment under test (EUT)	FS-Device, IODD, Dedicated Tool
Test case version	1.0
Category / type	Test of basic functionality with reference FS-Master
Specification (clause)	[4]
Configuration / setup	FS-Device, IODD and dedicated tool (if available) applied to a reference FS-Master

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Test of basic functionality of the EUT together with a reference FS-Master to show that the EUT is able to establish a safety communication also in regular automation environments.
Precondition	Setup of FS-Reference Master with Master Tool, Engineering and PLC.
Procedure	a) Setup FS-Reference Master System b) Connect EUT c) Configure FS-Device (opt. using Dedicated Tool) d) Evaluation 1) e) Start safe communication f) Evaluation 2) g) execute optional additional tests h) Evaluation 3)
Test parameter	-
Post condition	-

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check FSP_VerifyRecord 2) Check safety communication 3) Check results of additional tests
Test passed	1) FSP_VerifyRecord is available 2) Safety communication has started 3) All additional tests show expected results
Test failed (examples)	At least one test shows unexpected results
Report	Values OK : <yes/no>

11 FS-Master Port operations tests

11.1 Overview

The FS-Master Port operations test cases comprise the necessary information about the product to test, the basic FS-Master operations such as identification, authorization, and FSCP authenticity from an upper-level FSCP system and are part of the Functional Tests. Other test cases deal with Port power OFF/ON, VerifyRecord for verification, detection of misconnection, and safe FS-Device replacement. It is up to the manufacturer to assure complete testing for all implemented ports.

11.2 FS-Master meta data

11.2.1 User manual and safety assessment certificate

The test case checks whether not implemented “highly recommended” features are documented.

Table 169 defines the test conditions for this test case.

Table 169 – User manual and safety assessment certificate

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0155
Name	FSTCM_INFO_DOCUMENTS
Purpose (short)	Check user/safety manuals for exceptions, properties, and certificates
Equipment under test (EUT)	User/safety manual of FS-Master and Master Tool
Test case version	1.0
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4] "highly recommended" feature status, Annex H.6
Configuration / setup	–

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Manufacturers/vendors are obliged to inform in a user manual about not implemented "highly recommended" features and to provide a "Safety Manual" as well as a safety assessment certificate.
Precondition	–
Procedure	a) Identify in user manual not implemented "highly recommended" features b) Identify information in safety manual according to Annex H.6 in [4] c) Identify functional safety assessment certificate
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check exceptions in user manual 2) Check required parameters in safety manual 3) Check statements for relevant aspects of particular standard (IEC 61508/ ISO13849), the assessment body, and the certificate number
Test passed	Exceptions permitted, and Safety Manual available (for example "product mission time", "safety level - SIL/PL", "probability of a dangerous failure per hour – PFH", and statements on delay times for the calculation of safety function response times, and Certicate accepted and noted in test report
Test failed (examples)	Any check incorrect
Report	Documents OK: <yes/no> <ok | nok>

11.2.2 Connector and cable information

Table 170 defines the test conditions for this test case.

Table 170 – Connector and cable information

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0156
Name	FSTCM_CONF_INFO_CONNECTCABLE
Purpose (short)	Check user/safety manuals for connector and cable information (OSSDe)
Equipment under test (EUT)	User/safety manual of FS-Master
Test case version	1.0
Category / type	FS-Master test
Specification (clause)	[4] 4.1.4, Figure 9
Configuration / setup	–

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check user/safety manuals for connector and cable information for OSSDe operation.
Precondition	–
Procedure	a) Identify in user manual connector Pin layout in case of M type connector b) Identify cable recommendations with respect to robustness and loop resistence
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check Pin layout 2) Check recommendations on robustness and loop resistence
Test passed	Pin layouts are correct, and Robustness recommendations for cable coating such as "tear proof" and "cut resistant" as well as for loop resistance such that minimum supply voltages are guaranteed at maximum supply current are available
Test failed (examples)	Any check incorrect
Report	Documents OK: <yes/no> <ok | nok>

11.2.3 Default behavior (power, OSSDe, configurations)

Table 33 defines the test conditions for this test case.

Table 171 – Default behavior (power, OSSDe, configurations)

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0157
Name	FSTCM_CONF_INFO_DEFAULTPARAM
Purpose (short)	FS-Master information: Power supply, OSSDe filter, Port configurations
Equipment under test (EUT)	User manual of FS-Master
Test case version	1.0
Category / type	FS-Master test
Specification (clause)	[4] Table 7, Table 8
Configuration / setup	–
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	FS-Master information: Power supply (derating), OSSDe filter, Port configurations
Precondition	–
Procedure	a) Identify parameter "Port power supply" in safety/user manual b) Identify parameter "Discrepancy time" in safety/user manual c) Identify parameter "Filter time" in safety/user manual d) Identify "Port configurations" in safety/user manual e) Identify "Safety function response time" information
Test parameter	–
Post condition	Memorize power supply, OSSDe filter values, Port configurations, response time
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check "Port power supply" information 2) Check parameter "Discrepancy time" 3) Check parameter "Filter time" 4) Check possible Port configurations 5) Check SFRT information
Test passed	At least one Port can provide a current of ISMmax ≥ 1000 mA, and Value of "Discrepancy time - t_{dis}" = 3 ms, and Value of "Filter time" = 1ms according to test pulse duration t_i, and Port configurations comply with specification, and SFRT information refers to integration specification and IEC 61784-3 if appropriate
Test failed (examples)	Any check incorrect
Report	Documents OK: <yes/no> <ok | nok>

11.3 FS-Master operations

11.3.1 FS-Master identification

Table 172 defines the test conditions for this test case.

Table 172 – FS-Master identification

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0158
Name	FSTCM_INFO_FSMIDENT
Purpose (short)	Get FS-Master identification
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master test, test-to-pass
Specification (clause)	[2] 11.2.4
Configuration / setup	FS-Master-Tester-System
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Get FS-Master identification via service SMI_MasterIdentification
Precondition	EUT: PORT_MIXFSCOM SMTU: SMTU_STANDARD_STATE_32
Procedure	a) SMI_MasterIdentification(ArgBlock = 0x0001) *;returns Argblock "MasterIdent"* b) Evaluation 1)
Test parameter	–
Post condition	VendorID, MasterID, MasterType, Features_1, MaxNumberOfPorts, PortTypes
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check Argblock "MasterIdent"
Test passed	MasterIdent.VendorID corresponds to manual and IO-Link reference, and MasterIdent.MasterID corresponds to manual, and *;vendor specific* MasterIdent.MasterType = 3, and *;FS-Master* MasterIdent.Features_1.Bit 2 = 1, and *;PortPowerOffOn* MasterIdent.MaxNumberOfPorts corresponds to Manual, and *;max number = n* MasterIdent.PortTypes[0 to *n*] = {3, 4, or 5} *;no OSSD, OSSD, or Class B*
Test failed (examples)	Any check incorrect
Report	Identification OK: <yes/no> <ok | nok>

11.3.2 FS-Master access and authenticity

Table 173 defines the test conditions for this test case.

Table 173 – FS-Master authenticity

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0159
Name	FSTCM_INFO_FSMAUTHENT
Purpose (short)	Get FS-Master authenticity
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4] 10.2.2
Configuration / setup	FS-Master-Tester-System
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Get FS-Master authenticity via service SMI_FSMasterAccess
Precondition	EUT: PORT_MIXFSCOM SMTU: SMTU_STANDARD_STATE_32
Procedure	a) SMI_FSMasterAccess(ArgBlock = 0x0100 <PW, RPW, Role>) *;Test parameter* *;returns Argblock "FSCPAuthenticity"* b) Evaluation 1)
Test parameter	PW = FSMasterPassword *;acquired from manual* RPW = FSResetMasterPW = 0x0000 *;default, no reset of PW* Role = 0x00 *;default*
Post condition	FSCP_Authenticity1, FSCP_Authenticity2
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check ArgBlock "FSCPAuthenticity"
Test passed	Both elements correspond to settings from upper-level FSCP system
Test failed (examples)	Any check incorrect
Report	Authenticity OK: <yes/no> <ok | nok>

11.3.3 PREOPERATE – verification

The test case checks that the VerifyRecord is properly sent to the FS-Device during start-up.

Table 174 defines the test conditions for this test case.

Table 174 – PREOPERATE – verification

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0161
Name	FSTCM_FSOP_PREOPVERIFY
Purpose (short)	Check whether VerifyRecord is sent to FS-Device
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.1
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4] Annex A.2.10
Configuration / setup	FS-Master-Tester-System

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check whether VerifyRecord is sent to FS-Device
Precondition	EUT: PORT_MIXFSCOM SMTU: SMTU_STANDARD_STATE_32
Procedure	a) SMI_PortConfig (ABPS_FSCONFIG_SAFECOM) b) Wait for Port state "OPERATE" ;*e.g. via ArgBlock FSPortStatusList* c) SMTU_VerifyRecord_Get ;*returns "VerifyRecord*" d) Evaluation 1)
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Compare values of "VerifyRecord" with FSP parameters in Port configuration
Test passed	All compared parameters match
Test failed (examples)	Any comparison failed
Report	Values OK: <yes/no> <ok | nok>

11.3.4 PREOPERATE – misconnection

The test case checks whether the FS-Master detects that an FS-Device with unexpected authenticity is connected.

Table 175 defines the test conditions for this test case.

Table 175 – PREOPERATE – misconnection

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0162
Name	FSTCM_FSOP_PREOPMISSCONNECT
Purpose (short)	FS-Master indicates FS-Device misconnection
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.1
Category / type	FS-Master test, test-to-fail
Specification (clause)	[4] Annex G.4
Configuration / setup	FS-Master-Tester-System

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check whether misconnection is detected
Precondition	EUT: PORT_MIXFSCOM SMTU: SMTU_STANDARD_STATE_32
Procedure	a) SMTU_Authent_Set(Authent1=<different>) *;different Authent1 selected* b) SMI_PortConfig (ABPS_FSCONFIG_SAFECOM) c) Status = SMI_PortStatus(AB = 0x9100) *; returns FSPortStatusList* d) Repeat with c) until status = SCL_ENABLED e) Evaluation 1) f) Wait on SMI-DeviceEvent *; returns DeviceEvent* g) Evaluation 2
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check ArgBlock "FSPortStatusList" 2) Check ArgBlock "DeviceEvent"
Test passed	FSPortStatusList.PortStatusInfo = 8, and *;SCL_ENABLED* EventCode = 0xB003 *;unexpected authentication code*
Test failed (examples)	Any other PortStatusInfo, or other Eventcodes, or no Event
Report	Event: <yes/no> <ok | nok> FS-Device EventCode: <value> <ok | nok>

11.3.5 PREOPERATE – replacement

Table 176 defines the test conditions for this test case.

Table 176 – PREOPERATE – replacement

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0163
Name	FSTCM_FSOP_PREOPREPLACE
Purpose (short)	FS-Master performs FS-Device replacement correctly
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4] Annex G.3
Configuration / setup	FS-Master-Tester-System
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Check whether FS-Master performs FS-Device replacement correctly (Back-to-box)
Precondition	EUT: PORT_MIXFSCOM SMTU: SMTU_STANDARD_STATE_32 *;no FST Parameter*
Procedure	a) SMI_PortPowerOffOn(ABPS_PORT_OFF) b) SMTU_Authent_Set(Authent1/2=0, Port=0, CRC=0) *;"Authenticity" = 0* c) SMI_PortPowerOffOn(ABPS_PORT_ON) d) Wait 3 s *;self test time = 2 s* e) SMI_PortStatus(ArgBlock = 0x9100) *;returns ArgBlock "FSPortStatusList"* f) Evaluation 1) g) Wait on SMI_DeviceEvent *;returns ArgBlock "DeviceEvent"* h) Evaluation 2) i) Wait on SMI_PortEvent *;returns ArgBlock "PortEvent"* k) Evaluation 3)
Test parameter	–
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check ArgBlock "FSPortStatusList" 2) Check ArgBlock "DeviceEvent" 3) Check ArgBlock "PortEvent"
Test passed	FSPortStatusList.PortStatusInfo = 8, and *;SCL_ENABLED* None of the FS EventCodes *;see Annex B in* [4]
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

11.3.6 Ready Pulse Start

Table 179 defines the test conditions for this test case.

Table 177 – READY Pulse detection

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0196
Name	FSTCM_DLMH_READY
Purpose (short)	Check that FS-Master executes after port status change a PortPowerOffOn and waits for a ready pulse of the Device
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4] 7.2 Figure 29
Configuration / setup	FS-Master-Tester-System

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check that Port PowerOffOn and Startup Timing for Ready pulse is correct and measure FSP_MinShutDownTime
Precondition	EUT: PORT_POWER_OFF SMTU: SMTU_STANDARD_STATE_32 *; no FST Parameter*
Procedure	a) PortPowerOn b) SMTU_PowerOffTime_Start c) SMI_PortConfig (ABPS_FSCONFIG_SAFECOM) ; *Start safe communication* d) SMTU_SPDU_Change *; Communication started* e) Evaluation 1 f) POT = SMTU_PowerOffTime_Get ; *get PowerOffTime* g) Evaluation 2
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check that SMTU_SPDU_Change has returned 2) Check POT
Test passed	1) SMTU_SPDU_Change return within Timeout 2) POT >= FSP_MinShutDownTime
Test failed (examples)	Timeout occurred POT < FSP_MinShutDownTime
Report	Values OK: <yes/no> <ok | nok>

11.3.7 Start Repetition

Table 178 defines the test conditions for this test case.

Table 178 – Start Repetition

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_197
Name	FSTCM_DLMH_READY_REPEAT
Purpose (short)	Check that FS-Master executes after port status change cycles PortPowerOffOn and until FS-Device enters safe communication
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master test, test-to-fail
Specification (clause)	[4] 7.2 Figure 29
Configuration / setup	FS-Master-Tester-System

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check that Port PowerOffOn is repeated after missed ready pulse
Precondition	EUT: PORT_POWER_OFF SMTU: SMTU_STANDARD_STATE_32 *;No FST Parameter*
Procedure	a) SMI_PortConfig (ABPS_FSCONFIG_SAFECOM) ;*RP set to default = 5s* b) SMTU_Ready_Wait (t2R = 6.5s, tRP=0.75ms) ;*RP issued too late* c) STM_WAIT (FSP_MinShutDownTime*1.1) ;*Wait ShutDownTime* d) ps= SMTU_PowerState_Get ;*Check if power is on* e) Repeat from d) while ps == PowerOn f) Evaluate 1 *;Power is off 2nd time*
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check ps
Test passed	1) ps = Power Off
Test failed (examples)	Timeout occurred
Report	Values OK: <yes/no> <ok | nok>

12 FS-Master safety communication layer tests

12.1 Interface for the FS-Master SCL test scripts

The test scripts for the automated safety layer tests are encoded as XML files. Each and every test script ("FSMasterSclTestCaseSteps") consists of test step instructions as described in Table 179. The XML Schema of the interface parameters for the FS-Master automated safety layer test is illustrated in Figure 15. The tests described in this section are referred as SCL Tests.

NOTE The general concept of SCL protocol conformance testing is described in A.2.3. The automated safety layer tester for FS-Masters is described in A.2.4.

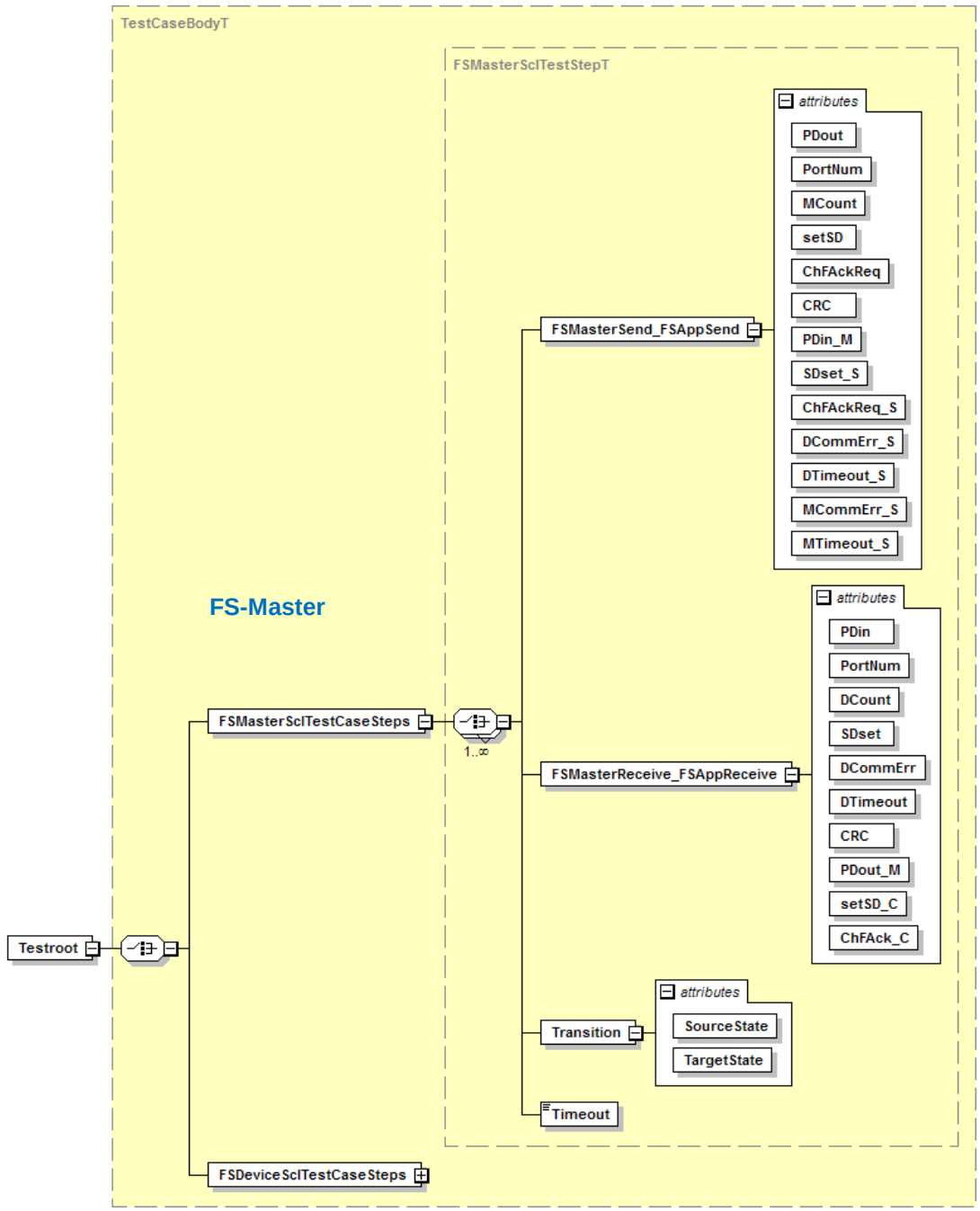


Figure 15 – Schema of steps and parameters/attributes

Table 179 defines the FS-Master interface parameters.

Table 179 – FS-Master interface parameters/attributes

Test step instruction	Parameter	Value range
FSMasterSend_FSAppSend (FS-Master → Test System) (see Annex A.2.3, Figure A.9)	PDout	SD –Test System expects SD values (= 0) PD – Test System expects PD values (> 0)
	PortNum	valid –Test System expects configured Port number
	MCount	0 to 7
	setSD	0, 1
	ChFAckReq	0, 1

Test step instruction	Parameter	Value range
	CRC	valid – Test System expects correct CRC-Signature
	PDin_M	SD – Test System expects SD values (= 0) PD – Test System expects PD values (> 0)
	Bit 0: SDset_S	0, 1
	Bit 1: ChFAckReq_S	0, 1
	Bit 2: DCommErr_S	0, 1
	Bit 3: DTimeout_S	0, 1
	Bit 4: MCommErr_S	0, 1
	Bit 5: MTimeout_S	0, 1
FSMasterReceive_FSAppReceive (Test System → FS-Master)	PDin	PD – Test System sends PD values (> 0)
	PortNum	valid – Test System sends configured Port number invalid – Test System sends not configured Port number
	DCount	0 to 7
	SDset	0, 1
	DCommErr	0, 1
	DTimeout	0, 1
	CRC	valid – Test System sends correct CRC-Signature invalid – Test System sends incorrect CRC-Signature
	PDout_M	PD – Test System sends PD values (> 0)
	Bit 0: setSD_C	0, 1
	Bit 1: ChFAck_C	0, 1
Timeout (Test System → FS-Master)		Test System sends no new message within a time delay ≥ MTime. See for example 12.2.3.
Transition (Tag)	SourceState	This parameter is informative and will be inserted only in test logging from test system
	TargetState	This parameter is informative and will be inserted only in test logging from test system

The test step instruction "FSMasterSend_FSAppSend" is used for messages sent by the FS-Master test object (EUT). Within these messages, the test data to the IO-Link communication port and to the FS-Master "processing" interface are specified in one test message. This approach has been chosen due to the special test setup not allowing explicit access for the test system to the "processing" port of the test object (in this case the FS-Master, see Figure A.7).

The values of the parameters *PDout*, *PortNum*, *MCount*, *setSD*, *ChFAckReq* and *CRC* are defined for the IO-Link communication port, whereas the values of the parameters *PDin_M*, *SDset_S*, *ChFAckReq_S*, *DCommErr_S*, *DTimeout_S*, *MCommErr_S,* and *MTimeout_S* are defined for the "processing" interface.

With the test step instruction "FSMasterReceive_FSAppReceive" the reception of test messages by the FS master is specified. The test messages comprise also the IO-Link communication Port and the "processing" interface.

The parameter values of *PDin*, *PortNum*, *DCount*, *SDset*, *DCommErr*, *DTimeout,* and *CRC* are determined for the IO-Link communication Port, whereas the values of the parameters *PDout_M*, *setSD_C*, and *ChFAck_C* are determined for the "processing" interface.

The test step instruction "Timeout" specifies for how long the test system shall not update the response SPDU. This time shall be greater than the watchdog time of the EUT (MTime).

The XML tag "Transition" is used for traceability of test messages with respect to the expected transition of the state machine specified in [4]. This information is only descriptive and has no impact on the test flow of the test tool.

12.2 FS-Master SCL test suite

12.2.1 Test script 1

Table 180 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 180 – FS-Master test script 1

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0164
Name	FSTCM_SCLM_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_1.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_1.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_1" date="20.11.2018: 14:01:29.066">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="7" SDset="0" DCommErr="1" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0"
CRC="invalid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="2" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
```

```
4866      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="5" SDset="0" DCommErr="1" DTimeout="0"
4867    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
4868      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
4869      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
4870      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
4871      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="3" setSD="1" ChFAckReq="0" CRC="valid"
4872    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
4873      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="4" SDset="0" DCommErr="0" DTimeout="1"
4874    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
4875      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
4876      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
4877      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
4878      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="4" setSD="1" ChFAckReq="0" CRC="valid"
4879    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="1" MCommErr_S="1" MTimeout_S="0"/>
4880      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="3" SDset="0" DCommErr="0" DTimeout="0"
4881    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
4882      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
4883      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
4884      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
4885      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="5" setSD="1" ChFAckReq="1" CRC="valid"
4886    PDin_M="SD" SDset_S="1" ChFAckReq_S="1" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
4887      <Transition SourceState="WaitOnResponse_7" TargetState="WaitOnResponse_7"/>
4888      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="2" SDset="0" DCommErr="0" DTimeout="0"
4889    CRC="valid" PDout_M="PD" setSD_C="1" ChFAck_C="1"/>
4890      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
4891      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_4"/>
4892      <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
4893      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="6" setSD="1" ChFAckReq="0" CRC="valid"
4894    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
4895      <Transition SourceState="WaitOnResponse_5" TargetState="WaitOnResponse_5"/>
4896      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="1" SDset="1" DCommErr="0" DTimeout="0"
4897    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
4898      <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
4899      <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_4"/>
4900      <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
4901      <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="7" setSD="0" ChFAckReq="0" CRC="valid"
4902    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
4903      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="0"
4904    CRC="invalid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
4905      <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
4906      <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
4907      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
4908      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
4909    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
4910     </FSMasterSclTestCaseSteps>
4911    </Testroot>
4912
```

12.2.2 Test script 2

Table 181 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and SDset.

Table 181 – FS-Master test script 2

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0165
Name	FSTCM_SCLM_FLOW_SETSD1MC0SDSET1
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_2.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_2.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_2" date="20.11.2018: 14:01:29.066">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="7" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_4"/>
    <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
    <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"
PDin_M="PD" SDset_S="0" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_4"/>
    <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
    <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="5" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_4"/>
    <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
```

```
4949      <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"
4950    PDin_M="PD" SDset_S="0" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
4951      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="4" SDset="0" DCommErr="0" DTimeout="0"
4952    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
4953      <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
4954      <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_4"/>
4955      <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
4956      <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="4" setSD="0" ChFAckReq="0" CRC="valid"
4957    PDin_M="PD" SDset_S="0" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
4958      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="3" SDset="0" DCommErr="0" DTimeout="0"
4959    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
4960      <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
4961      <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_4"/>
4962      <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
4963      <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="5" setSD="0" ChFAckReq="0" CRC="valid"
4964    PDin_M="PD" SDset_S="0" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
4965      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="1"
4966    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
4967      <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
4968      <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
4969      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
4970      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="6" setSD="1" ChFAckReq="0" CRC="valid"
4971    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="1" MCommErr_S="1" MTimeout_S="0"/>
4972     </FSMasterSclTestCaseSteps>
4973    </Testroot>
4974
```

12.2.3 Test script 3

Table 182 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and ChannelFailureAck =1.

Table 182 – FS-Master test script 3

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0166
Name	FSTCM_SCLM_FLOW_SETSD1MC0CFAC1
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_3.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_3.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_3" date="20.11.2018: 14:01:29.067">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="WaitOnResponse_2"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="7" SDset="1" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="1"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_4"/>
    <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
    <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <Timeout/>
    <Transition SourceState="WaitOnResponse_5" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="1"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="7" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="1"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="1" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="1" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
```

```
5012      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0"
5013    CRC="invalid" PDout_M="PD" setSD_C="0" ChFAck_C="1"/>
5014      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
5015      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
5016      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5017      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="2" setSD="1" ChFAckReq="0" CRC="valid"
5018    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
5019      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="5" SDset="0" DCommErr="1" DTimeout="0"
5020    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="1"/>
5021      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
5022      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
5023      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5024      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="3" setSD="1" ChFAckReq="0" CRC="valid"
5025    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
5026      <Timeout/>
5027      <Transition SourceState="WaitOnResponse_7" TargetState="PrepareSPDU_6"/>
5028      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5029      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
5030    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="1"/>
5031      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="0"
5032    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="1"/>
5033      <Transition SourceState="WaitOnResponse_7" TargetState="WaitOnResponse_7"/>
5034     </FSMasterSclTestCaseSteps>
5035    </Testroot>
5036
```

5037

12.2.4 Test script 4

Table 183 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a setSD error, MCount = 0, and DCommErr.

Table 183 – FS-Master test script 4

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0167
Name	FSTCM_SCLM_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_4.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_4.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_4" date="20.11.2018: 14:01:29.067">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="7" SDset="0" DCommErr="1" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0"
CRC="invalid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="2" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="5" SDset="0" DCommErr="1" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
```

```
5074      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="3" setSD="1" ChFAckReq="0" CRC="valid"
5075    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
5076      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="4" SDset="0" DCommErr="0" DTimeout="1"
5077    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
5078      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
5079      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
5080      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5081      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="4" setSD="1" ChFAckReq="0" CRC="valid"
5082    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="1" MCommErr_S="1" MTimeout_S="0"/>
5083      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="3" SDset="0" DCommErr="0" DTimeout="1"
5084    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
5085      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
5086      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
5087      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5088      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="5" setSD="1" ChFAckReq="0" CRC="valid"
5089    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="1" MCommErr_S="1" MTimeout_S="0"/>
5090      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="2" SDset="0" DCommErr="0" DTimeout="1"
5091    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
5092      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
5093      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
5094      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5095      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="6" setSD="1" ChFAckReq="0" CRC="valid"
5096    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="1" MCommErr_S="1" MTimeout_S="0"/>
5097      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="1" SDset="0" DCommErr="0" DTimeout="0"
5098    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
5099      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
5100      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
5101      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5102      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="7" setSD="1" ChFAckReq="1" CRC="valid"
5103    PDin_M="SD" SDset_S="1" ChFAckReq_S="1" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
5104      <Transition SourceState="WaitOnResponse_7" TargetState="WaitOnResponse_7"/>
5105      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="0"
5106    CRC="valid" PDout_M="PD" setSD_C="1" ChFAck_C="1"/>
5107      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
5108      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_4"/>
5109      <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
5110      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
5111    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
5112      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="0"
5113    CRC="valid" PDout_M="PD" setSD_C="1" ChFAck_C="1"/>
5114      <Transition SourceState="WaitOnResponse_5" TargetState="WaitOnResponse_5"/>
5115     </FSMasterSclTestCaseSteps>
5116    </Testroot>
5117
5118
```

12.2.5 Test script 5

Table 184 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD error, MCount = 0, and DCommErr.

Table 184 – FS-Master test script 5

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0168
Name	FSTCM_SCLM_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_5.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_5.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_5" date="20.11.2018: 14:01:29.067">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="1" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="7" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="WaitOnResponse_7"/>
  </FSMasterSclTestCaseSteps>
</Testroot>
```

12.2.6 Test script 6

Table 185 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD =1, MCount =0, and DCommErr.

Table 185 – FS-Master test script 6

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0169
Name	FSTCM_SCLM_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_6.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_6.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_6" date="20.11.2018: 14:01:29.067">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="7" SDset="0" DCommErr="1" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="2" setSD="1" ChFAckReq="1" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="1" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="WaitOnResponse_7"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="5" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="1"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_4"/>
    <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
```

```
5186      <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"
5187    PDin_M="PD" SDset_S="0" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
5188      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0"
5189    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="1"/>
5190      <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
5191      <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
5192      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5193      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="4" setSD="1" ChFAckReq="0" CRC="valid"
5194    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
5195     </FSMasterSclTestCaseSteps>
5196    </Testroot>
5197
```

12.2.7 Test script 7

Table 186 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD =1, MCount =0, and DCommErr.

Table 186 – FS-Master test script 7

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0170
Name	FSTCM_SCLM_FLOW_SETSD1MC0DCE1
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_7.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_7.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_7" date="20.11.2018: 14:01:29.067">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="7" SDset="0" DCommErr="1" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="2" setSD="1" ChFAckReq="1" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="1" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="WaitOnResponse_7"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="5" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="1"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_4"/>
    <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
```

```
    <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"
PDin_M="PD" SDset_S="0" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0"
CRC="invalid" PDout_M="PD" setSD_C="0" ChFAck_C="1"/>
    <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="4" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
  </FSMasterSclTestCaseSteps>
</Testroot>
```

12.2.8 Test script 8

Table 187 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD =1, MCount =0, DCommErr, and Portnumber error.

Table 187 – FS-Master test script 8

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0171
Name	FSTCM_SCLM_FLOW_SETSD1MC0DCE1PNERR
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_8.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_8.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_8" date="20.11.2018: 14:01:29.068">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="7" SDset="0" DCommErr="1" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="2" setSD="1" ChFAckReq="1" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="1" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="WaitOnResponse_7"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="5" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="1"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_4"/>
    <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
```

```
5284      <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"
5285    PDin_M="PD" SDset_S="0" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
5286      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="6" SDset="0" DCommErr="0" DTimeout="0"
5287    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="1"/>
5288      <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
5289      <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
5290      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5291      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="4" setSD="1" ChFAckReq="0" CRC="valid"
5292    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
5293     </FSMasterSclTestCaseSteps>
5294    </Testroot>
5295
```

12.2.9 Test script 9

Table 188 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD =1 and MCount =0.

Table 188 – FS-Master test script 9

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0172
Name	FSTCM_SCLM_FLOW_SETSD1MC0
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_9.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_9.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_9" date="20.11.2018: 14:01:29.068">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="7" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_4"/>
    <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
    <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="1" setSD="0" ChFAckReq="0" CRC="valid"
PDin_M="PD" SDset_S="0" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="1" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_4"/>
    <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
    <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="2" setSD="0" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="5" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_4"/>
    <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
    <FSMasterSend_FSAppSend PDout="PD" PortNum="valid" MCount="3" setSD="0" ChFAckReq="0" CRC="valid"
PDin_M="PD" SDset_S="0" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
```

```
5333      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="0" SDset="0" DCommErr="0" DTimeout="1"
5334    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
5335      <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
5336      <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
5337      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5338      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="4" setSD="1" ChFAckReq="0" CRC="valid"
5339    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="1" MCommErr_S="1" MTimeout_S="0"/>
5340     </FSMasterSclTestCaseSteps>
5341    </Testroot>
5342
```

12.2.10 Test script 10

Table 189 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD =1, MCount =0, Port number error, and CRC error.

Table 189 – FS-Master test script 10

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0173
Name	FSTCM_SCLM_FLOW_PNERRCRCERR
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_10.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_10.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_10" date="20.11.2018: 14:01:29.068">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="7" SDset="0" DCommErr="1" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0"
CRC="invalid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="2" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="5" SDset="0" DCommErr="1" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
```

```
5379      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="3" setSD="1" ChFAckReq="0" CRC="valid"
5380    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
5381      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="4" SDset="0" DCommErr="0" DTimeout="1"
5382    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
5383      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
5384      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
5385      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5386      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="4" setSD="1" ChFAckReq="0" CRC="valid"
5387    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="1" MCommErr_S="1" MTimeout_S="0"/>
5388      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="3" SDset="0" DCommErr="0" DTimeout="1"
5389    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
5390      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
5391      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
5392      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5393      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="5" setSD="1" ChFAckReq="0" CRC="valid"
5394    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="1" MCommErr_S="1" MTimeout_S="0"/>
5395      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="2" SDset="0" DCommErr="0" DTimeout="1"
5396    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
5397      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
5398      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
5399      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5400      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="6" setSD="1" ChFAckReq="0" CRC="valid"
5401    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="1" MCommErr_S="1" MTimeout_S="0"/>
5402      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="1" SDset="0" DCommErr="0" DTimeout="0"
5403    CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
5404      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
5405      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
5406      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5407      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="7" setSD="1" ChFAckReq="1" CRC="valid"
5408    PDin_M="SD" SDset_S="1" ChFAckReq_S="1" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
5409      <Transition SourceState="WaitOnResponse_7" TargetState="WaitOnResponse_7"/>
5410      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="0"
5411    CRC="valid" PDout_M="PD" setSD_C="1" ChFAck_C="1"/>
5412      <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
5413      <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_4"/>
5414      <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
5415      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
5416    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
5417      <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="1" DTimeout="0"
5418    CRC="valid" PDout_M="PD" setSD_C="1" ChFAck_C="1"/>
5419      <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
5420      <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
5421      <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
5422      <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="2" setSD="1" ChFAckReq="0" CRC="valid"
5423    PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
5424     </FSMasterSclTestCaseSteps>
5425    </Testroot>
5426
```

12.2.11 Test script 11

Table 190 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of setSD =1, MCount =0, Port number error, and CRC error.

Table 190 – FS-Master test script 11

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0174
Name	FSTCM_SCLM_FLOW_PNERRCRCERR
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_11.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_11.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_11" date="20.11.2018: 14:01:29.068">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="7" SDset="0" DCommErr="1" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="6" SDset="0" DCommErr="0" DTimeout="0"
CRC="invalid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="2" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="5" SDset="0" DCommErr="1" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
```

```
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="3" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="1" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="4" SDset="0" DCommErr="0" DTimeout="1"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="4" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="1" MCommErr_S="1" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="3" SDset="0" DCommErr="0" DTimeout="1"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="5" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="1" MCommErr_S="1" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="2" SDset="0" DCommErr="0" DTimeout="1"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="6" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="1" MCommErr_S="1" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="1" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="7" setSD="1" ChFAckReq="1" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="1" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="WaitOnResponse_7"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="1" ChFAck_C="1"/>
    <Transition SourceState="WaitOnResponse_7" TargetState="CheckSPDU_8"/>
    <Transition SourceState="CheckSPDU_8" TargetState="PrepareSPDU_4"/>
    <Transition SourceState="PrepareSPDU_4" TargetState="WaitOnResponse_5"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="1" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="1" ChFAck_C="1"/>
    <Transition SourceState="WaitOnResponse_5" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="2" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
  </FSMasterSclTestCaseSteps>
</Testroot>
```

12.2.12 Test script 12

Table 191 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of a port number error and MCount =0.

Table 191 – FS-Master test script 12

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0175
Name	FSTCM_SCLM_FLOW_PNERRMC0
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_12.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_12.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_12" date="20.11.2018: 14:01:29.068">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="WaitOnResponse_2"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="invalid" DCount="0" SDset="0" DCommErr="0" DTimeout="0"
CRC="valid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
  </FSMasterSclTestCaseSteps>
</Testroot>
```

12.2.13 Test script 13

Table 192 defines the test conditions for this test case. The associated XML file contains steps and message parameters for the state flow check in case of CRC error and MCount =0.

Table 192 – FS-Master test script 13

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0176
Name	FSTCM_SCLM_FLOW_CRCERRMC0
Purpose (short)	
Equipment under test (EUT)	FS-Master
Test case version	1.0
Category / type	FS-Master automated SCL protocol test
Specification (clause)	[4] clause 11.3.2, Figure 40 (services); clause 11.5.2, Figure 45 (state chart)
Configuration / setup	See Table A.6

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Protocol flow in case of distinct error
Precondition	FS-Master to send first message
Procedure	See XML file "IO-Link-Safety_spec_master_final_testsuite_testcase_13.xml"
Test parameter	See Table 179 and XML file
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	Comparison of expected and received values according to the XML file
Test passed	Comparison OK
Test failed (examples)	Comparison not OK
Report	Printout of the automated SCL protocol tester <pass/fail>

Content of file "IO-Link-Safety_spec_master_final_testsuite_testcase_13.xml":

```
<?xml version="1.0" encoding="UTF-8"?>
<Testroot xsi:noNamespaceSchemaLocation="IO-Link-Safety-Test-Procedure_Types_V1.0.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.2" name="tc_13" date="20.11.2018: 14:01:29.068">
  <FSMasterSclTestCaseSteps>
    <Transition SourceState="Init" TargetState="PrepareSPDU_1"/>
    <Transition SourceState="PrepareSPDU_1" TargetState="WaitOnResponse_2"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="0" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="0" MTimeout_S="0"/>
    <FSMasterReceive_FSAppReceive PDin="PD" PortNum="valid" DCount="0" SDset="0" DCommErr="0" DTimeout="0"
CRC="invalid" PDout_M="PD" setSD_C="0" ChFAck_C="0"/>
    <Transition SourceState="WaitOnResponse_2" TargetState="CheckSPDU_3"/>
    <Transition SourceState="CheckSPDU_3" TargetState="PrepareSPDU_6"/>
    <Transition SourceState="PrepareSPDU_6" TargetState="WaitOnResponse_7"/>
    <FSMasterSend_FSAppSend PDout="SD" PortNum="valid" MCount="1" setSD="1" ChFAckReq="0" CRC="valid"
PDin_M="SD" SDset_S="1" ChFAckReq_S="0" DCommErr_S="0" DTimeout_S="0" MCommErr_S="1" MTimeout_S="0"/>
  </FSMasterSclTestCaseSteps>
</Testroot>
```

13 FS-Master additional functional tests

13.1 Overview

The FS-Master with reference FS-Devices test comprise tests, where several approved FS-Devices as reference are available. Rules for reference systems are defined in A.2.7.

An approved SMTU shall be used for the following test cases except for the basic reference test FSTCM_REFT_RD where reference Devices from regular automation environments must be used.

The FS-Master in additional functional tests comprise tests of the splitter and composer for Process Data. Since tests for SR PD are already included in 12.2, the test cases here focus on the NSR PD part. They are followed by test cases for pecial SMI services for read back of the (safety) Port configuration and Port status and optionally by test cases for the correct Process Data in case of OSSDe (FS-DI) Port mode. In addition, Port Events are tested. Besides tests for the FS-Master SCL protocol watchdog, the aspects of Safety Function Response Time (SFRT) are covered.

13.2 Splitter/composer

13.2.1 Splitter in mixed PD mode (CRC32)

Table 193 defines the test conditions for this test case.

Table 193 – Splitter in mixed PD mode (CRC32)

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0177
Name	FSTCM_FSOP_SPLITTERMIXPD32
Purpose (short)	Check whether NSR PD of an FS-Device (sensor) are transferred correctly
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4] 10.2, 10.3, 10.5
Configuration / setup	FS-Master-Tester-System

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check whether NSR PD of an FS-Device (sensor) are transferred correctly with the help of SMI_PDIn in case of CRC32 and in mixed mode.
Precondition	EUT: PORT_MIXFSCOM SMTU: SMTU_STANDARD_STATE_32
Procedure	a) SMTU_NSR_Set(NSR, PDValid) *;set NSR Process Data + PDValid* b) SMTU_SPDU_Change *;wait until SPDU has changed* c) SMI_PDIn *;return ArgBlock "PDIn"* d) Evaluate 1)
Test parameter	NSR[1] = {3}, PDValid = 1
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check (NSR) "PDIn"
Test passed	PDIn.InputDataLength = 1, PDIn.PDI0 = 3 PDIn.PQI = 1
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

13.2.2 Splitter in mixed PD mode (CRC16)

Table 194 defines the test conditions for this test case.

Table 194 – Splitter in mixed PD mode (CRC16)

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0179
Name	FSTCM_FSOP_SPLITTERMIXPD16
Purpose (short)	Check whether NSR PD of an FS-Device (sensor) are transferred correctly
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4] 10.2, 10.3, 10.5
Configuration / setup	FS-Master-Tester-System
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Check whether NSR PD of an FS-Device (sensor) are transferred correctly with the help of SMI_PDIn in case of CRC16
Precondition	EUT: PORT_MIXFSCOM SMTU: SMTU_STANDARD_STATE_16
Procedure	a) SMTU_NSR_Set(NSR, PDValid) *;set NSR Process Data + PDValid* b) SMTU_SPDU_Change *;wait until SPDU has changed* c) SMI_PDIn *;return ArgBlock "PDIn"* d) Evaluate 1)
Test parameter	NSR[4] = {3, 6, 9, 12}, PDValid = 1
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check (NSR) "PDin"
Test passed	PDIn.InputDataLength = 4, PDIn.PDIi [i = 0, …, 3] = {3, 6, 9, 12}, PDIn.PQI = 1
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

13.2.3 Composer in mixed PD mode (CRC32)

Table 195 defines the test conditions for this test case.

Table 195 – Composer in mixed PD mode (CRC32)

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0181
Name	FSTCM_FSOP_COMPOSERMIXPD32
Purpose (short)	Check whether NSR PD to an FS-Device (actuator) are transferred correctly
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4] 10.2, 10.3, 10.5
Configuration / setup	FS-Master-Tester-System

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check whether NSR PD to an FS-Device (actuator) are transferred correctly via SMI_PDOut and checked via SMTU instruction case of CRC32.
Precondition	EUT: PORT_MIXFSCOM SMTU: SMTU_STANDARD_STATE_32
Procedure	a) SMI_PDOut(ABPS_PDOUT32<OutputDataLength=1>,<PDO=NSR>) b) STM_WAIT_TIMEOUT *;wait for FSP_Watchdog timeout* c) SMI_FSPDInOut *;returns "FSPDInOut"* d) Evaluate 1) e) SMTU_SPDU_Change *;wait until SPDU has changed* f) SMTU_MixData_Get *;returns "mixed PD"* g) Evaluate 2)
Test parameter	NSR[1] = {3}
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check "FSPDInOut" 1) Check "mixed PD"
Test passed	FSPDInOut.PDO0 = 3, and NSR = {3}, OE = Valid
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

13.2.4 Composer in mixed PD mode (CRC16)

Table 196 defines the test conditions for this test case.

Table 196 – Composer in mixed PD mode (CRC16)

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0183
Name	FSTCM_FSOP_COMPOSERMIXPD16
Purpose (short)	Check whether NSR PD to an FS-Device (actuator) are transferred correctly
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4] 10.2, 10.3, 10.5
Configuration / setup	FS-Master-Tester-System
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Check whether NSR PD are correctly transferred to an FS-Device (actuator) via SMI_PDOut and checked via SMTU instruction in case of CRC16
Precondition	EUT: PORT_MIXFSCOM SMTU: SMTU_STANDARD_STATE_16
Procedure	a) SMI_PDOut(ABPS_PDOUT32<OutputDataLength=4>,<PDO=NSR>) b) STM_WAIT_TIMEOUT *;wait for FSP_Watchdog timeout* c) SMI_FSPDInOut *;returns "FSPDInOut"* d) Evaluate 1) e) SMTU_SPDU_Change *;wait until SPDU has changed* f) SMTU_MixData_Get *;returns "mixed PD"* g) Evaluate 2)
Test parameter	NSR[4] = {3, 6, 9, 12}
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check "FSPDInOut" 2) Check "mixed PD"
Test passed	FSPDInOut.PDO0 = 3, FSPDInOut.PDO0 = 6, FSPDInOut.PDO0 = 9, FSPDInOut.PDO0 = 12, and NSR = {3, 6, 9, 12}, OE = Valid
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

13.3 SMI service tests (safety)

13.3.1 Read back safety configuration

Table 197 defines the test conditions for this test case.

Table 197 – Read back safety configuration

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0185
Name	FSTCM_SMIS_READBACKCONFIG
Purpose (short)	Check whether safety configuration is read back correctly
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.1
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Master-Tester-System

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check whether safety configuration is read back correctly with the help of SMI_ReadbackPortConfiguration using Argblock 0x8100
Precondition	EUT: PORT_POWER_OFF SMTU: SMTU_STANDARD_STATE_32
Procedure	a) SMI_PortConfiguration(ABPS_FSCONFIG_MIXEDCOM) b) SMI_ReadBackPortConfiguration(0x8100) ;*returns ArgBlock "FSPortConfigList*" c) Evaluation 1)
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Compare ArgBlock "FSPortConfigList" with ABPS_FSCONFIG_MIXEDCOM
Test passed	All comparisons match
Test failed (examples)	Any mismatch at comparison
Report	Mismatches: <yes/no> <ok | nok>

13.3.2 Safety Port status

Table 198 defines the test conditions for this test case.

Table 198 – Safety Port status

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0186
Name	FSTCM_SMIS_FSPORTSTATUS
Purpose (short)	Check whether Port status is read back correctly and the PDoutValidity of NSR data is set to invalid
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.1
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4]10.3.5
Configuration / setup	FS-Master-Tester-System

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check whether the safety Port status can be read out using the SMI_PortStatus service and Argblock 0x9100. Check the output validity of the NSR PDout data that must be invalid before an PDOut SMI service has been issued.
Precondition	EUT: PORT_MIXFSCOM SMTU: SMTU_STANDARD_STATE_32
Procedure	a) SMI_PortStatus(0x9100) ;returns ArgBlock "FSPortStatusList" b) Evaluation 1) c) SMI_PDOut(invalid) d) Wait(2*Watchdogtimeout) d) OE = SMTU_MixData_Get e) Evaluation 2) f) SMI_PDOut(valid) g) Wait(2*Watchdogtimeout) h) OE = SMTU_MixData_Get i) Evaluation 3)
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Compare ArgBlock "FSPortStatusList" with assignments in "PORT_MIXFSCOM" 2) Check Value of OE and check if any FS related Event occurs (see [4] Table B.2) 3) Check Value of OE and check if any FS related Event occurs (see [4] Table B.2)
Test passed	1,2) PortStatusInfo = SCL_ENABLED PortQualityInfo.Bit0/1 = 0 *;all PD valid* RevisionID = 0x11 TransmissionRate = COM2 MasterCycleTime ≥ 0x80 *;>33 ms* InputDataLength = 0x20 *;PDInLength = 32 octets* OutputDataLength = 0x20 *;PDOutLength = 32 octets* VendorID = 0xFDE8 *;IO-Link Community* DeviceID = 0x002BD2 *;Tester* NumberofDiags = 0 DiagEntry0 = 0 DiagEntry1 = 0, and OE = invalid and no Event 3) OE = valid and no Event
Test failed (examples)	Any check deviating
Report	Values OK: <yes/no> <ok | nok>

13.4 Port with FS-DI/OSSDe (optional)

Testing of this functionality is covered by SDCI_FSTC_0008 in 5.4.1.

13.5 Events

13.5.1 Port specific Event

Table 199 defines the test conditions for this test case.

Table 199 – Port specific Event

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0187
Name	FSTCM_REFD_PORTEVENTCORRECT
Purpose (short)	Check whether Port Events are generated correctly
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.1
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4] Table B.2
Configuration / setup	FS-Master-Tester-System

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check whether Port Event is generated correctly, e.g. a transmission Error (Timeout) occurred.
Precondition	EUT: PORT_MIXFSCOM SMTU: SMTU_STANDARD_STATE_32 *;no FST Parameter*
Procedure	a) SMI_PDOut(ABPS_PDOUT32<OutputDataLength=1>) b) SMTU_SPDU_Repetition (>WatchdogTimeout) ;Pause SCL on Device> WatchdogTimeout c) Wait on SMI_PortEvent ;returns ArgBlock "PortEvent" d) Evaluation 1)
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check ArgBlock "PortEvent"
Test passed	EventCode = 0x2002 *;Transmission Error (Timeout)*
Test failed (examples)	No Event or EventCode incorrect
Report	Port Event OK: <yes/no> <ok | nok>

13.5.2 FS-Device Event

Table 200 defines the test conditions for this test case.

Table 200 – FS-Device Event

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0188
Name	FSTCM_REFD_FSDEVICEEVENTCORRECT
Purpose (short)	Check whether FS-Device Event is propagated correctly
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Master-Tester-System

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check whether FS-Device Event is propagated correctly, e.g. unexpected authentication code (0xB003)
Precondition	EUT: PORT_MIXFSCOM SMTU: SMTU_STANDARD_STATE_32 *;no FST Parameter*
Procedure	a) SMI_PortConfig (ABPS_FSCONFIG_SAFECOM<FSCP_Authenticity1=2>) b) Wait(1s + FSP-MinShutdownTime + FSP_TimeToReady) c) Wait on SMI_DeviceEvent *;returns ArgBlock "DeviceEvent"* d) Evaluation 1)
Test parameter	–
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check ArgBlock "DeviceEvent"
Test passed	EventCode = 0xB003 *;Unexpected authentication code*
Test failed (examples)	No Event or EventCode incorrect
Report	FS-Device Event OK: <yes/no> <ok | nok>

13.6 Safety function response time

13.6.1 General concepts and accuracies

Figure 16 illustrates the effects of the worst-case delay times (WCDT) and one fault delay times (OFDT) of the components involved in a safety function based on a pure FS-Master and FS-Device system. see Annex H.6 in [4], which requires for a

- a manufacturer/vendor of FS-Devices to provide the "worst-case delay time" (WCDT) value. WCDT is defined as the time from triggering an FS-Device (sensor) until the output shows a corresponding signal change or Process Data change. For an FS-Device (actuator) it is the time from signal change or Process Data change to the actuator's safe state.

- a manufacturer/vendor of FS-Devices to provide the "one fault delay time" (OFDT) value. The definition of OFDT is similar to WCDT, however in case of a fault within the FS-Device at the time of the measurement.

Therefore, since it is mandatory for all components to provide WDCT and OFDT in user manuals, FS-Master tools are enabled to provide values for the total worst case delay time (TWCDT) and safety function response time.

An FS-Master shall also provide values for FS-Master_WD (OFDT), usually derived from program processing duration and for IOL-S WD for the output side.

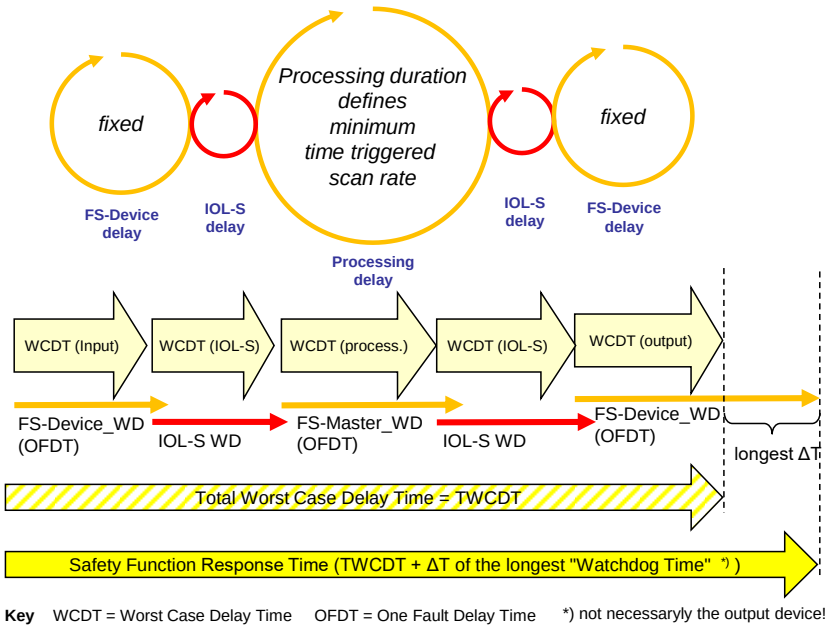


Figure 16 – SFRT of a stand-alone FS-Master with processing

Only one fault shall be assumed per trip. The watchdog time with the largest impact on the safety function response time (SFRT) shall be considered for a safety function. For a machine usually an overtravel measurement (usually at least 10 measurements) is performed.

Table 201 shows the accuracies and tolerances to be used for timings.

Table 201 – Accuracies and tolerances for timings

Item	Accuracy	Remarks
Measurement accuracy	+/- 1 %	–
Permitted watchdog time tolerance	+/- 10 %	–

Figure 17 illustrates the effects of the worst-case delay times (WDCT) and one fault delay times (OFDT) of the components involved in a safety function based on FS-Master and FS-

Devices integrated in a fieldbus functional safety communication profile (FSCP), see for example [11].

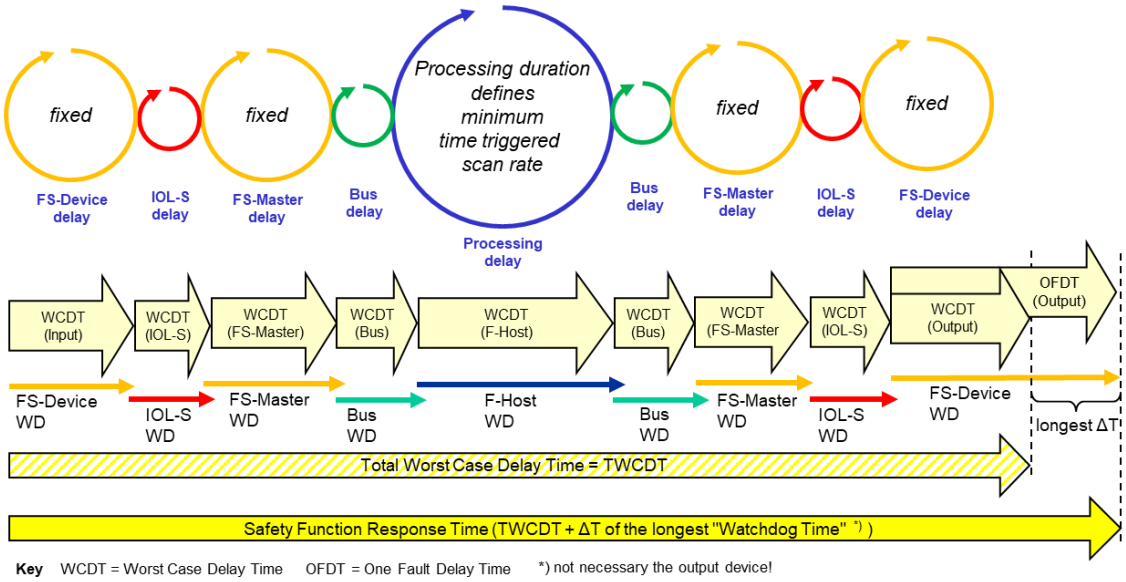


Figure 17 – SFRT including IOL-S and FSCP

Figure 18 illustrates, how the watchdog timer of an FS-Master is tested. The Safety Master Tester Unit (SMTU), playing the role of an FS-Device, is controlled in such a way that the response SPDU ("DCount_i = 3") is delayed through artificial repetitions. For details see 13.6.2.

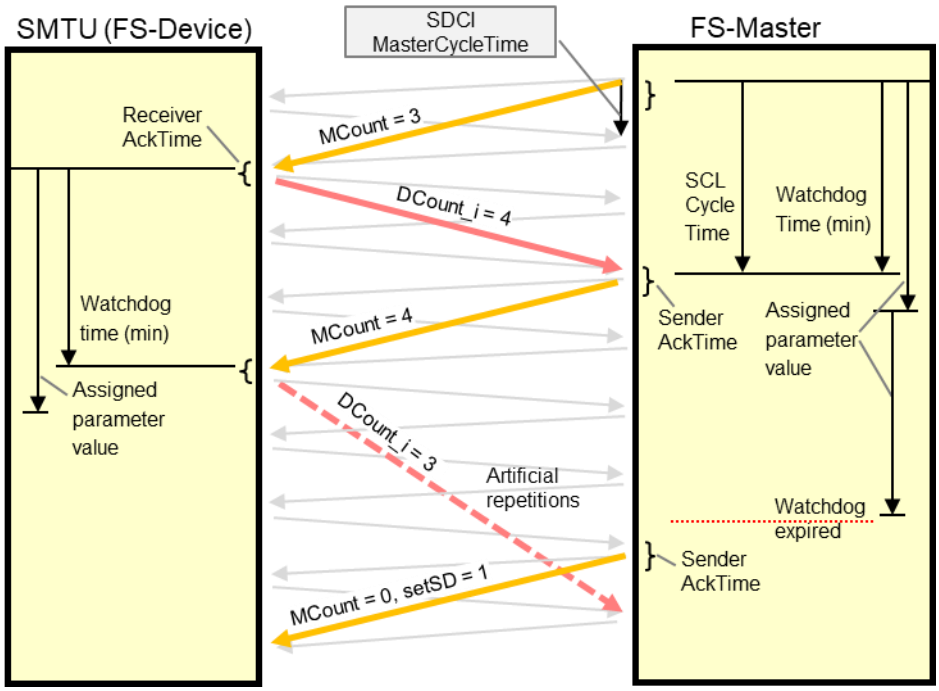


Figure 18 – Test of the FS-Master watchdog

The actual watchdog response time cannot be measured with IO-Link on-board equipment. This shall be measured by the manufacturer using development tools or determined via software analysis (safety assessment, see 8.3.3). It is however possible, to validate in a test case that the FS-Watchdog timeout is within certain limits. The IO-Link Interface Specification [2],A.3.7 provides a definition of the MinCycleTime that is a property of the Device.

The manufacturer of the IO-Link Device specifies the MinCycleTime of the Device.

$$MinCycleTime \ = t_{bc,min}$$

In addition, the Manufacturer of the IO-Link FS-Device specifes the io-update time $t_{io,update}$, (see [4] A.2.6). Based on the description in [4], the io-update time shall cover the processing time of the SCL layer in the FS-Device plus the transmission time of the black channel including all repetitions and some synchronization delay.Thus the IO-update time shall fulfill the following requirement.

$$t_{io,update} \geq 6.6\, t_{bc,min} + t_{scl,d}$$

Where $t_{scl,d}$ is the processing time of the FS-Device, which is the time between the capturing of an update of the SPDU-Out from the FS-Master by the SCL and the updating of the SPDU-IN forwarded to the FS-Master. The io-update time is published in the IODD of the FS-Device as Default value of the parameter FSP-Watchdog. With the Mastertool, the value $t_{io,update}$ is extended by the processing time of the FS-Master $t_{scl,m}$ and the MinCycleTime $t_{bc,min}$, which is replaced by the selected nominal master cycle time

$$t_{bc,nom} \geq t_{bc,min}$$

The resulting Watchdog timeout t_{WD} is stored in the FSP-Watchdog parameter.

$$t_{WD} > 6.6\, t_{bc,nom} + t_{scl,d} + t_{scl,m}$$

The SCL Master cycle time $t_{scl,m}$ is a property of the FS-Master that must be made available by the Manufactuer of the FS-Master to the Master tool and the FS-Master tester. The duration of $t_{scl,m}$ covers the processing time between the capturing an SPDUIn from the FS-Device by the SCL and the update of the SPDUOut by the FS-Master.

For validating the FSWatchdog, the following assumptions are made:

- The test is executed under controlled conditions, thus no repetitions occur during the test.
- An update of the SCL state in the FS-Master is copied to SPDUOut within the effective IO-Link cycle time t_{bc}

$$0.99\, t_{bc,nom} \leq t_{bc} \leq 1.1\, t_{bc,nom}$$

- An update of SPDUIN is copied to the SCL of the FS-Master within $t_{scl.m} \leq t_{WD}$.
- The Watchdog Timeout t_{WD} shall be validated only by the SMTU.
- The SMTU observes $PD_{In,Out}$ and/or $SPDU_{In,Out}$ discretized by the effective IO-Link cycle time t_{bc}.
- The watchdog timeout value can be reduced to

$$t_{WD,test} \geq 2.2\, t_{bc,min} + t_{scl,m} + t_{scl,d}$$

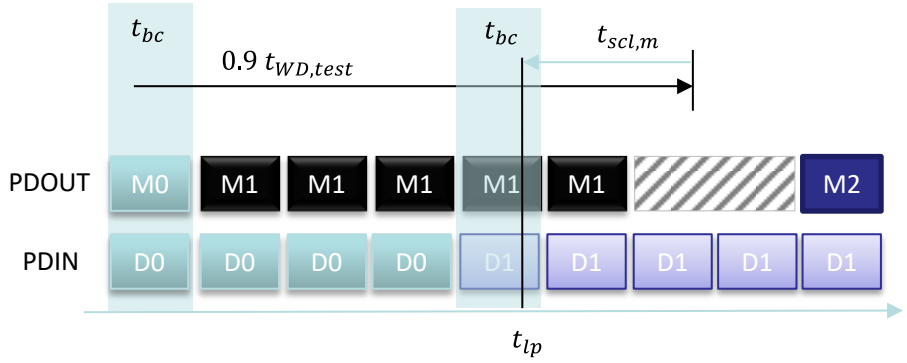
The validation of the Watchdog timeout on the FS-Master is done by checking boundary conditions. First, it is checked that a Watchdog timeout never occurs on the FS-Master, when the SCL of the FS-Device responds within a time longestpass

$$t_{lp} \leq \ 0.9\, t_{wd,test} - 2\, t_{bc} - t_{scl,m}; \quad t_{lp} \geq 0$$

Secondly, it is checked that a Watchdog timeout always occurs on the FS-Master, when the SCL of the FS-Device responds at a time shortestfail

$$t_{sf} \geq 1.1\, t_{WD,test} + 2\, t_{bc} + t_{scl,m}$$

The prefixes 0.9 and 1.1 are reflecting the tolerance of the Watchdog timeout.



$$t_{lp} = 0.9\ t_{WD,test} - 2\ t_{bc} - t_{scl,m}$$

Figure 19 Longest SCL response t_{lp} that never leads to an FSWatchdog Timeout

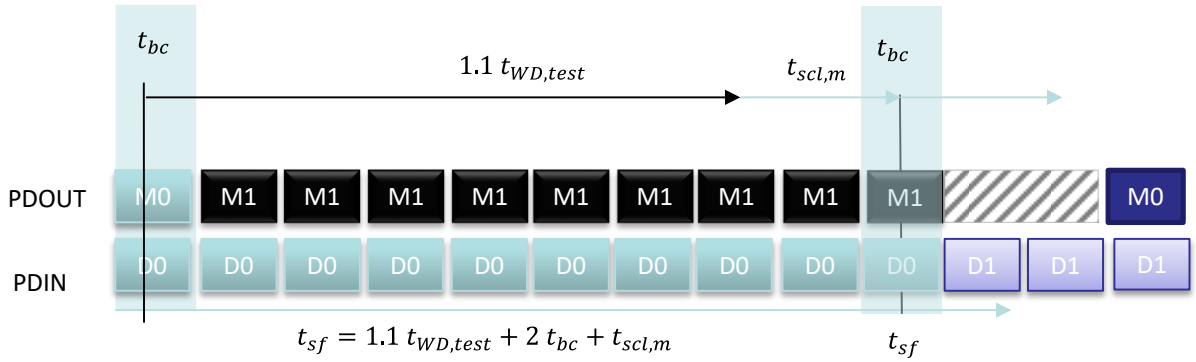


Figure 20 Shortest response t_{sf} that always leads to an FSWatchdog Timeout

In Figure 19 and Figure 20, M0, M1 or M2 are indicating MCount in SPDUOut of the FS-Master. D0 or D1 are indicating DCount in SPDUIn of the FS-Device.

The times are shortened respectively prolonged by the 2 times the blackchannel jitter t_{bc} and the SCL cycle time of the FS-Master as a second source of jitter due to the asynchronousity between black channel and SCL.

13.6.2 FS-Master watchdog test

Table 202 defines the test conditions for this test case.

Table 202 – FS-Master watchdog test

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0189
Name	FSTCM_SCLM_WATCHDOGPRECISION
Purpose (short)	Check whether the watchdog timeout reaction of the FS-Master meets expected timing constraints.
Equipment under test (EUT)	FS-Master
Test case version	1.1
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4]
Configuration / setup	FS-Master-Tester-Unit (SMTU)

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check whether FS-Master's safety reaction time upon watchdog timeout lies within the expected limits considering the SCL cycle time of the FS-Master and given properties of the SMTU.
Precondition	EUT: Port config DEACTIVATED; Transmission rate = COM2 SMTU: SMTU_STANDARD_STATE_32 FS Master SCL cycle time $t_{scl,m}$, SCL cycle time of SMTU $t_{scl,d} = 25.2\ ms$
Procedure	a) Choose new Watchdog_value from first FSP_Watchdog in A) b) Update Verifyrecord with new Watchdog_value from A) c) Update longestpass (t_{lp}) and shortestfail (t_{sf}) with new valuse from A d) Perform ISDU-Write with Watchdog_value to FSP_Watchdog parameter e) Set PortConfig with current FSP_VerifyRecord e.g. via SMI_PortConfiguration using ArgBlock 0x8100 f) SMTU_DelaySPDU(t_{lp}) *;return M_COUNT* g) Evaluation 1) h) Perform ISDU-Write with Watchdog_value to FSP_Watchdog parameter i) Set PortConfig with current FSP_VerifyRecord e.g. via SMI_PortConfiguration using ArgBlock 0x8100 j) SMTU_DelaySPDU(t_{sf}) *;return M_COUNT* k) Evaluation 2) l) Repeat from c) 3 times m) Update watchdog_value with next FSP_Watchdog from A) n) Repeat from b)
Test parameter	A) FSP protocol parameter record: *;MinCycleTime = 25.2 ms* FSP_Watchdog ={ $t_{WD} = 90\ ms + t_{scl,m}$, $t_{WD} = 140\ ms + t_{scl,m}$ } $t_{lp} = 0.9\ t_{WD} - t_{scl,m} - 55\ ms$ $t_{sf} = 1.1\ t_{WD} + t_{scl,m} + 55\ ms$ FSP_ProtVersion = defaultValue in IODD, FSP_ProtMode = defaultValue in IODD, FSP_IOStructCRC = defaultValue in IODD, FSP_TechParCRC = valid CRC signature *;responsibility of tester* FSP_ProtParCRC = valid CRC signature *;responsibility of tester*
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) get M_COUNT
Test passed	1) M_COUNT <> 0 2) M_COUNT = 0
Test failed (examples)	Any check incorrect
Report	For every repetition 1) M_COUNT = <value> <ok | nok> 2) M_COUNT= <value> <ok | nok>

TEST CASE RESULTS	CHECK / REACTION

5731

13.6.3 Integration aspects

In 13.6.1, the general concepts are explained also for a more complex FS-Master integrated in a fieldbus's functional safety communication profile (FSCP) according to the IEC 61784-3 series. In this case, usually the FS-Master plays only the role of a mapper of Process Data from one safety communication system to the other.

The designer/manufacturer of such a mapping FS-Master/Gateway shall provide WCDT and OFDT for the mapping part to enable computer-aided approximation of a safety function response time. Integration specifications to FSCPs should comprise definitions and descriptions how to achieve these values.

13.7 Test with Reference FS-Devices

13.7.1 Test in regular automation environments

Table 203 defines the test conditions for this test case.

Table 203 – Test of FS-Master with Reference FS-Devices

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0199
Name	FSTCM_REFT_RD
Purpose (short)	Basic test of FS_Master with Reference FS-Devices
Equipment under test (EUT)	FS-Master, Mastertool
Test case version	1.0
Category / type	Test of basic functionality of FS-Master and Master Tool with 3 reference FS-Devices
Specification (clause)	[4]
Configuration / setup	Standard setup of FS-Master System and Master Tool connected to 3 reference FS-Devices with IODDs and Dedicated Tools

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Test of basic functionality of the EUT together with 3 reference FS-Devices to show that the EUT is able to establish a safety communication also in regular automation environments
Precondition	Setup of FS- Master with Master Tool, Engineering and PLC connected to reference FS-Devices
Procedure	For each reference FS-Device: a) Install Dedicated Tool b) Evaluation 1) c) Start Dedicated Tool and configure FST parameters and return FSP_TechParCRC d) Evaluation 2) e) Configure Port to SAFETYCOM or MIXEDSAFETYCOM f) Evaluation 3) g) Execute optional additional tests h) Evaluation 4)
Test parameter	-
Post condition	-

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check installation result 2) Check FSP_TechParCRC 3) Check safety communication 4) Check results of additional tests
Test passed	1) Installation of Device Tool was successful 2) FSP_TechParCRC is not “0” 3) Safety communication has started 4) Tests show expected results
Test failed (examples)	At least one test shows unexpected results

TEST CASE RESULTS	CHECK / REACTION
Report	Values OK : <yes/no>

14 FS-Master Tool tests

14.1 IODD import

Table 204 defines the test conditions for this test case.

Table 204 – IODD import

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0190
Name	FSTCM_TOOL_IODDIMPORT
Purpose (short)	IODD of the SMTU can be imported into FS-Master Tool
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master Tool test, test-to-pass
Specification (clause)	[4]
Configuration / setup	EUT + IODD of SMTU (or any FS-Device)

TEST CASE	CONDITIONS / PERFORMANCE
Purpose (detailed)	Check whether IODD of the SMTU can be imported into FS-Master Tool and FSP_ParamDescCRC is correct.
Precondition	–
Procedure	a) Import IODD b) Evaluation 1) c) Evaluation 2)
Test parameter	IODD of SMTU
Post condition	–

TEST CASE RESULTS	CHECK / REACTION
Evaluation	1) Check import status (CRC signature, Display) 2) Check FSP_ParamDescCRC
Test passed	All checks correct
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

14.2 IODD conventions (PD headlines coloring)

Table 205 defines the test conditions for this test case.

Table 205 – IODD conventions (PD headlines coloring)

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0191
Name	FSTCM_TOOL_IODDCONVENTIONS
Purpose (short)	IODD of the SMTU is displayed according to IODD rules
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master Tool test, test-to-pass
Specification (clause)	[4]
Configuration / setup	EUT + IODD of SMTU
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Check whether IODD of the SMTU is displayed according to IODD rules, e.g. headers of Process Data and FS parameters in yellow color
Precondition	–
Procedure	a) Import and open IODD of the SMTU b) Evaluation 1)
Test parameter	FS parameter in user manual
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check display
Test passed	Headers of Process Data and FS parameters in yellow color according to IODD rules
Test failed (examples)	Display not according to IODD rules
Report	Values OK: <yes/no> <ok | nok>

14.3 FS parameters visible completely

Table 206 defines the test conditions for this test case.

Table 206 – FS parameters visible completely

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0192
Name	FSTCM_TOOL_IODDDISPLAYCOMPLETE
Purpose (short)	IODD FS parameter of the SMTU are displayed completely and appropriately
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master Tool test, test-to-pass
Specification (clause)	[4]
Configuration / setup	EUT + IODD of SMTU (or any FS-Device) + user manual
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	IODD FS parameter of the SMTU are displayed completely and appropriately
Precondition	–
Procedure	a) Import and open IODD of the SMTU b) Display all FSP parameters c) Evaluation 1) d) Display all FST parameters e) Evaluation 2)
Test parameter	FS parameter in user manual
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Compare all FSP parameters with user manual 2) Compare all FST parameters with user manual
Test passed	All comparisons correct or tolerable (no misunderstandings)
Test failed (examples)	Any comparison incorrect
Report	Comparisons OK: <yes/no> <ok | nok>

14.4 FS-Device parameterization

Table 207 defines the test conditions for this test case.

Table 207 – FS-Device parameterization

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0193
Name	FSTCM_TOOL_FSTPARAMETERS
Purpose (short)	FST parameterization is possible
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master Tool test, test-to-pass
Specification (clause)	[4]
Configuration / setup	EUT + IODD of SMTU (or any FS-Device)
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	FS-parameterization is possible
Precondition	–
Procedure	a) Import IODD b) Establish communication with SMTU c) Modify FS parameter d) Evaluation 1)
Test parameter	FST parameter in user manual
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Compare SMTU behavior with description in SMTU user manual
Test passed	All checks correct or tolerable (no misunderstandings)
Test failed (examples)	Any check incorrect
Report	Behavior OK: <yes/no> <ok | nok>

14.5 Dedicated Tool operation

Table 208 defines the test conditions for this test case.

Table 208 – Dedicated Tool operation

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0194
Name	FSTCM_TOOL_COMMDEDITOOL
Purpose (short)	Dedicated Tool of the SMTU can communicate with Master Tool
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4]
Configuration / setup	EUT + IODD of SMTU + Dedicated Tool from SMTU
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	FS-Master Tool invokes Dedicated Tool and passes over FST parameter via TPF. Subsequently, calculation of TechParCRC upon parameter changes takes place. Parameter values and TechParCRC are returned to FS-Master Tool via TBF ("Back Channel"). After parameter changes in FS-Master Tool, an update of the parameter values in the Dedicated Tool shall not occur automatically but only upon invocation of the Dedicated Tool. Check whether Dedicated Tool of the SMTU can communicate with FS-Master Tool.
Precondition	–
Procedure	a) Launch/invoke Dedicated Tool b) Evaluation 1) c) Try changing parameter values in FS-Master Tool d) Evaluation 2) e) Close Dedicated Tool f) Evaluation 3) g) Modify FST parameter values in FS-Master Tool h) Relaunch Dedicated Tool i) Evaluation 4) j) Evaluation 5) k) Perform commissioning of SMTU l) Evaluation 6)
Test parameter	–
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check availability of TechParCRC display (decimal value) in Dedicated Tool (memorize CRC value) 2) Editing of values in FS-Master Tool shall be blocked 3) Check identical TechParCRC display (decimal value) in FS-Master Tool (see 1)) 4) Compare parameter values in displays of Dedicated Tool and FS-Master Tool (parameter values shall match) 5) Compare FST_TechParCRC on FS-Master Tool with TechParCRC of Dedicated Tool (CRC values should differ due to parameter changes) 6) Check behavior of FS-Master system with connected SMTU
Test passed	All checks correct
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

14.6 DDO exchange

Table 209 defines the test conditions for this test case.

Table 209 – DDO exchange

TEST CASE ATTRIBUTES	IDENTIFICATION / REFERENCE
Identification (ID)	SDCI_FSTC_0195
Name	FSTCM_TOOL_DDOEXCHANGE
Purpose (short)	Device Data Objects (DDOs) can be exchanged between tools
Equipment under test (EUT)	FS-Master + Tool
Test case version	1.0
Category / type	FS-Master test, test-to-pass
Specification (clause)	[4]
Configuration / setup	–
TEST CASE	**CONDITIONS / PERFORMANCE**
Purpose (detailed)	Check whether Device Data Objects (DDOs) can be exchanged with the Master Tool
Precondition	–
Procedure	a) Import Test-DDO into FS_Master Tool b) Evaluation 1) c) Create a DDO in FS-Master Tool d) Import the DDO into FS-Master Tester or FS-Device Tester Tool. e) Evaluation 2)
Test parameter	Test-DDO
Post condition	–
TEST CASE RESULTS	**CHECK / REACTION**
Evaluation	1) Check whether FS-Master Tool display matches imported Test-DDO 2) Check whether display of Tester Tool matches exported DDO of FS-Master Tool
Test passed	All checks correct
Test failed (examples)	Any check incorrect
Report	Values OK: <yes/no> <ok | nok>

15 Environmental tests

15.1 General

Annex H in [2] defines the basic EMC tests for the SDCI communication part of an FS-Master/FS-Device system. Clause 5.4.2 in [2] specifies environmental conditions (e.g. electrical safety) especially for FS-Master with Port Class B.

It depends on the technology of an FS-Device and the countries of deployment, whether additional EMC tests or environmental tests are required to achieve for example a CE mark in Europe.

15.2 Product specific standards

Usually, the sector specific EMC standard IEC 61326-3-1 or the generic EMC standard 61000-6-7 are relevant for FS-Master.

For FS-Devices, there are several EMC standards, including but not limited to:

- Product standard IEC 61496-1 (Electro-sensitive protective equipment)
- Product standard IEC 60947-5-3 (Proximity switches)
- Sector standard IEC 61326-3-1 (Factory automation)
- Generic standard IEC 61000-6-7 (in case of no sector or product standard, such as in case of drives)

The following rule applies: Product standards shall be observed if available, otherwise sector standard or then generic standard.

15.3 EMC tests

EMC tests in respect of a particular phenomenon are defined in the IEC 61000-4-x series. Details for the respective test set-ups are described in Annex H.1.6 in [2] and in 4.4.

15.4 Test report templates

Tests are required for the following phenomena:

- Electrostatic discharge (ESD: IEC 61000-4-2)
- Electromagnetic field (HF: IEC 61000-4-3)
- Fast transients (Burst: IEC 61000-4-4)
- Surge protection (Surge: IEC 61000-4-5): optional, depending on deployment
- Conducted radio frequency (CRF: IEC 61000-4-6)

Usually, the test levels and durations exceed the values of NSR devices. A special performance criterion "DS" allows the devices to enter a Defined State at these extended "stress" tests, which is supposed to be safe in safety functions.

A passed EMC test is a precondition for a Manufacturer Declaration of Conformity. It shall comprise statements on the results of the above EMC tests. The forms in [9] may be used if they contain the appropriate information.

Annex A
(normative)

Test configurations, principles, and tools

Tolerances of test signal generators and measurement equipment shall be considered to assure that min- and max values are reached.

A.1 Measurement circuits / setups

A.1.1 Measurement circuits for static FS-Master parameter tests

Figure A.1 illustrates the measurement circuits for static FS-Master parameter tests in 5.2.

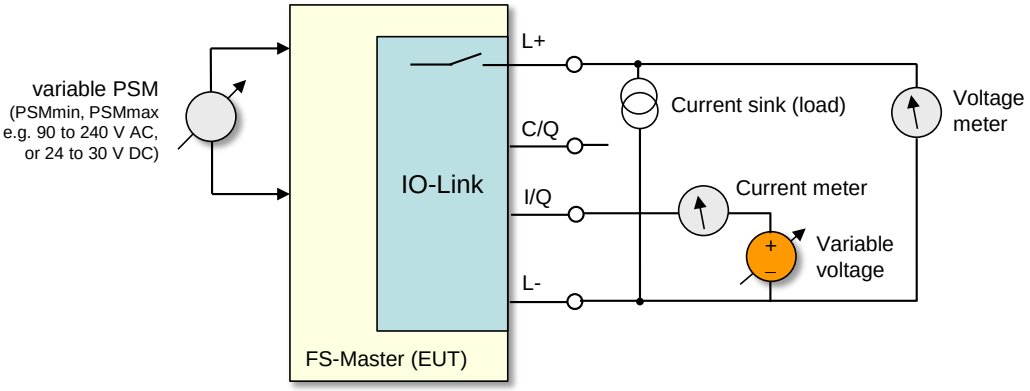


Figure A.1 – Measurement circuits for static FS-Master parameter tests

A.1.2 Measurement circuits for static FS-Device parameter tests

Figure A.2 illustrates the measurement circuits for static FS-Device parameter tests in 5.3. Method ① or ② can be applied.

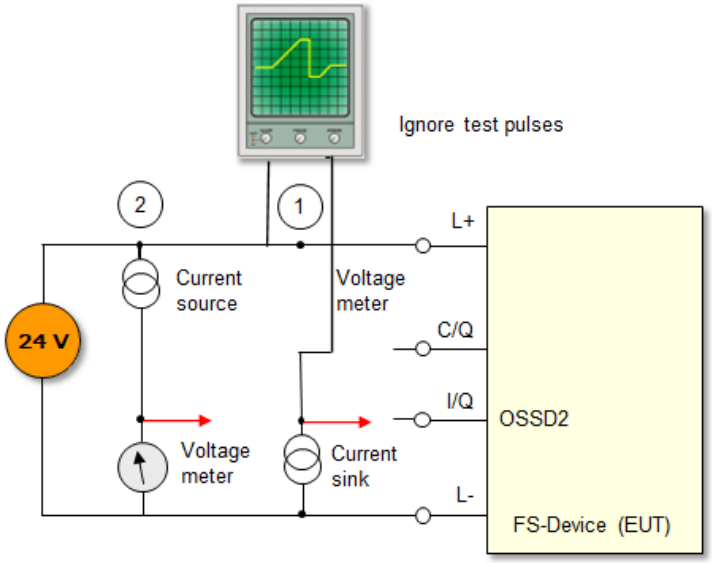


Figure A.2 – Measurement circuits for static FS-Device parameter tests

A.1.3 Measurement circuits for dynamic FS-Master parameter tests

Figure A.3 illustrates the measurement circuits for dynamic FS-Master parameter tests in 5.4

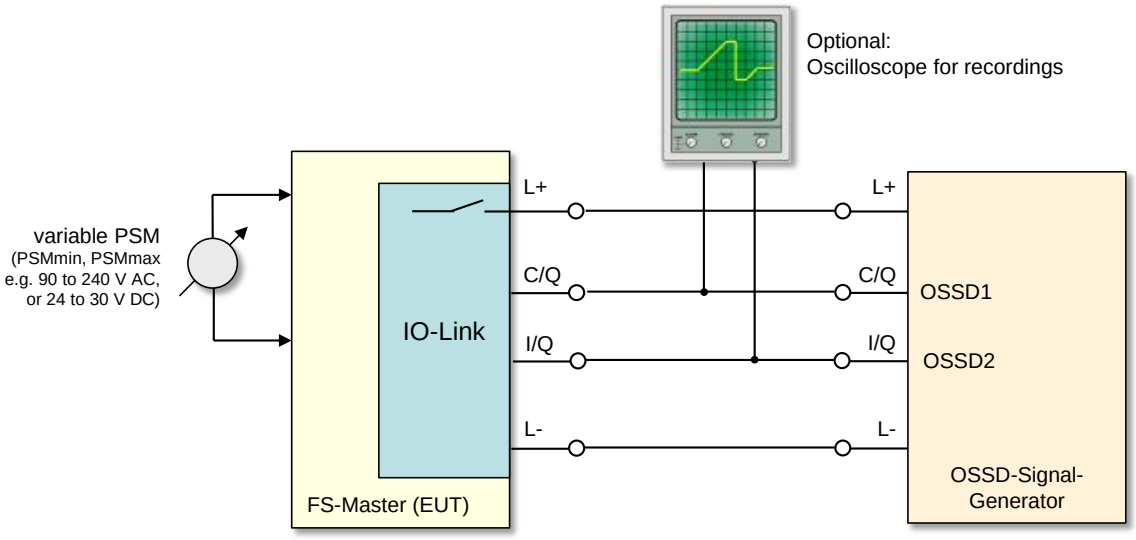


Figure A.3 – Measurement circuits for dynamic FS-Master parameter tests

A.1.4 Measurement circuits for dynamic FS-Device parameter tests

Figure A.4 illustrates the measurement circuits for dynamic FS-Device parameter tests in 5.5.

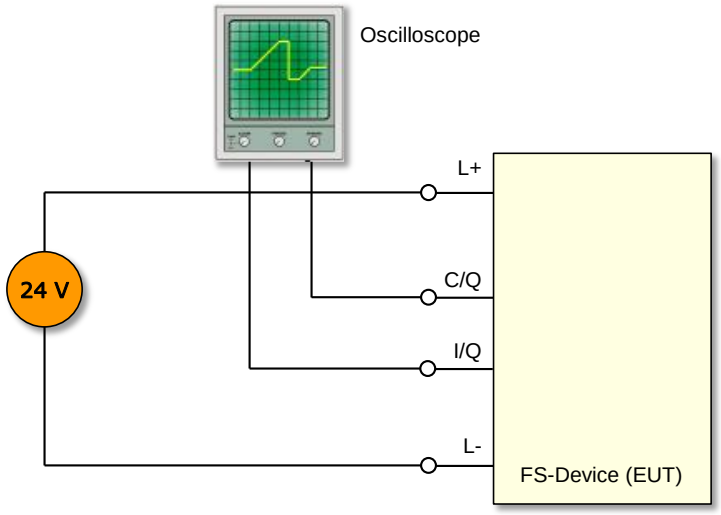


Figure A.4 – Measurement circuits for dynamic FS-Device parameter tests

A.2 Test tools

A.2.1 Overview

Seven tools have been identified supporting the performance of the test cases in this document:

- "OSSD Signal Generator", see A.2.2
- "Upper-Tester" (UT) for SCL protocol conformance testing, see A.2.3
- "FS-Master tester system" including the "Safety Master Tester Unit" (SMTU), see A.2.4
- "FS-Device tester" (FSDT), see A.2.5
- "IODD Checker Tool", see A.2.6
- Reference FS-Master/Tool and FS-Devices, see A.2.7
- "EMC-Test tool" (optional)

A.2.2 OSSD signal generator

Several test cases require complex correlated signal sequences on both OSSD channels, which cannot be stimulated by a reference off-the-shelf FS-Device. An OSSD signal generator, acting as a controllable FS-Device, which is connected to an FS-Master, can provide the required OSSD signals and the superimposed OSSD test pulses (see Figure A.3).

Figure A.5 shows an example of an OSSD signal sequence and its description.

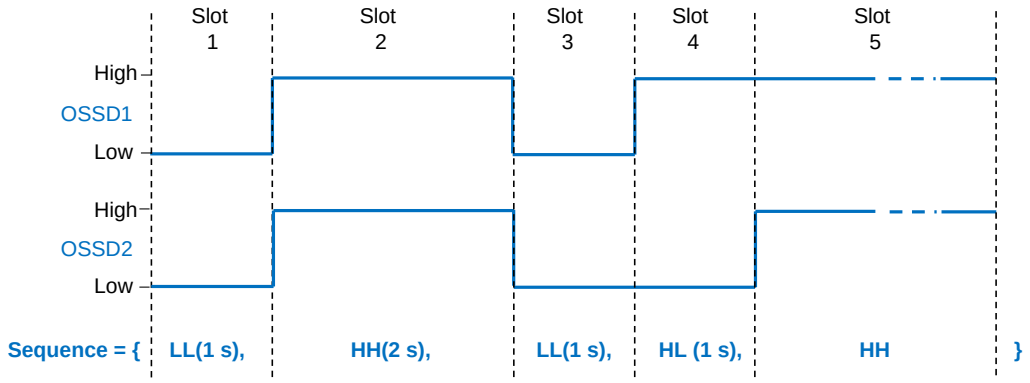


Figure A.5 – Example of an OSSD signal sequence description

The OSSD signal sequences are specified by the symbols "H" and "L", describing the OSSD signal levels during a time slot. Unless otherwise noted, the duration of a slot is longer than required for the detection of any possible signal combination.

The combined symbols for the description of OSSD sequences are defined in Table A.1.

Table A.1 – Description means for OSSD signal sequences

Combined symbol	OSSD1 level	OSSD2 level	Duration of time slot
HH(d)	High	High	d
HL(d)	High	Low	d
LH(d)	Low	High	d
LL(d)	Low	Low	d

Figure A.6 shows means to describe OSSD test pulses for the FS-Device output testing (see [4] 5.3.2.3). Parameters are "T" for period, "d" for duration of the test pulse, and "o" for the offset between test pulse train1 and train2.

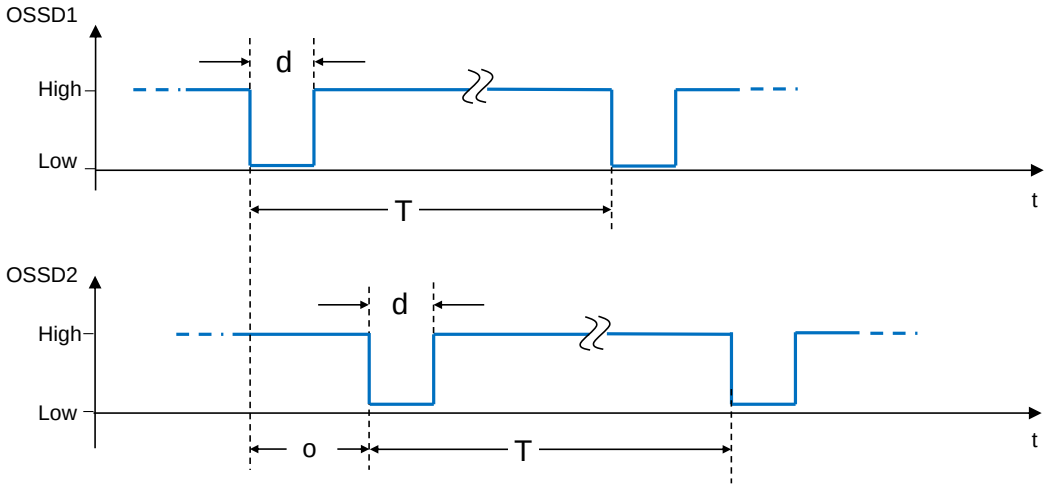


Figure A.6 – OSSD test pulses

The OSSD test pulses are specified by test pulse symbol pairs, like the OSSD signal sequence in curly brackets.

Table A.2 – Test pulse symbols

Test pulse symbol	Definition
p(T, d)	Train1 of low pulses with repetition period "T" and duration "d"
p(T, d, o)	Train2 of low pulses with repetition period "T", duration "d", and offset "o" to train1

A complete OSSD signal can be described by the combination of an OSSD signal sequence and a test pulse symbol pair. The test pulses are only affecting the OSSD signal when the signal shows a "high" level.

A.2.3 Principles of SCL protocol conformance testing

In case of IO-Link Safety, the conformance test is a black box test verifying the IUT (Implementation Under Test) against the specification [4] at defined PCO (Point of Control and Observation).

The IUT for IO-Link-Safety is the FS-Master state machine or the FS-Device state machine. It is embedded in the DUT (Device Under Test) and has the following interfaces:

- IO-Link communication interface (SPDU)
- IO-Link SCL interface to "Mapping" (FS-Master) or "Technology" (FS-Device)

In order to test the "Mapping/Technology" interface, a special "test application" would normally be required at the DUT. This "test application" is supposed to apply and check test patterns at the SCL interface inputs/outputs and thus requires control by the tester performing the test scripts.

For the sake of simplicity, IO-Link Safety uses the non-safety part of IO-Link messages as "test control channel" in order to remotely access the "test application" as shown in Figure A.7. In this case "the test application" is called "Upper Tester" (UT).

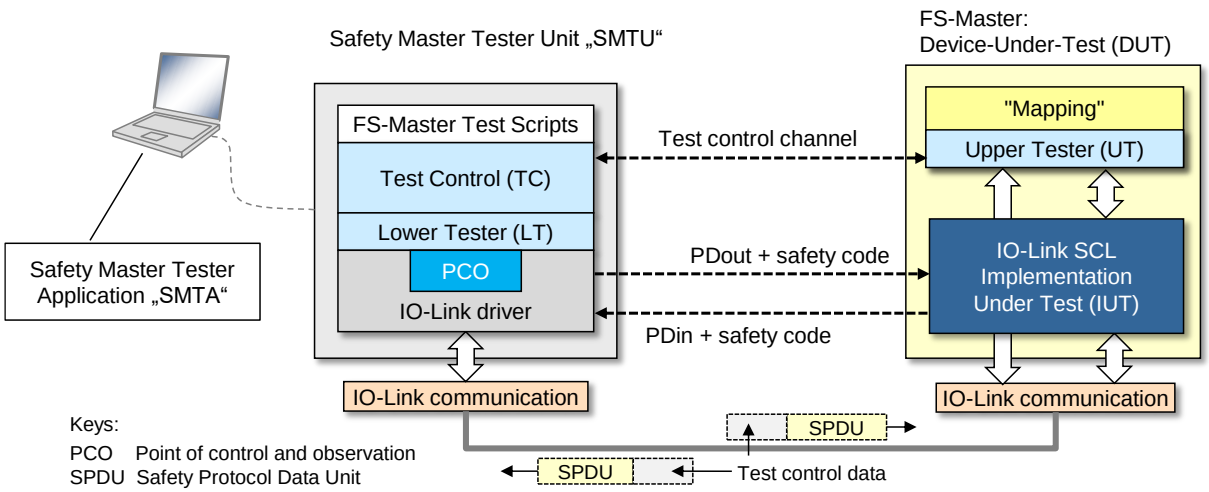


Figure A.7 – Principle of FS-Master SCL testing

The UT is embedded in the IO mapping part of the safety gateway to an FSCP as shown in Figure A.8. It is only active during testing and controlled by certain values of the FSP parameter "FSP_ProtMode" (see [4] Annex A.2.5). These values are not visible in the IODD of an FS-Device and cannot be set by an FS-Master Tool. Solely the FS-Master Tester system is enabled.

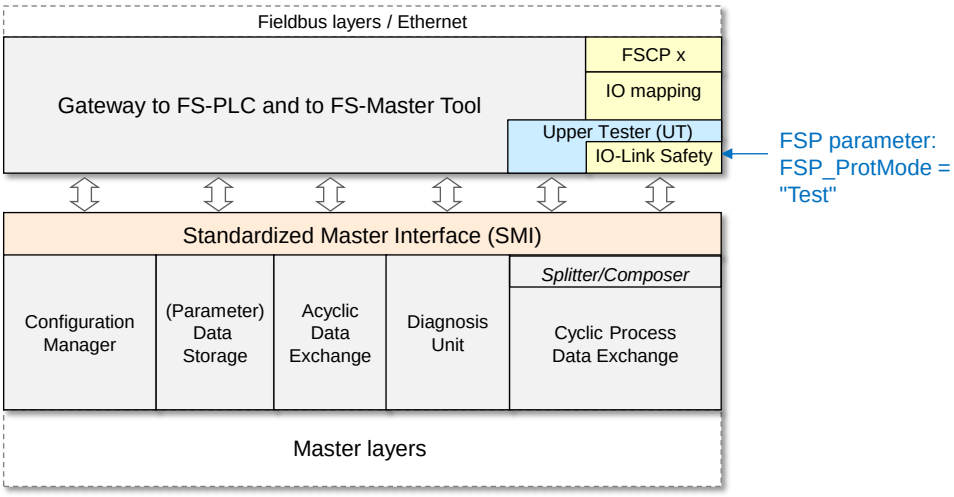


Figure A.8 – Remote Upper Tester (UT) as "test application"

This allows for a quite simple "test application" by just copying data between the safety and non-safety transmission parts as shown in detail in Figure A.9. Thus, the test patterns ("FS-Master Test Scripts") for the FS-Master set and check all safety process data and signals of the communication interface (SPDU) as well as all safety process data and signals of the "Mapping" interface.

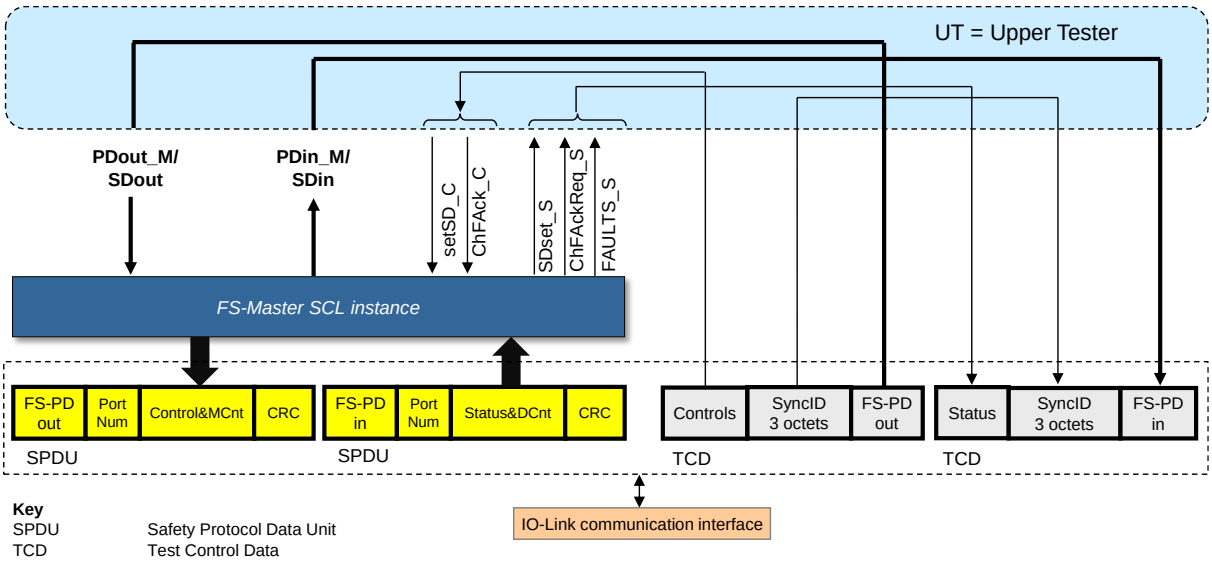


Figure A.9 – Upper Tester logic operations (copy)

Figure A.10 shows how synchronization check of data (test patterns) is achieved through an 8 bit counter (TestSyncCounter) within the "test control channel" in case of "FSP_ProtMode" = "Test1" (16 bit CRC) and "Test2" (32 bit CRC) (see Table 179).

The Octets for test message identifications "TestMessageIDhigh" and "TestMessageIDlow" shall be treated as "reserved".

ProtMode "Test1"

Octet0	Octet1	Octet2	Octet3	Octet4	Octet5
Process Data1 safe	Process Data2 safe	Port Number safe	Cntrl+Cnt/ Status+Cnt, safe	CRC 16-1 safe	CRC 16-2 safe
PDs1	PDs2	PNs	CSsafe	CRC1	CRC2

Octet6	Octet7	Octet8	Octet9	Octet10	Octet11
Cntrl+Cnt/ Status+Cnt, non-safe	TestSync Counter	Test Message IDhigh	Test Message IDlow	Process Data1 non-safe	Process Data2 non-safe
CSnon-safe	Sync	MessID1	MessID2	PDns1	PDns2

SyncID

ProtMode "Test 2"

Octet0	Octet1	Octet2	Octet3	Octet4	Octet5	Octet6	Octet7
Process Data1 safe	Process Data2 safe	Port Number safe	Cntrl+Cnt/ Status+Cnt, safe	CRC 32-1 safe	CRC 32-2 safe	CRC 32-3 safe	CRC 32-4 safe
PDs1	PDs2	PNs	CSsafe	CRC1	CRC2	CRC3	CRC4

Octet8	Octet9	Octet10	Octet11	Octet12	Octet13
Cntrl+Cnt/ Status+Cnt, non-safe	TestSync Counter	Test Message IDhigh	Test Message IDlow	Process Data1 non-safe	Process Data2 non-safe
CSnon-safe	Sync	MessID1	MessID2	PDns1	PDns2

SyncID

Figure A.10 – Data transfer in safety and test control channel

Details are defined for the actual FS-Master SCL protocol tester tool in A.2.4.

Many FS-Device DUTs have a fixed technology application and limited resources such that no test control channel and no remote Upper Tester can be established. Thus, a simplified FS-Device SCL testing has been chosen as shown Figure A.11. It results in the following restrictions for the test creation and performance.

The test scripts for the FS-Device set and check all safety process data and signals of the communication interface (SPDU). A static configuration with safety process data >0 and SDset_DS =0 is defined for the parameters of the "Fixed technology" interface. An FS-Device shall always provide valid process data values for the test.

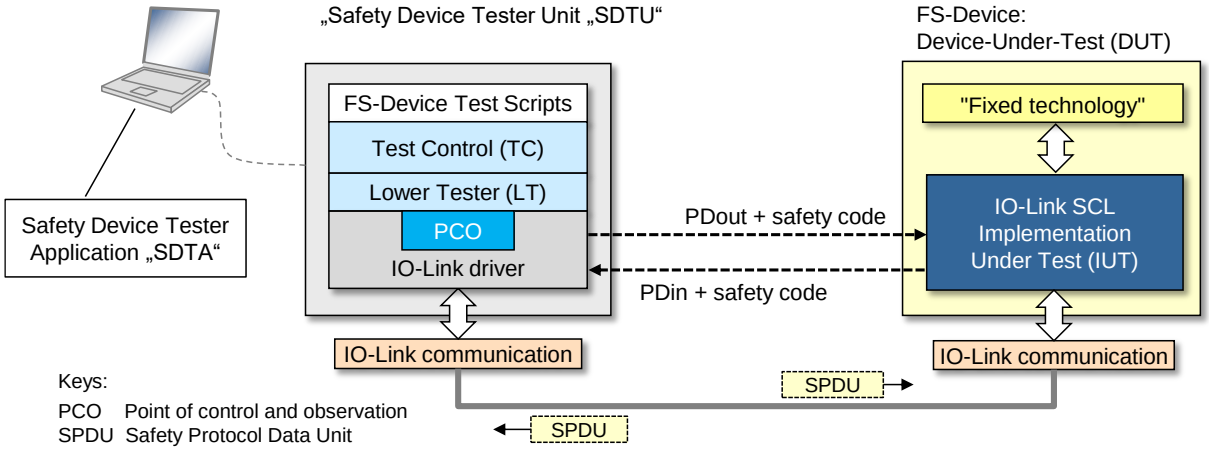


Figure A.11 – Principle of FS-Device SCL testing

A.2.4 FS-Master tester system

Figure A.12 shows the possible configurations for an FS-Master tester system including SCL testing. This configuration can be used for all test cases such as VerifyRecord, FS-Master/FS-Device configuration, and SCL protocol test scripts, but not for physical layer tests.

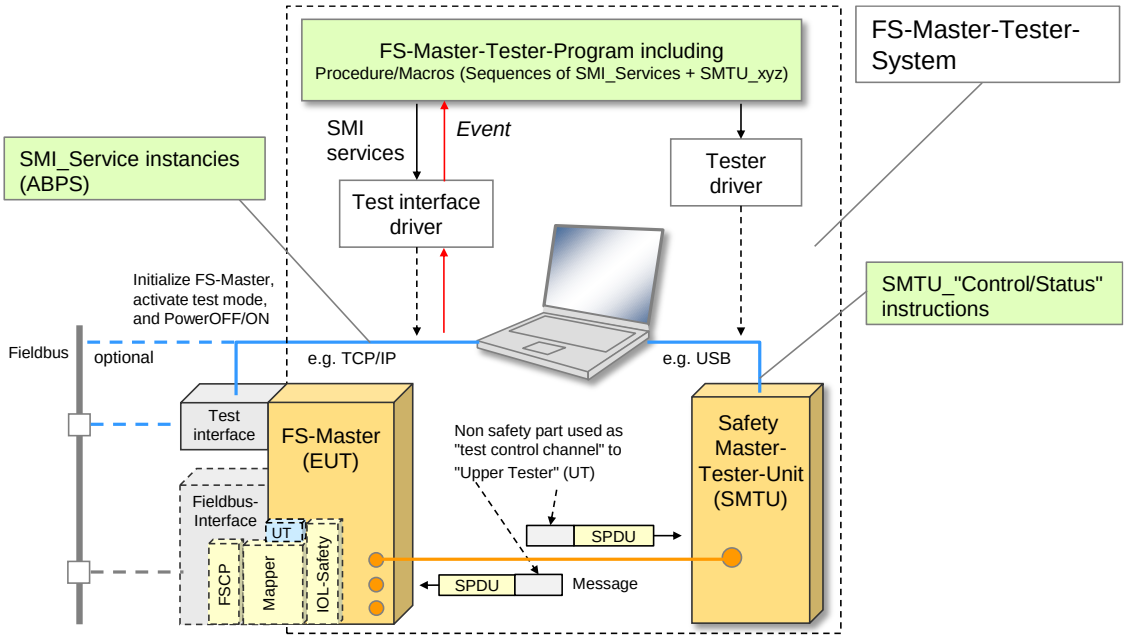


Figure A.12 – FS-Master tester system

Input for the FS-Master-Tester-Program are test scripts based on test cases in this document, mainly coded in XML and secured for possible audits by assessment bodies. Test results (verdict) shall be logged together with test scripts and versions of the FS-Master-Tester-Program for later reproduction. Thus, versioning of testers is required.

In order to drive the tests, the FS-Master-Tester-Program uses SMI services defined in [2] and specific SMI services defined in [4], as well as MTU instructions defined in [9] and SMTU instructions defined in A.4.7.

A.2.5 FS-Device tester (FSDT)

Figure A.13 shows the possible configurations for an FS-Device tester (FSDT). With the help of the IODD of the FS-Device, the test can be adjusted to the fixed IO data structures of the FS-Device.

Test results (verdict) shall be logged together with test scripts and versions of FS-Device Tester Software for later reproduction. Thus, versioning of testers is required.

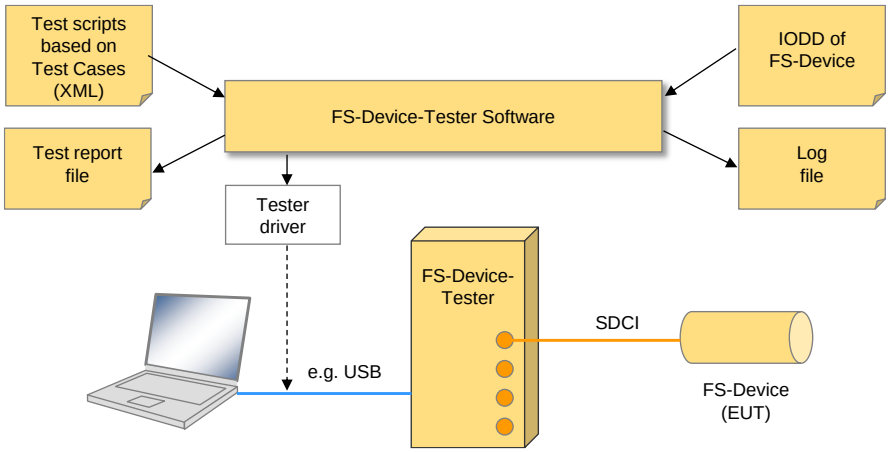


Figure A.13 – FS-Device SCL protocol tester

A.2.6 IODD Checker Tool

The existing Checker Tool for non-safety IODDs shall be augmented according to Clause 6.2.

A.2.7 Reference FS-Master/FS-Master Tool and FS-Devices

A number of test cases can only be performed in an economic manner by reference FS-Master/FS-Master Tool and FS-Devices. The IO-Link Community identifies such a reference based on suggestions of the IO-Link Safety working group. The working group can revise suggestions in case the reference does not meet specified requirements. After a start-up phase it is expected that at least 3 different reference FS-Devices are available.

A.2.8 Responsibility of test equipment manufacturers

A number of test cases are dealing with verification, configuration, and parameterization. Some of them can be performed automatically, some of them only manually. It is up to the manufacturers of test equipment whether they support all or some of these test cases in the particular test equipment. However, they are responsible for complete support of all test cases for either FS-Device or FS-Master including FS-Master Tool for the manufacturer declaration. For test cases not covered by the automated test equipment, manufacturers of test equipment shall provide instructions and auxiliary means, how the tests can be performed manually.

A.3 Assessment and audits of test equipment

There are no functional safety-related requirements on the hardware of the test equipment such as redundancy. However, tester software development shall observe the rules defined in IEC 61508 or ISO 13849 for T2 level.

Therefore, functional safety assessment by an accredited or recognized assessment body shall be performed for the equipment. The test scripts shall be "sealed" by CRC signature.

If competence or test centers are established by the IO-Link Community, audits by the IO-Link Community and an assessment body are required for personal and test equipment.

A.4 Components of FS-Master test cases

A.4.1 Overview

Figure A.14 provides an overview of the components of FS-Master test cases, comprising EUT- and SMTU-preconditions as well as safety test macros, ArgBlock parameter sets (ABPS) for SMI service instances, and SMTU instructions to control and monitor the SMTU.

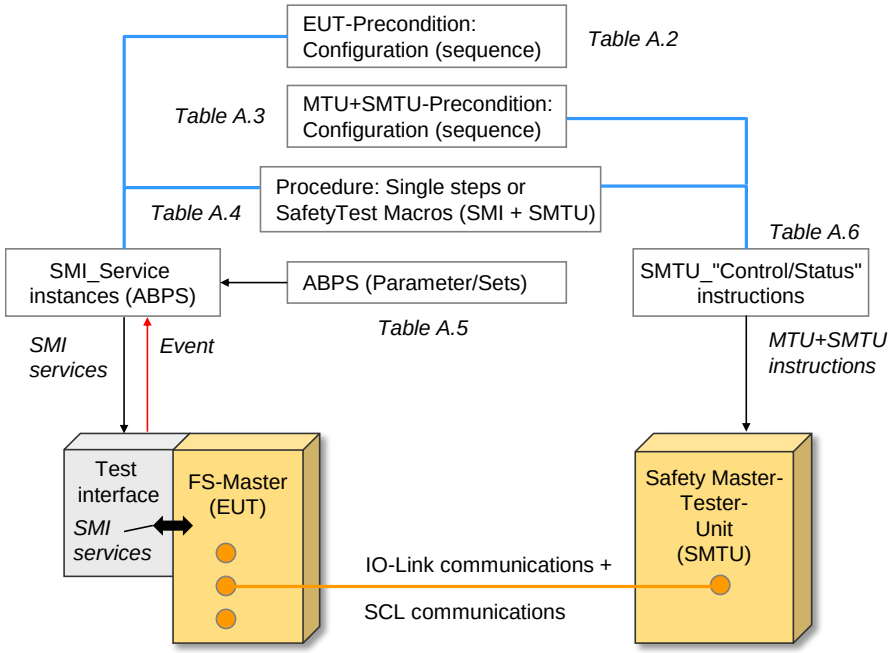


Figure A.14 – Components of FS-Master test cases

SMI service instances and MTU/SMTU instructions can be directly used to define test procedure steps. In certain cases, it is advantageous to use macros combining SMI service instances and

MTU/SMTU-Instructions. Flow control expressions such as "wait until", "repeat from", etc. can supplement these macros. They shall be named intuitively and shall be preceded by the prefix "STM_" for safety test macro.

A.4.2 EUT preconditions (FS-Master Port)

Table A.3 shows preconditions of the EUT in addition to the preconditions for NSR testing defined in [9]. They can represent a description of a state or a sequence of activities to reach a certain state of the EUT. Parameters are listed in Table A.7.

Table A.3 – Preconditions of the EUT

Identifier	Description of state or activities to reach state
PORT_OSSDe	Port is in OSSDe Mode *;SMI_FSPortConfiguration*
PORT_FSCOM	Port is in SAFETYCOM Mode *;pure FS-PD exchange*
PORT_MIXFSCOM	Port is in MIXEDSAFETYCOM Mode *;FS-PD and PD exchange*
PORT_POWER_OFF	Port Power L+ switched off *;SMI_PortPowerOffOn*
PORT_FSP_PARAMETERS	FSP-Parameters are stored in FS-Master for VerifyRecord *;SMI_FSPortConfiguration*

A.4.3 SMTU preconditions

Table A.4 shows macros of preconditions of the SMTU playing the role of a controllable and observable FS-Device. They describe values (instances) of parameters of a state or a sequence of activities to reach a certain state of the SMTU.

Table A.4 – Preconditions of the SMTU

Identifier	Description of state or activity to reach state
SMTU_STANDARD_STATE_16	Change/expand the MTU_STANDARD_STATE in [9] to: DPP1(M-sequenceCapability) = 0x1F *;PREOPERATE = TYPE1_2,* *;OPERATE = TYPE_2_V* *;ISDU supported* DPP1(ProcessDataIn) = 0x8A *;PDIn = 88 bit* DPP1(ProcessDataOut) = 0x8A *;PDOut = 88 bit* DPP1(DeviceID) = 0x002BD3 NOTE 1 *;DID = 11219* DPP1(MinCycleTime)=*0x56* *;15.2 ms* Mandatory Indices: Index 0x0012 (ProductName) = "SMTU" *;UTF8 coding* Index 0x4200 (Authenticity record): FSCP_Authencity = xxx(non-zero) NOTE 4 *;"Armed"* FSP_Port = yyy (non-zero) NOTE 4 *;valid Port Number* FSP_AuthentCRC = CRC-16 *;valid signature for Authenticity* Index 0x4201 (Protocol record): FSP_ProtVersion = 0x01 *;current protocol version* FSP_ProtMode = 0x01 *;3 octets FS-PD maximum* FSP_Watchdog = yyy NOTE 2 *;reasonable time value!* FSP_IO_StructCRC = CRC-16 *;valid signature for IO_Struct* FSP_TechParCRC = CRC-32 *;valid signature for no FST-Param.* FSP_PortParCRC = CRC-16 *;valid signature for Protocol record* FSP-MinShutdownTime = 100 *;1 second* FSP_TimeToReady = 500 *;5 seconds* Index 0x4212 (FSP_ParamDescCRC) = CRC-32 *;from IODD*
SMTU_STANDARD_STATE_32	Same as SMTU_STANDARD_STATE_16, except for: DPP1(ProcessDataIn) = 0x9F *;PDIn = 32 octets* DPP1(ProcessDataOut) = 0x9F *;PDOut = 32 octets* DPP1(MinCycleTime) = 0x6F; *;25.2 ms* Mandatory Indices: Index 0x4201 (Protocol record): FSP_ProtMode = 0x02 *;25 octets FS-PD maximum*
NOTE 1 Only this ID can be overwritten by FS-Master for compatibility tests (see clause 8.5 in [9]). It differs from the ID value in [9].	

Identifier	Description of state or activity to reach state
NOTE 2 A reasonable value should be chosen allowing watchdog tests without long test durations (<< 1 min) NOTE 3 The SMTU shall issue Events within 1 second after its occurrence. NOTE 4 To be preconfigured based on the Authentication of the FS-Master and the target Port.	

6001

6002 ### A.4.4 SafetyTestMacros (STM) of the FS-Master-Tester-Program

6003 Table A.5 shows SafetyTestMacros of the Safety-Master-Tester-Program for both EUT (FS-
6004 Master) and SMTU. All STMs shall return after ≤ 30 s (default Test_Timeout).

6005 **Table A.5 – SafetyTestMacros of the FS-Master-Tester-Program**

STM identifier	Variable	Test Service Action to enter mode	Comment
STM_SCL_START16	–	Set FS-Master to SCL state "wait on SPDU" and set SMTU to SCL state "not ready"	–
STM_SCL_START32	–	Set FS-Master to SCL state "wait on SPDU" and set SMTU to SCL state "not ready"	–
STM_WAIT_TIMEOUT	–	Wait for FSP_Watchdog timeout	–
STM_WAIT	Timeout	FS Master Tester pauses for the indicated duration	in ms

6006

6007 ### A.4.5 SMI Event handling

6008 The Safety-Master-Tester-Program uses the mechanisms as specified in Annex A.4.5 in [9].

6009 ### A.4.6 SMI ArgBlock parameter sets (ABPS)

6010 The ArgBlock parameter sets (ABPS) defined in Annex A.4.6 in [9] are supplemented for safety.
6011 The same rules apply.

6012 **Table A.6 – ArgBlock Parameter Sets (ABPS) for safety**

ABPS	ArgBlock	Element	Type	Value
ABPS_FSCONFIG_ MIXEDCOM	FSPortConfigList	ArgBlockID	Unsigned16	0x8001
		PortMode	Unsigned8	50 (MIXSAFETYCOM)
		Validation&Backup	Unsigned8	3 ("V1.1", B+R)
		I/Q Behavior	Unsigned8	0 (not supported)
		PortCycleTime	Unsigned8	0 (AFAP)
		VendorID	Unsigned16	0xFDE8
		DeviceID	Unsigned32	0x002BD3 (different)
		InputDataLength	Unsigned8	31 (total)
		OutputDataLength	Unsigned8	31 (total)
		FSCP_Authenticity1	Unsigned32	1
		FSCP_Authenticity2	Unsigned32	1
		FSP_Port	Unsigned8	1 (default)
		FSP_AuthentCRC	Unsigned16	64191 (0xFABF)
		FSP_ProtVersion	Unsigned8	0x01
		FSP_ProtMode	Unsigned8	0xF9 (32 bit CRC) ("upper tester")
		FSP_WatchdogTime	Unsigned16	1000 ms (0x03E8)
		FSP_IO_StructCRC	Unsigned16	39137 (0x98E1)

ABPS	ArgBlock	Element	Type	Value
		FSP_TechParCRC	Unsigned32	1 (0x00000001)
		FSP_ProtParCRC	Unsigned16	62167 (0xF2D7)
		IO_DescVersion	Unsigned8	1 (Version 1)
		SPDUInLength	Unsigned8	8
		TotalOfInBits	Unsigned8	0
		TotalOfInOctets	Unsigned8	0
		TotalOfInInt16	Unsigned8	1
		TotalOfInInt32	Unsigned8	0
		SPDUOutLength	Unsigned8	8
		TotalOfOutBits	Unsigned8	0
		TotalOfOutOctets	Unsigned8	0
		TotalOfOutInt16	Unsigned8	1
		TotalOfOutInt32	Unsigned8	0
		FSP-MinShutdownTime	Unsigned16	100 (Unit 10 ms)
		FSP_TimeToReady	Unsigned16	500 (Unit 10 ms)
ABPS_FSCONFIG_OSSDE	FSPortConfigList	ArgBlockID	Unsigned16	0x8100
		PortMode	Unsigned8	51 (OSSDE)
		…	…	Don't care (≠ 0)
		SPDUInLength	Unsigned8	1 octet (fixed)
		…	…	Don't care (≠ 0)
		FSP-MinShutdownTime	Unsigned16	100 (Unit 10 ms)
		FSP_TimeToReady	Unsigned16	500 (Unit 10 ms)
ABPS_FSCONFIG_SAFECOM	FSPortConfigList	ArgBlockID	Unsigned16	0x8100
		PortMode	Unsigned8	49 (SAFETYCOM)
		Validation&Backup	Unsigned8	3 ("V1.1", B+R)
		I/Q Behavior	Unsigned 8	0 (not supported)
		PortCycleTime	Unsigned8	0 (AFAP)
		VendorID	Unsigned16	0xFDE8
		DeviceID	Unsigned32	0x002BD3 (different)
		InputDataLength	Unsigned8	31 (total)
		OutputDataLength	Unsigned8	31 (total)
		FSCP_Authenticity1	Unsigned32	1
		FSCP_Authenticity2	Unsigned32	1
		FSP_Port	Unsigned8	1 (default)
		FSP_AuthentCRC	Unsigned16	64191 (0xFABF)
		FSP_ProtVersion	Unsigned8	0x01
		FSP_ProtMode	Unsigned8	0xF9 (32 bit CRC) ("upper tester")
		FSP_WatchdogTime	Unsigned16	1000 ms (0x03E8)
		FSP_IO_StructCRC	Unsigned16	39137 (0x98E1)
		FSP_TechParCRC	Unsigned32	1 (0x00000001)
		FSP_ProtParCRC	Unsigned16	62167 (0xF2D7)

ABPS	ArgBlock	Element	Type	Value
		IO_DescVersion	Unsigned8	1 (Version 1)
		SPDUInLength	Unsigned8	8
		TotalOfInBits	Unsigned8	0
		TotalOfInOctets	Unsigned8	0
		TotalOfInInt16	Unsigned8	1
		TotalOfInInt32	Unsigned8	0
		SPDUOutLength	Unsigned8	8
		TotalOfOutBits	Unsigned8	0
		TotalOfOutOctets	Unsigned8	0
		TotalOfOutInt16	Unsigned8	1
		TotalOfOutInt32	Unsigned8	0
		FSP-MinShutdownTime	Unsigned16	100 (Unit 10 ms)
		FSP_TimeToReady	Unsigned16	500 (Unit 10 ms)
ABPS_PDOUT6	PDOUT	ArgBlockID	Unsigned16	0x1002
	OE		Unsigned8	1
	OutputDataLength		Unsigned8	6
	PDO0		Unsigned8	11
	PDO1		Unsigned8	22
	PDO2		Unsigned8	33
	PDO3		Unsigned8	44
	PDO4		Unsigned8	55
	PDO5		Unsigned8	66
ABPS_PDOUT32	PDOut	ArgBlockID	Unsigned16	0x1002
		OE	Unsigned8	1
		OutputDataLength	Unsigned8	32
		PDOut [i=0…31]	Unsigned8	3*(i+1)
ABPS_PORT_OFF	PortPowerOffOn	ArgBlockID	Unsigned16	0x7003
		PortPowerMode	Unsigned8	1 (OFF permanent)
		PortPowerOffTime	Unsigned16	0
ABPS_PORT_ON	PortPowerOffOn	ArgBlockID	Unsigned16	0x7003
		PortPowerMode	Unsigned8	2 (ON permanent)
		PortPowerOffTime	Unsigned16	0
ABPS_POWER_CYCLE	PortPowerOffOn	ArgBlockID	Unsigned16	0x7003
		PortPowerMode	Unsigned8	0 (OFF-ON cycle)
		PortPowerOffTime	Unsigned16	0x01F4 (~ 1 s)

A.4.7 SMTU instructions

Instructions of the Master-Tester-Program for the MTU specified in Annex A.4.7 in [9] are supplemented for safety. Table A.7 shows (fixed) instructions of the Safety-Master-Tester-Program for the SMTU (Safety-Master-Tester-Unit). Every SMTU instruction returns the specified parameters defined in "Return value".

6019 **Table A.7 – SMTU instructions**

Name	Parameter	Return value	Definition
SMTU_Authent_Set	Authent1, Authent2, Port, CRC	–	Set deviating values
SMTU_PowerState_Get	–	1= Power On 0= Power Off	Returns current state of L+ power
SMTU_PowerOffTime_Start	–	–	Starts measurement of the PowerOffOn time
SMTU_PowerOffTime_Get	–	PowerOffTime	Returns measured PowerOffTime in ms after a PowerOffOn cycle
SMTU_Delay_SPDU	delay in ms	M_COUNT	SMTU to check Watchdog timeout 1) Keep SPDUIN DCount un-changed for delay if MCount gets 1 2) update DCount with first cycle after delay 3) Return when M_Count changes or 2.2*FSP_Watchdog after MCount got 1
SMTU_MixData_Get	–	SR, NSR, OE	Readback mixed Process Data from SMTU
SMTU_NSR_Set	NSR, PQI	–	Sets NSR Process Data in SMTU
SMTU_Pause	Pause time in seconds	–	SMTU does not respond during pause
SMTU_Ready_Wait	t2R, tRP	–	Start-up of FS-Device
SMTU_SPDU_Repetition	Time in seconds	–	Artificially repeat SPDU
SMTU_SPDU_Change	–	–	SMTU to wait until SPDU changed. Usually this is an MCount or DCount value.
SMTU_VerifyRecord_Get	–	VerifyRecord	Returns entire VerifyRecord

6020

6021 ### A.4.8 Fictive IODD for SMTU

6022 The FS-Master tester system provides a fictive IODD for the SMTU.

Annex B
(normative)

Assessment and certification

B.1 General

In case of safety for machinery, a manufacturer declaration is only sufficient for a product to be launched, if the manufacturer fulfils certain preconditions. Otherwise, functional safety assessments by assessment bodies are required based on international standards such as IEC 61508, IEC 62061, or ISO 13849. There are three types of assessment objects in IO-Link Safety:

- Specification (see [4]),
- SCL-stacks and software tools,
- Functional safety products such as FS-Device and FS-Master including Master-Tools.

The actual assessment of IO-Link Safety can only comprise a concept approval of the specification ([4]) and companion documents as a precondition for the conformity of implementations (see B.4).

Since it is possible to implement the safety communication layers (SCL) of IO-Link Safety in a completely hardware-independent manner, manufacturers can save quite some effort and time if pre-certified SCL-stacks and software tools are available on the market. Preconditions are described in B.5.2.

Procedures and constraints for functional safety products are described in detail in B.5.

B.2 Safety policy

In order to prevent and protect the manufacturers and vendors of FS-Masters and FS-Devices from possibly misleading understandings or wrong expectations and negligence actions regarding safety-related developments and applications the following shall be observed and explained in each training, seminar, workshop and consultancy.

- Any non-safety-related device automatically will not be applicable for safety-related applications just by using fieldbus or IO-Link communication and a safety communication layer. The safety technology part of a safety device shall be approved for a Safety Integrity Level (SIL) or Performance Level (PL) suitable for the intended safety functions. The IO-Link Safety part shall be implemented and approved for the same SIL/PL or better.
- In order to enable a product for safety-related applications, appropriate development processes according to safety standards shall be observed (see IEC 61508, IEC 62061, ISO 13849) and an assessment from a competent assessment body or authorized manufacturer department shall be achieved.
- The manufacturer/vendor of a safety product is responsible for the correct implementation of the safety communication layer technology, the correctness and completeness of the product documentation and information.
- Supplemental safety-related information to the regular specification in [4] shall be observed for implementation, test and assessment if applicable. Normally, this information is provided by the working group as response to a change request (CR) within the CR-database that is in state "implementation" and approved by an assessment body. The working group can decide to publish these CRs through a separate "Corrigendum" document for download on the IO-Link website.

B.3 Obligations for international business

As a rule, the international safety standards are accepted (ratified) globally. However, since safety technology in automation is relevant to occupational safety and the concomitant insurance risks in a country, recognition of the rules pointed out here is still a sovereign right. The national "Authorities" decide on the recognition of assessment reports. The observation of additional national regulations may be required.

B.4 Concept approval of IO-Link Safety

For the approval of the safety concepts of IO-Link Safety the following has been provided by the community:

- Specification of IO-Link Safety ([4])
- Documentation of the modelling, the model checking, and the simulation including fault injection of the IO-Link safety communication layer (SCL)
- Document "Safety considerations" with Functional Safety Management, calculation of relevant Residual Error Rates, and software tool chain FMEA
- Document "Document Management and Working Group rules"

B.5 Product assessment and certification

B.5.1 Overview

Products within the domain of IO-Link Safety can be pre-certified software stacks or safety devices.

B.5.2 Pre-certified software stacks

Software shall be valid for the architecture required by the certain SIL or PL, for example redundancy in case of SIL3 or PLe. The requirements for compliant items according to IEC 61508-3 shall be observed for the assessment of a pre-certified SCL-stack.

Software shall be "sealed" to protect it from unintended changes. The user is only permitted to adapt the interfaces and keep the core part of the software untouched in order to keep the certificate.

B.5.3 Certified FS-Devices and FS-Masters

Figure B.1 below illustrates the assessment procedures of FS-Device and FS-Master.

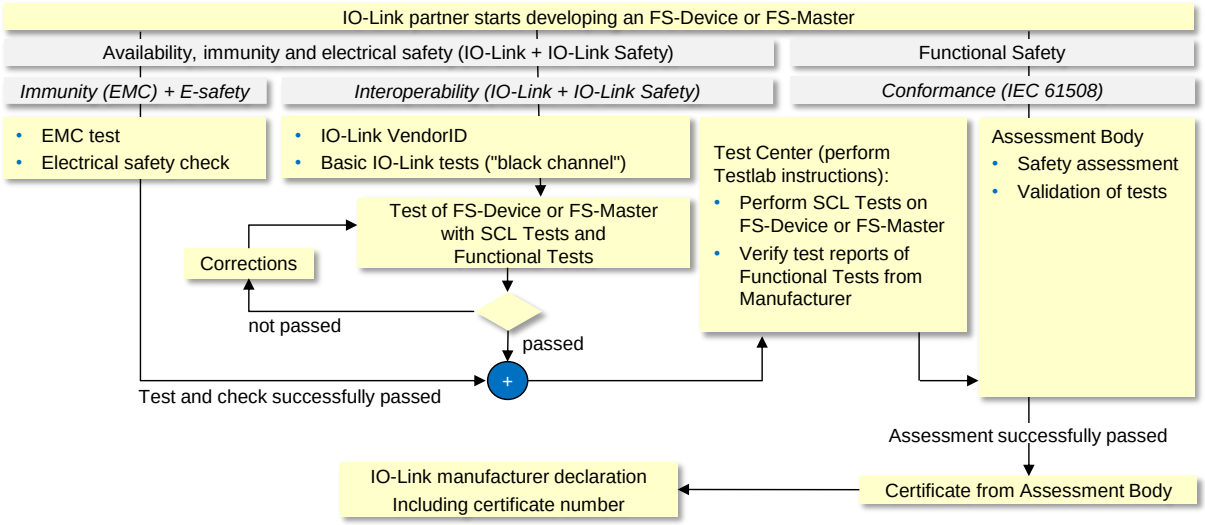


Figure B.1 – Assessment of FS-Device and FS-Master

Test, assessment, and certification of FS-Devices and FS-Masters comprise three aspects:

- Conformity with regulations, for example European Directives such as Electromagnetic Compatibility (EMC – IEC 61000-6-7) and Low Voltage Directive (electrical safety – IEC 61010-2-201) with possibly deviating issues depending on the standards to be considered (generic, domain, or product),

- IO-Link Interoperability, that means conformity of the FS-Device with the IO-Link specifications: The IO-Link community arranged for Functional Tests (test tool suite) based on this document and supported by Technology Providers,
- Conformance of functional safety development process with IEC 61508 (due to software/firmware involvement).

NOTE Usually, from a fieldbus/FSCP point-of-view, the FS-Master is a fieldbus device and shall be developed, tested, and assessed according to the interoperability/conformity rules of the individual fieldbus/FSCP. The result is a certificate of the fieldbus organization.

B.5.4 Usage of Functional Tests and SCL Tests

In Figure B.1 Functional Tests and SCL Tests are mentioned. The Test Systems for FS-Device and FS-Master may implement both kinds of tests, however separated from each other in order and under different conditions.

SCL Tests are safety-related and thus safety assessed and certified. The SCL Tests shall be embedded in the tester software without changing the semantics of the SCL test scripts. The corresponding tests check whether the protocol software of an FS-Device or FS-Master is performed as specified in [4]. General requirements for test tools are given in A.3. With respect to the SCL Tests, the test tools shall in particular fulfil the following requirements:

- Testlab Instructions, created by the IO-Link Community, describing the behavior and handling of the test tools and their constraints as well as a configuration management.
- Prove that each and every test case of the SCL Tests has been performed in accordance with the SCL test scripts.
- Prove that each deviation of the FS-Master or FS-Device responses from the expected responses as given by the SCL test scripts is detected by the test system.
- SCL Tests are fixed, versioned and "locked/sealed" by signature (e.g. CRC) and must not be changed during an update of the test system.

Functional Tests can be variable to a certain extent and be adjusted to customer requirements. The corresponding test cases are specified in this document. An update of the Functional Tests and the corresponding test system is possible without safety assessment as long as the SCL Tests keep untouched.

While developers can perform tests during development to ensure a high degree of conformity/interoperability with IO-Link and IO-Link Safety, this is not enough for functional safety. Additional requirements are given below.

Four parties are involved in the procedure of test and assessment:

- The manufacturer of an IO-Link product, responsible for performing conformance tests with test tools (Functional Tests),
- The FS-Test-Center, responsible for verification and approval of tests. FS-Test-Centers are accredited by the IO-Link Community and audited periodically. They are performing tests and checks according to "Test Lab Instructions" approved by the IO-Link Community.
- The Assessment Body, verifying and validating the product and its development.
- The IO-Link business office, managing the manufacturer declarations of conformity.

The procedure of test and assessment consists of the following steps:

1) Manufacturer performs basic IO-Link Tests (“Black Channel”) during and at the end of development, based on IO-Link Test specification, V1.1.3. if applicable for FS-Masters or FS-Devices.
2) Manufacturer performs additional safety tests (“FS-Device or FS-Master”) as well as some “Black Channel” extensions such as Ready Pulse, VerifyRecord, etc., during and at the end of development, based on IO-Link Safety Test & Assessment specification, V1.1.
3) Manufacturer cares for Physical Layer testing, EMC-testing according to the IO-Link V1.1.3 specification and an electrical safety check before handing over to the FS-Test Center, to protect its personnel.
4) Manufacturer contracts an FS-Test-Center and hands over the FS-Device or FS-Master including Device Tools, IODD, Engineering, etc., together with the test reports.
5) FS-Test-Center verifies test reports of Functional Tests and performs SCL Tests.
6) FS-Test Center returns an “FS-Test Report” based on the results of its verification work to the Manufacturer.
7) Manufacturer provides this “FS Test Report” to the Assessment Body as prerequisite for the assessment procedure.
8) The Assessment Body checks additional safety related parameters like additional safety related EMC-Tests, electrical safety checks etc., required for the safety certificate that is handed over to the Manufacturer.
9) Finally, the Manufacturer completes the manufacturer's declaration referencing the safety certificate based on a standardized template which might be forwarded to the IO-Link Business Office to be published in the approved component list (ACL).

B.6 Grandfathering rules

In future releases of this document, grandfathering rules will be necessary once the "black channel", i.e. the IO-Link layer stack is changed in an FS-Master or in an FS-Device.

Same is true for SCL stack changes in an FS-Master or in an FS-Device.

Annex C
(informative)

Information on testing of FS-Devices and FS-Master/Tools

Information about test laboratories, which test and validate the conformity of IO-Link Safety products such as FS-Masters and FS-Devices with IO-Link specifications can be obtained from the following organization:

IO-Link Community
c/o PROFIBUS Nutzerorganisation e.V.
Haid-und-Neu-Str. 7
76131 Karlsruhe
GERMANY
Phone: +49 721 9658 590
Fax: +49 721 9658 589
E-Mail: info@io-link.com
URL: www.io-link.com

Annex D
(normative)

Manufacturer declaration for safety devices

A dedicated manufacturer declaration for FS-Devices and FS-Masters can be downloaded from the download area in www.io-link.com.

Annex E
(informative)
Listing of FS test cases

E.1 Listing of FS test cases sorted by IDs

Table E.1 shows the Test cases and its references.

Table E.1 – FS test cases sorted by IDs

FSTC ID	FSTC Name	Reference
FSTC_0001	FSTCM_PHYL_PWR1_SWITCHABLE	Table 12
FSTC_0002	FSTCM_PHYL_OSSD_HIGHVIMIQ	Table 13
FSTC_0003	FSTCM_PHYL_OSSD_LOWVIMIQ	Table 14
FSTC_0004	FSTCM_PHYL_OSSD_VHYSMCI	Table 15
FSTC_0005	FSTCM_PHYL_OSSD_LOADIQ	Table 16
FSTC_0006	FSTCD_PHYL_OSSD_HSRESVOLT	Table 17
FSTC_0007	FSTCD_PHYL_OSSD_LSRESVOLT	Table 18
FSTC_0008	FSTCM_PHYL_INTF_OSSDSENS	Table 19
FSTC_0009	FSTCM_PHYL_INTF_DISCREPANCY	Table 20
FSTC_0010	FSTCM_PHYL_INTF_TESTPULSERES	Table 21
FSTC_0011	FSTCM_PHYL_INTF_READYDETECT	Table 22
FSTC_0012	FSTCM_PHYL_INTF_WAKEUPTOREADYDELAY	Table 23
FSTC_0013	FSTCD_PHYL_OSSD_DISCREP	Table 24
FSTC_0014	FSTCD_PHYL_INTF_TESTPULSPERIOD	Removed
FSTC_0015	FSTCD_PHYL_INTF_TESTPULSDURATION	Table 25
FSTC_0016	FSTCD_PHYL_INTF_READYPULSDUR	Table 26
FSTC_0017	FSTCD_PHYL_INTF_READY2OSSD	Table 27
FSTC_0018	FSTCI_IODD_FSPD_IODDPARAMDESCCRC	Table 29
FSTC_0019	FSTCI_IODD_FSPD_DEDICTOOL	Table 30
FSTC_0020	FSTCD_CONF_INFO_DOCUMENTS	Table 31
FSTC_0021	FSTCD_CONF_INFO_CONNECTCABLE	Table 32
FSTC_0022	FSTCD_CONF_INFO_DEFAULTBEHAVIOR	Table 33
FSTC_0023	FSTCD_CONF_FSPD_PORTINVAL	Table 34
FSTC_0024	FSTCD_CONF_FSPD_AUTHENTCRCINVAL	Table 35
FSTC_0025	FSTCD_CONF_FSPD_PROTVINVAL	Table 36
FSTC_0026	FSTCD_CONF_FSPD_PMODEINVAL	Table 37
FSTC_0027	FSTCD_CONF_FSPD_WDOGRANGE	Table 38
FSTC_0028	FSTCD_CONF_FSPD_PRCRCINVAL	Table 39
FSTC_0029	FSTCD_CONF_DEFAULTFST	Table 40
FSTC_0030	FSTCD_CONF_IODDFSTPAR	Table 41
FSTC_0031	FSTCD_CONF_CRCDEDTOOL	Table 42
FSTC_0032	FSTCD_CONF_SWTOOSSD	Table 43
FSTC_0033	FSTCD_CONF_SETUPCOMMI	Table 44
FSTC_0034	FSTCD_CONF_SETUPARMED	Table 45
FSTC_0035	FSTCD_PARM_VRFY_ARMED	Table 46
FSTC_0036	FSTCD_PARM_VRFY_COMMISTEST	Table 47

FSTC_0037	FSTCD_PARM_VRFY_ARMEDNOVFY	Table 48
FSTC_0038	FSTCD_PARM_VRFY_TESTNOVFY	Table 49
FSTC_0039	FSTCD_PARM_VRFY_TECHPARN0	Table 50
FSTC_0040	FSTCD_PARM_VRFY_TECHPAR0	Table 51
FSTC_0041	FSTCD_PARM_VRFY_AUTH1WRONG	Table 52
FSTC_0042	FSTCD_PARM_VRFY_AUTH2WRONG	Table 53
FSTC_0043	FSTCD_PARM_VRFY_PORTWRONG	Table 54
FSTC_0044	FSTCD_PARM_VRFY_AUTHCRCWRG	Table 55
FSTC_0045	FSTCD_PARM_VRFY_PPARCRCWRG	Table 56
FSTC_0046	FSTCD_PARM_VRFY_TPARCRCWRG	Table 57
FSTC_0047	FSTCD_PARM_VRFY_IOSTCRCWRG	Table 58
FSTC_0048	FSTCD_PARM_VRFY_WDTIMEINVL	Table 59
FSTC_0049	FSTCD_PARM_VRFY_PVERSINVL	Table 60
FSTC_0050	FSTCD_PARM_VRFY_PMODEINVL	Table 61
FSTC_0051	FSTCD_SCLD_WATCHDOGANDIODD	Table 62
FSTC_0052	FSTCD_SCLD_FLOW_NOERRMC1TO	Table 64
FSTC_0053	FSTCD_SCLD_FLOW_SETSD1MC0	Table 65
FSTC_0054	FSTCD_SCLD_FLOW_ SETSD0MC5TO	Table 66
FSTC_0055	FSTCD_SCLD_FLOW_SETSD0MC1TO	Table 67
FSTC_0056	FSTCD_SCLD_FLOW_SETSD1MC0	Table 68
FSTC_0057	FSTCD_SCLD_FLOW_SETSD0MC2TO	Table 69
FSTC_0058	FSTCD_SCLD_FLOW_SETSD0MC1TO	Table 70
FSTC_0059	FSTCD_SCLD_FLOW_SETSD0MC7TO	Table 71
FSTC_0060	FSTCD_SCLD_FLOW_CRC1MC0TO	Table 72
FSTC_0061	FSTCD_SCLD_FLOW_SETSD1MC0TO	Table 73
FSTC_0062	FSTCD_SCLD_FLOW_SETSD1MC0	Table 74
FSTC_0063	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 75
FSTC_0064	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 76
FSTC_0065	FSTCD_SCLD_FLOW_SETSD0MC2DCE1	Table 77
FSTC_0066	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 78
FSTC_0067	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 79
FSTC_0068	FSTCD_SCLD_FLOW_PNERRMC0	Table 80
FSTC_0069	FSTCD_SCLD_FLOW_SETSD0MC2TO	Table 81
FSTC_0070	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 82
FSTC_0071	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 83
FSTC_0072	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 84
FSTC_0073	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 85
FSTC_0074	FSTCD_SCLD_FLOW_SETSD1MC1DCE1	Table 86
FSTC_0075	FSTCD_SCLD_FLOW_SETSD1MC1DCE1	Table 87
FSTC_0076	FSTCD_SCLD_FLOW_SETSD0MC1TO	Table 88
FSTC_0077	FSTCD_SCLD_FLOW_SETSD0MC1TO	Table 89
FSTC_0078	FSTCD_SCLD_FLOW_SETSD0MC1TO	Table 90
FSTC_0079	FSTCD_SCLD_FLOW_SETSD0MC2TO	Table 91
FSTC_0080	FSTCD_SCLD_FLOW_SETSD0MC2TO	Table 92
FSTC_0081	FSTCD_SCLD_FLOW_SETSD0MC2TO	Table 93

FSTC_0082	FSTCD_SCLD_FLOW_SETSD0MC3TO	Table 94
FSTC_0083	FSTCD_SCLD_FLOW_SETSD0MC3TO	Table 95
FSTC_0084	FSTCD_SCLD_FLOW_SETSD0MC3TO	Table 96
FSTC_0085	FSTCD_SCLD_FLOW_SETSD0MC4TO	Table 97
FSTC_0086	FSTCD_SCLD_FLOW_SETSD0MC4TO	Table 98
FSTC_0087	FSTCD_SCLD_FLOW_SETSD0MC4TO	Table 99
FSTC_0088	FSTCD_SCLD_FLOW_SETSD0MC5TO	Table 100
FSTC_0089	FSTCD_SCLD_FLOW_SETSD0MC5TO	Table 101
FSTC_0090	FSTCD_SCLD_FLOW_SETSD0MC5TO	Table 102
FSTC_0091	FSTCD_SCLD_FLOW_SETSD0MC6TO	Table 103
FSTC_0092	FSTCD_SCLD_FLOW_SETSD0MC6TO	Table 104
FSTC_0093	FSTCD_SCLD_FLOW_SETSD0MC7TO	Table 105
FSTC_0094	FSTCD_SCLD_FLOW_SETSD0MC7TO	Table 106
FSTC_0095	FSTCD_SCLD_FLOW_SETSD0MC7TO	Table 107
FSTC_0096	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 108
FSTC_0097	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 109
FSTC_0098	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 110
FSTC_0099	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 111
FSTC_0100	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 112
FSTC_0101	FSTCD_SCLD_FLOW_SETSD0MC2TO	Table 113
FSTC_0102	FSTCD_SCLD_FLOW_SETSD0MC2DCE1	Table 114
FSTC_0103	FSTCD_SCLD_FLOW_SETSD0MC3TO	Table 115
FSTC_0104	FSTCD_SCLD_FLOW_SETSD0MC3TO	Table 116
FSTC_0105	FSTCD_SCLD_FLOW_SETSD0MC4TO	Table 117
FSTC_0106	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 118
FSTC_0107	FSTCD_SCLD_FLOW_SETSD1MC0	Table 119
FSTC_0108	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 120
FSTC_0109	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 121
FSTC_0110	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 122
FSTC_0111	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 123
FSTC_0112	FSTCD_SCLD_FLOW_SETSD1MC0	Table 124
FSTC_0113	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 125
FSTC_0114	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 126
FSTC_0115	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 127
FSTC_0116	FSTCD_SCLD_FLOW_SETSD1MC0	Table 128
FSTC_0117	FSTCD_SCLD_FLOW_SETSD1MC0	Table 129
FSTC_0118	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 130
FSTC_0119	FSTCD_SCLD_FLOW_SETSD1MC0	Table 131
FSTC_0120	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 132
FSTC_0121	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 133
FSTC_0122	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 134
FSTC_0123	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 135
FSTC_0124	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 136
FSTC_0125	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 137
FSTC_0126	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 138

FSTC_0127	FSTCD_SCLD_FLOW_SETSD1MC0	Table 139
FSTC_0128	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 140
FSTC_0129	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 141
FSTC_0130	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 142
FSTC_0131	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 143
FSTC_0132	FSTCD_SCLD_FLOW_SETSD0MC1TO	Table 144
FSTC_0133	FSTCD_SCLD_FLOW_SETSD0MC1TO	Table 145
FSTC_0134	FSTCD_SCLD_FLOW_SETSD0MC1TO	Table 146
FSTC_0135	FSTCD_SCLD_FLOW_SETSD0MC2TO	Table 147
FSTC_0136	FSTCD_SCLD_FLOW_SETSD0MC2TO	Table 148
FSTC_0137	FSTCD_SCLD_FLOW_SETSD0MC2TO	Table 149
FSTC_0138	FSTCD_SCLD_FLOW_SETSD0MC3TO	Table 150
FSTC_0139	FSTCD_SCLD_FLOW_SETSD0MC3TO	Table 151
FSTC_0140	FSTCD_SCLD_FLOW_SETSD1MC0DCE1	Table 152
FSTC_0141	FSTCD_SCLD_FLOW_SETSD0MC2TO	Table 153
FSTC_0142	FSTCD_SCLD_FLOW_SETSD0MC1TO	Table 154
FSTC_0143	FSTCD_SCLD_FLOW_SETSD0MC1TO	Table 155
FSTC_0144	FSTCD_SCLD_FLOW_SETSD0MC3	Table 156
FSTC_0145	FSTCD_SCLD_FLOW_SETSD0MC1TO	Table 157
FSTC_0146	FSTCD_SCLD_FLOW_SETSD0MC3TO	Table 158
FSTC_0147	FSTCD_SCLD_FLOW_SETSD0MC2TO	Table 159
FSTC_0148	FSTCD_REFT_INVOKEDEDITOOL	Table 160
FSTC_0149	FSTCD_REFT_CALCDEDITOOL	Table 161
FSTC_0150	FSTCD_REFT_BACKDEDITOOL	Table 162
FSTC_0151	FSTCD_REFT_COMMDEDITOOL	Table 163
FSTC_0152	FSTCD_REFT_CORRECTFSTVALUES	Table 164
FSTC_0153	FSTCD_REFT_INCORRECTFSPVALUES	Table 165
FSTC_0154	FSTCD_REFT_COMMINTERRUPT	Table 167
FSTC_0155	FSTCM_INFO_DOCUMENTS	Table 169
FSTC_0156	FSTCM_CONF_INFO_CONNECTCABLE	Table 170
FSTC_0157	FSTCM_CONF_INFO_DEFAULTPARAM	Table 171
FSTC_0158	FSTCM_INFO_FSMIDENT	Table 172
FSTC_0159	FSTCM_INFO_FSMAUTHENT	Table 173
FSTC_0160	FSTCM_FSOP_PORTPOWOFFON	Removed
FSTC_0161	FSTCM_FSOP_PREOPVERIFY	Table 174
FSTC_0162	FSTCM_FSOP_PREOPMISSCONNECT	Table 175
FSTC_0163	FSTCM_FSOP_PREOPREPLACE	Table 176
FSTC_0164	FSTCM_SCLM_FLOW_SETSD1MC0DCE1	Table 180
FSTC_0165	FSTCM_SCLM_FLOW_SETSD1MC0SDSET1	Table 181
FSTC_0166	FSTCM_SCLM_FLOW_SETSD1MC0CFAC1	Table 182
FSTC_0167	FSTCM_SCLM_FLOW_SETSD1MC0DCE1	Table 183
FSTC_0168	FSTCM_SCLM_FLOW_SETSD1MC0DCE1	Table 184
FSTC_0169	FSTCM_SCLM_FLOW_SETSD1MC0DCE1	Table 185
FSTC_0170	FSTCM_SCLM_FLOW_SETSD1MC0DCE1	Table 186
FSTC_0171	FSTCM_SCLM_FLOW_SETSD1MC0DCE1PNERR	Table 187

FSTC_0172	FSTCM_SCLM_FLOW_SETSD1MC0	Table 188
FSTC_0173	FSTCM_SCLM_FLOW_PNERRCRCERR	Table 189
FSTC_0174	FSTCM_SCLM_FLOW_PNERRCRCERR	Table 190
FSTC_0175	FSTCM_SCLM_FLOW_PNERRMC0	Table 191
FSTC_0176	FSTCM_SCLM_FLOW_CRCERRMC0	Table 192
FSTC_0177	FSTCM_FSOP_SPLITTERMIXPD32	Table 193
FSTC_0178	FSTCM_FSOP_SPLITTERSAFEPD32	Removed
FSTC_0179	FSTCM_FSOP_SPLITTERMIXPD16	Table 194
FSTC_0180	FSTCM_FSOP_SPLITTERSAFEPD16	Removed
FSTC_0181	FSTCM_FSOP_COMPOSERMIXPD32	Table 195
FSTC_0182	FSTCM_FSOP_COMPOSERSAFEPD32	Removed
FSTC_0183	FSTCM_FSOP_COMPOSERMIXPD16	Table 196
FSTC_0184	FSTCM_FSOP_COMPOSERSAFEPD16	Removed
FSTC_0185	FSTCM_SMIS_READBACKCONFIG	Table 197
FSTC_0186	FSTCM_SMIS_FSPORTSTATUS	Table 198
FSTC_0187	FSTCM_REFD_PORTEVENTCORRECT	Table 199
FSTC_0188	FSTCM_REFD_FSDEVICEEVENTCORRECT	Table 200
FSTC_0189	FSTCM_SCLM_WATCHDOGPRECISION	Table 202
FSTC_0190	FSTCM_TOOL_IODDIMPORT	Table 204
FSTC_0191	FSTCM_TOOL_IODDCONVENTIONS	Table 205
FSTC_0192	FSTCM_TOOL_IODDDISPLAYCOMPLETE	Table 206
FSTC_0193	FSTCM_TOOL_FSTPARAMETERS	Table 207
FSTC_0194	FSTCM_TOOL_COMMDEDITOOL	Table 208
FSTC_0195	FSTCM_TOOL_DDOEXCHANGE	Table 209
FSTC_0196	FSTCM_DLMH_READY	Table 177
FSTC_0197	FSTCM_DLMH_READY_REPEAT	Table 178
FSTC_0198	FSTCD_REFT_RM	Table 168
FSTC_0199	FSTCM_REFT_RD	Table 203

6205

Bibliography

[1] IEC 61131-9:2022[3], *Programmable controllers – Part 9: Single-drop digital communication interface for small sensors and actuators (SDCI)*, www.iec.ch

[2] IO-Link Community, *IO-Link Interface and System*, V1.1.3, June 2019, Order No. 10.002

[3] IO-Link Community, *IO-Link Corrigendum & Package 2020*, January 2021, Order No. 10.122

[4] IO-Link Community, *IO-Link Safety System Extensions*, V1.1.3, March 2022, Order No. 10.092

[5] IO-Link Community, *IO Device Description (IODD)*, V1.1.3, January 2021, Order No. 10.012

[6] IO-Link Community, *Common Profile*, V 1.1, December 2021, Order No. 10.072

[7] ISO/IEC 19505-2:2012, *Information technology – OMG Unified Modeling Language (OMG UML)*, Revision 2

[8] ZVEI-Recommendation https://www.zvei.org/fileadmin/user_upload/Presse_und_Medien/Publikationen/2021/Juni/ZVEI_Empfehlung_Klassifizierung_Binaerer_24-V-Schnittstellen/24V-Schnittstellen_final.pdf

[9] IO-Link Community, *IO-Link Test*, V1.1.3, January 2021, Order No. 10.032

[10] IO-Link Community, *IO-Link Exceptions*, V1.0, January 2020, Order No. 10.232

[11] PI Profile Specification, *IO-Link Safety Integration in PROFIsafe*, V1.0, Februar 2022, Order No. 3.312

_____

[3] Under preparation. Stage at the time of publication: IEC/AFDIS 61131-9:2022

IO-Link Community
c/o PROFIBUS Nutzerorganisation e.V.
Haid-und-Neu-Str. 7
76131 Karlsruhe
Germany
Phone: +49 (0) 721 / 986 197 0
Fax: +49 (0) 721 / 986 197 11
e-mail: info@io-link.com
http://www.io-link.com/