IO-Link

Corrigendum & Package 2020

including "How to use the IO-Link Change Request database"

related to

IO-Link Interface and System Specification V1.1.3

IO-Link Test Specification V1.1.3

IODD – IO Device Description Specification V1.1.3

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This Corrigendum has been prepared by the technology working groups of the IO-Link community. It is – together with the "IO-Link Interface and System" specification Version 1.1.3, the "IO-Link Test" specification Version 1.1.3, and the "IODD – IO Device Description" specification V 1.1.3 – the basis for implementation and test of Masters and Devices and for the corresponding manufacturer declarations.

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 website www.io-link.com.

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 devices 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:

IO-Link ® is registered trademark. It is restricted for use by 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:

may:	indicates flexibility of choice with no implied preference.
should:	indicates flexibility of choice with a strongly preferred implementation.
shall:	indicates a mandatory requirement. Designers **shall** implement such mandatory requirements to ensure interoperability and to claim conformity with this specification.
highly recommended:	indicates that a feature shall be implemented except for well-founded cases. Vendor shall document the deviation in the user manual and in the manufacturer declaration.

CONTENTS

Introduction

The Single-drop Digital Communication Interface (SDCI) and system technology (IO-Link™ [1])) for low-cost sensors and actuators is standardized within IEC 61131-9 [2] as well as in [1]. The technology is an answer to the need of these digital/analog sensors and actuators to exchange process data, diagnosis information and parameters with a controller (PC or PLC) using a low-cost, digital communication technology while maintaining backward compatibility with the current DI/DO signals as defined in IEC 61131-2.

Tools allow the association of Devices with their corresponding electronic IO Device Descriptions (IODD) and their subsequent configuration to match the application requirements [3].

A test specification [5] supplements the technology specifications and guarantees quality assurance together with a manufacturer declaration.
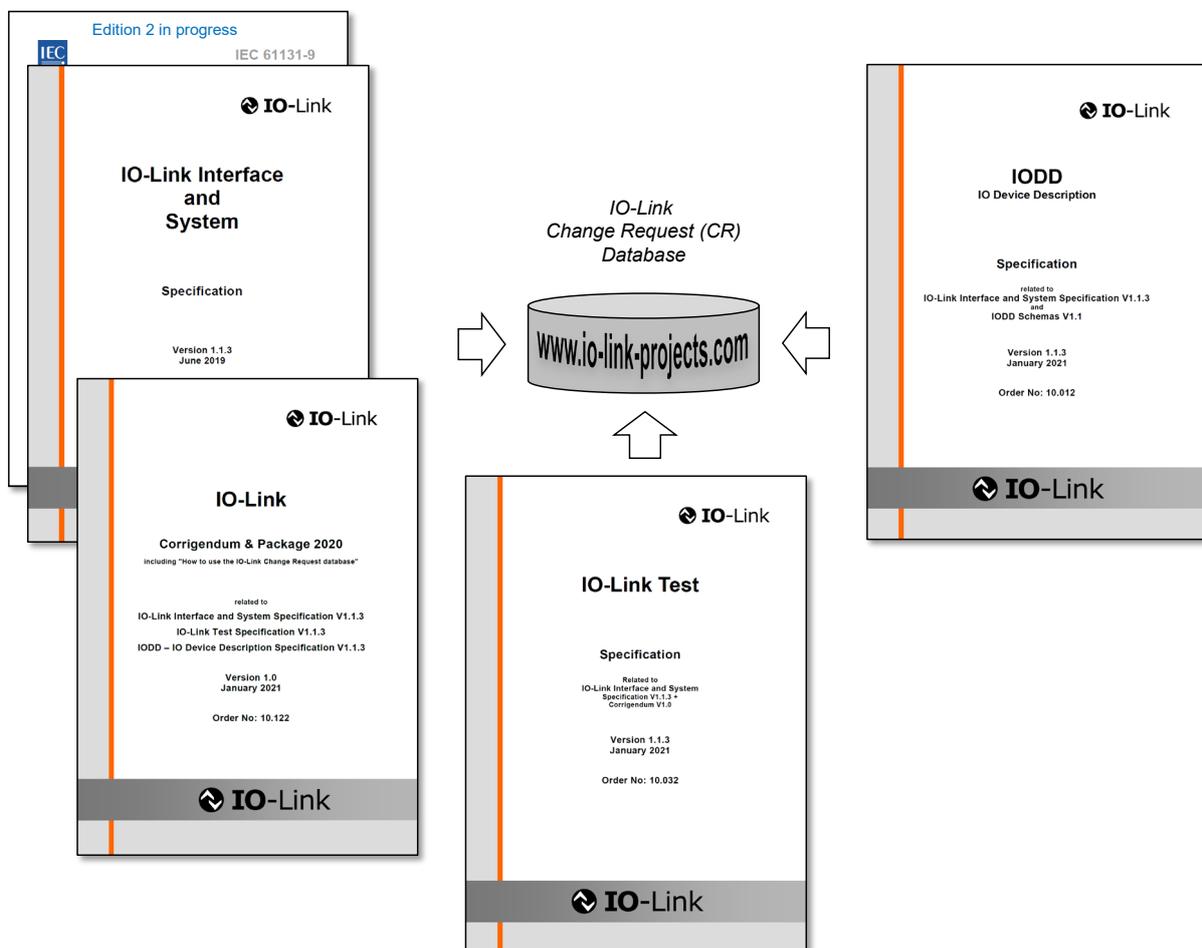
Figure 1 – Ensemble of IO-Link relevant standards and specifications

The IO-Link Community established and maintains a so-called Change Request database for those users having problems to understand while reading the specifications, or who found real bugs, or who would like to get some advice at particular implementation situations. The IO-Link working groups are obliged to provide answers within a reasonable timeframe. This Corrigendum is a collection of approved answers to important change requests (CR).

A manual on "How to use the IO-Link change request database" can be found in Annex C.

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1 IO-Link™ is a trade name of the "IO-Link Community". This information is given for the convenience of users of this specification. Compliance to this specification 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".

IO-Link Corrigendum & Package 2020 —

related to IO-Link specifications

1 Motivation and scope

Over time, the number of applications in the field is growing and users of the IO-Link specifications

- IO-Link Interface and System
- IO-Link Test, and
- IODD – IO Device Description,

may realize some problems with the published versions of these specifications. Usually, it is possible for them to enter problems into a so-called Change Request database maintained by the IO-Link community. Information on how to access the database is available on the second page of each specification (access, login, and password, see Figure C.1). It is the task of the assigned working group to respond to the individual user problem report or change request (see Figure 1).

A particular release package of the relevant versions of the specifications and the relevant concluded change requests (CR) or problem reports out of the databases respectively has been defined in 2020.

This Corrigendum lists the CRs for the IO-Link Interface and System specification V1.1.3 [1] and provides pointers to the particular locations within this specification. Additional explanations and figures serve for easier reading and better understanding.

All these listed changes within the CRs are mandatory to observe for implementation and testing, as well as for the test equipment by the time of the release of this document. For transitions see Annex A.2 and [6].

Annex C provides a manual for those users, who are not familiar with the usage of the IO-Link CR database.

2 Normative references

The referenced documents in [1] apply.

3 Symbols and abbreviated terms

CR-xx	Change Request (Identification number of the particular database)
IP	IO Device Description Specification V1.1.3
SP	IO-Link Interface and System Specification V1.1.3
TP	IO-Link Test Specification V1.1.3

52 ## 4   Reports on Interface and System Specification V1.1.3

53 ### 4.1   Overview

54 Table 1 shows the IO-Link Interface and System specification reports relevant for implementation and
55 test sorted by CR-ID. Problem descriptions are hyper-linked with the individual reports (click on text).

56 **Table 1 – IO-Link Interface and System specification reports**

SP CR-ID	Abstract/Problem	Affected clauses	Affected test cases
214	Undated references of EMC standards are causing confusion	2, Table H.2	
215	Triggers of Events "0xFF2x" are incorrect	Annex D.3	
216	How to inform about Device readiness via SMI service?	Annex D.3	
218	Ambiguous transitions in Device PM state machine	10.3, Figure 86	
219	Term "StoreRequest" in Device PM state machine is misleading	10.3, Figure 86	
224	Timing constraints for appearing/disappearing Events are unclear	10.10.2	
226	PM state machine does not consider reset SystemCommands	10.3, Figure 86	
228	EMI – Influence of signal slew rate	Table 9	
231	Incomplete M-sequence definitions	Table A.9	
232	T18 of Master System Management state machine can freeze Port	Table 85	
233	Reduce complexity for parameters with "write only" access rights	10.8.5	
235	Rules for MasterID classes not defined yet	11.2.4, Table E.2	
236	Coding of empty Data Storage objects missing	Annex G	
237	Inconsistent DS objects or PortMode at SMI_ParServToDS	11.2.9	
238	Minimum Port C/Q current at COM or DI mode	Table 6	
239	Missing compatibility check of CRID for Device V1.0	Figure 74	
240	Permitted coding of "TRUE/FALSE" (Boolean) is misleading	F.2.2	
241	List of patents not up to date	0.2	
242	Status of Port_Power_Off	Table E.4	

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58 See Annex B for another reference table sorted by clauses.

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60 ## 4.2 Undated references of EMC standards are causing confusion

61 This problem report refers to change request ID 214 in the database.

62 Table 2 shows the problem report and the solution.

63 **Table 2 – Dated references and corrected test values**

Problem	Over time the values for EMC testing in IEC 61000 series are changing. The specification V1.1.3 refers to outdated values for immunity and burst.
Solution	The specification will use dated references to IEC 61000-4-x standards in Clause 2 and Table H.2 and change values. Corrections in clause 2 and Table H.2: IEC 61000-4-2:2008 IEC 61000-4-3:2020 IEC 61000-4-4:2012 IEC 61000-4-5 IEC 61000-4-6:2013 IEC 61000-4-11. Corrections in Table H.2: 1. Row 3, column "Test level": 2 000 MHz – 6 000 MHz, 3 V/m 2. Row 4, column "Constraints": 5 kHz or 100 kHz (see also IEC 60947-5-2:2019).
Clauses	Clause 2 and Annex H
Subclauses	Annex H.1 (Table H.2)
Impact on	–
Remark	–

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65   ## 4.3   Triggers of Events "0xFF2x" are incorrect

66   This problem report refers to change request ID 215 in the database.

67   Table 3 shows the problem report and the solution.

68   **Table 3 – Triggers of Events "0xFF2x"**

Problem	The Triggers of Events "0xFF21" and "0xFF26" do not match the indicated transitions T9 and T12 respectively in state machine of Figure 101. Thus, shall an Event "0xFF26" be thrown at any state change?
Solution	Introduction of the Standardized Master Interface (SMI) in V1.1.3 and the new Configuration Manager state machine in Figure 101 make the Event triggers a relict from previous designs in V1.1.2 that are partly not recommended for implementation as already stated in V1.1.3. Remodeling of the entire Port Event scenario led to the following changes: 1. Triggers of Events "0xFF21" to "0xFF27" and "0xFF31" are removed (see Annex D.3 in 4.4). 2. Events "0xFF26" and 0xFF27" are optional. New triggers are defined in Annex D.3 in 4.4. 3. General rule: Each change of PortStatusInfo (see Table E.4) causes an Event via SMI_PortEvent (Notification, EventCode = "0xFF26"). For details see new Annex D.3 in 4.4.
Clauses	Annex D and clause 11
Subclauses	Annex D.3 (Table D.2) and clause 11.3.2 (Figure 101)
Impact on	–
Remark	See SP-CR-ID 216

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70 **4.4 How to inform about Device readiness via SMI service?**

71 This problem report refers to change request ID 216 in the database.

72 Table 4 shows the problem report and the solution.

73 **Table 4 – Indication of Device readiness via SMI service**

Problem	Since Event "0xFF21" should not be supported anymore it is not clear how the readiness of a Device shall be reported. A disappearing "0x1800" Event is not an option since a disappearing Event without an appearing Event makes no sense. Throwing an appearing "0x1800" Event at any time after configuration until the Device is in OPERATE is not acceptable due to possible problems with upper-level systems.
Solution	1. The state machine of Configuration Manager in Figure 101 shows transitions leading to new information in SMI_PortStatus.PortStatusInfo (see Table E.4). Suggested changes to these transitions in Table 126 are documented below. 2. The new information in Table 126 leads to Port Events specified in Annex D.3. Changes are documented in Annex D.3 below 4. This Annex D.3 now defines mandatory and optional Port Events 5. It also makes stringent use of the Event appearing/disappearing rule 6. It also details what is meant with "Port status changed" and its indication 7. The Port Events distinguish between errors caused by the communication system and those caused by the application (Event "INSTANCE"). Consequently, Table A.17 is changed: Value = 4, Definition = Application (APP); Value = 5, Definition = System (SYS).
Clauses	Clause 11, Annex D, Annex A
Subclauses	Clause 11.3.2, Annex D.3 (Table D.2), Annex A.6.4 (Table A.17)
Impact on	–
Remark	See SP-CR-IDs 215, 242

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76 New clause 11.3.2 – "State machine of the Configuration Manager" with colored corrections:

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11.3.2 State machine of the Configuration Manager

Figure 101 shows the state machine of the Configuration Manager. In general, states and transitions correspond to those of the message handler: STARTUP, PREOPERATE (fault or Data Storage), and at the end OPERATE. Dedicated "SM_PortMode" services are driving the transitions (see 9.2.2.4). A special state is related to SIO mode DI or DO.

Configuration Manager can receive the information COMLOST from Port x Handler through "SM_PortMode" at any time. It also can receive a service "SMI_PortConfiguration" from the gateway application with changed values in "PortConfigList" at any time (see 11.2.5).

Via service "SMI_ParServToDS", it also can receive a Data Storage object with a changed parameter set from the gateway application triggering action in the Configuration Manager if Data Storage is activated.

Port x is started/restarted in all cases.

Figure 101 together with Table 126 also shows transitions leading to corresponding changes in "PortStatusInfo" of ArgBlock "PortStatusList" (see Table E.4). Based on these transitions, Events are triggered via SMI_PortEvent. For details see Annex D.3.

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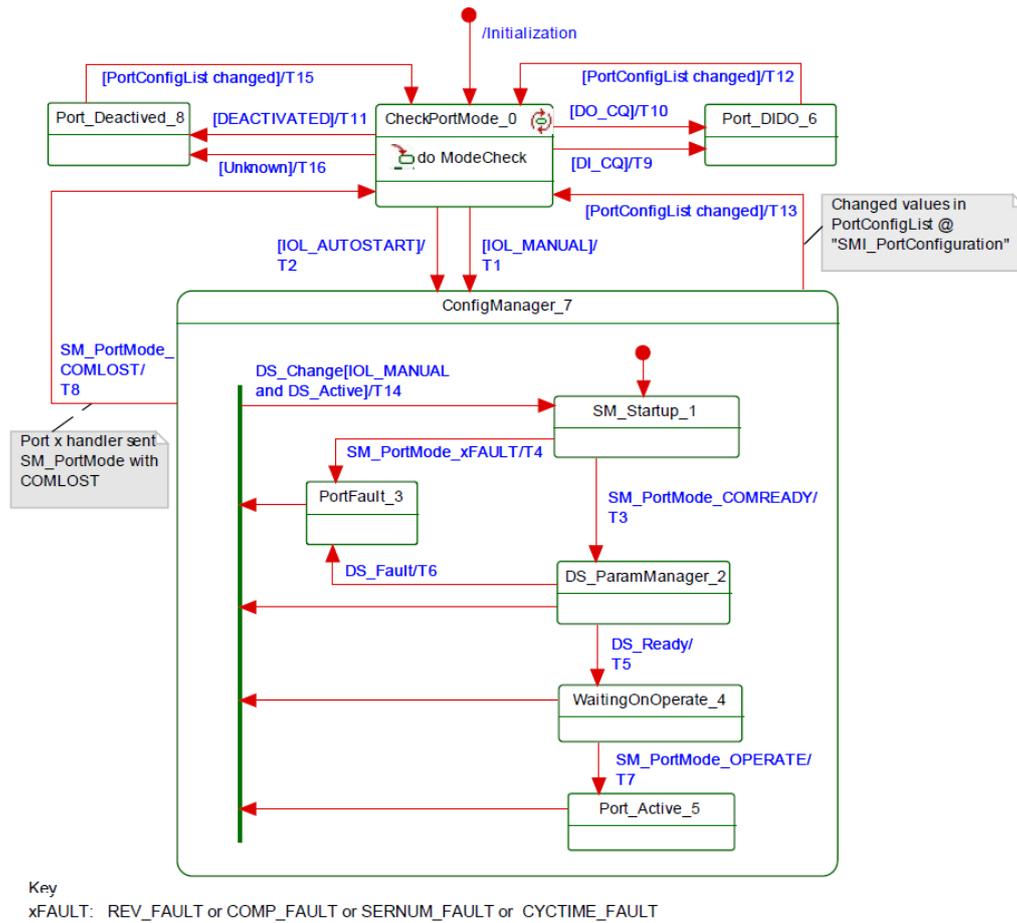
Figure 101 – State machine of the Configuration Manager

Table 126 shows the state transition tables of the Configuration Manager.

Table 126 – State transition tables of the Configuration Manager

STATE NAME	STATE DESCRIPTION
CheckPortMode_0	Check "Port Mode" element in parameter "PortConfigList" (see 11.2.5)
SM_Startup_1	Waiting on an established communication or loss of communication or any of the faults REVISION_FAULT, COMP_FAULT, or SERNUM_FAULT (see Table 85)
DS_ParamManager_2	Waiting on accomplished Data Storage startup. Parameter are downloaded into the Device or uploaded from the Device.
PortFault_3	Device in state PREOPERATE (communicating). However, one of the three faults REVISION_FAULT, COMP_FAULT, SERNUM_FAULT, or DS_Fault, or PORT_DIAG occurred.
WaitingOnOperate_4	Waiting on SM to switch to OPERATE.
Port_Active_5	Port is in OPERATE mode. The gateway application is exchanging Process Data and ready to send or receive On-request Data.
Port_DIDO_6	Port is in DI or DO mode. The gateway application is exchanging Process Data (DI or DO).
ConfigManager_7	This superstate handles Port communication operations and allows all states inside to react on COMLOST via SM_PortMode service. A Port restart is managed inside the superstate triggered by the DS_Change signal (see Table 125).
Port_Deactivated_8	Port is in DEACTIVATED mode.

TRANSITION	SOURCE STATE	TARGET STATE	ACTION
T1	0	7	Invoke DS-Delete if identification (VendorID, DeviceID) within DS is different to configured port identification. SM_SetPortConfig_CFGCOM
T2	0	7	Invoke DS-Delete. SM_SetPortConfig_AUTOCOM
T3	1	2	DS_Startup: The DS state machine is triggered. Update parameter elements of "PortStatusList": - PortStatusInfo = NOT_AVAILABLE - RevisionID = (real) RRID - Transmission rate = COMx - VendorID = (real) RVID - DeviceID = (real) RDID - MasterCycleTime = value - Port QualityInfo = invalid
T4	1	3	Update parameter elements of "PortStatusList": - PortStatusInfo = PORT_DIAG - RevisionID = (real) RRID - Transmission rate = COMx - VendorID = (real) RVID - DeviceID = (real) RDID - Port QualityInfo = invalid
T5	2	4	SM_Operate
T6	2	3	Data Storage failed. Rollback to previous parameter set. Update parameter elements of "PortStatusList": - PortStatusInfo = PORT_DIAG - RevisionID = (real) RRID - Transmission rate = COMx - VendorID = (real) RVID - DeviceID = (real) RDID - Port QualityInfo = invalid
T7	4	5	Update parameter elements of "PortStatusList": - PortStatusInfo = OPERATE - RevisionID = (real) RRID - Transmission rate = COMx - VendorID = (real) RVID - DeviceID = (real) RDID - Port QualityInfo = x
T8	1,2,3,4,5	0	Update parameter elements of "PortStatusList": - PortStatusInfo = NO_DEVICE - RevisionID = 0 - Transmission rate = 0 - VendorID = 0 - DeviceID = 0 - Port QualityInfo = invalid Delete DiagEntries (SOURCE = Device) in PortStatusList (see Table E.4)
T9	0	6	Invoke DS-Delete. SM_SetPortConfig_DI. Update parameter elements of "PortStatusList": - PortStatusInfo = DI_C/Q - RevisionID = 0 - Transmission rate = 0 - VendorID = 0 - DeviceID = 0 - Port QualityInfo = invalid Delete DiagEntries (SOURCE = Device) in PortStatusList (see Table E.4)
T10	0	6	Invoke DS-Delete. SM_SetPortConfig_DO. Update parameter elements of "PortStatusList": - PortStatusInfo = DO_C/Q - RevisionID = 0 - Transmission rate = 0 - VendorID = 0 - DeviceID = 0 - Port QualityInfo = invalid Delete DiagEntries (SOURCE = Device) in PortStatusList (see Table E.4)
T11	0	8	Invoke DS-Delete. SM_SetPortConfig_INACTIVE. Update parameter elements of "PortStatusList": - PortStatusInfo = DEACTIVATED

TRANSITION	SOURCE STATE	TARGET STATE	ACTION
			- RevisionID = 0 - Transmission rate = 0 - VendorID = 0 - DeviceID = 0 - Port QualityInfo = invalid Delete DiagEntries (SOURCE = Device) in PortStatusList (see Table E.4)
T12	6	0	Update parameter elements of "PortStatusList": - PortStatusInfo = NOT_AVAILABLE - RevisionID = 0 - Transmission rate = 0 - VendorID = 0 - DeviceID = 0 - Port QualityInfo = invalid Delete DiagEntries (SOURCE = Device) in PortStatusList (see Table E.4)
T13	1,2,3,4,5	0	Update parameter elements of "PortStatusList": - PortStatusInfo = NOT_AVAILABLE - RevisionID = 0 - Transmission rate = 0 - VendorID = 0 - DeviceID = 0 - Port QualityInfo = invalid Delete DiagEntries (SOURCE = Device) in PortStatusList (see Table E.4)
T14	1,2,3,4,5	1	SM_SetPortConfig_CFGCOM Update parameter elements of "PortStatusList": - PortStatusInfo = NOT_AVAILABLE - RevisionID = 0 - Transmission rate = 0 - VendorID = 0 - DeviceID = 0 - Port QualityInfo = invalid Delete DiagEntries (SOURCE = Device) in PortStatusList (see Table E.4)
T15	8	0	Update parameter elements of "PortStatusList": - PortStatusInfo = NOT_AVAILABLE - RevisionID = 0 - Transmission rate = 0 - VendorID = 0 - DeviceID = 0 - Port QualityInfo = invalid Delete DiagEntries (SOURCE = Device) in PortStatusList (see Table E.4)
T16	0	8	Invoke DS-Delete. SM_SetPortConfig_INACTIVE. Update parameter elements of "PortStatusList": - PortStatusInfo = DEACTIVATED - RevisionID = 0 - Transmission rate = 0 - VendorID = 0 - DeviceID = 0 - Port QualityInfo = invalid Delete DiagEntries (SOURCE = Device) in PortStatusList (see Table E.4)

INTERNAL ITEMS	TYPE	DEFINITION
PortConfigList changed	Guard	Values of "PortConfigList" have changed
DS_Ready	Signal	Data Storage sequence (upload, download) accomplished; see Table 125.
DS_Fault	Signal	See Table 125
DEACTIVATED	Guard	See Table E.3
IOL_MANUAL	Guard	See Table E.3
IOL_AUTOSTART	Guard	See Table E.3
DI_C/Q	Guard	See Table E.3
DO_C/Q	Guard	See Table E.3
DS_Change	Signal	See Table 125
DS_Active	Guard	Port configured to "Backup + Restore" (3) or "Restore" (4); see Table E.3

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84 New Annex D.3 – "EventCodes for Ports" with colored corrections:

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D.3 EventCodes for Ports

Table D.2 lists the specified EventCode identifiers and their definitions for Ports. The EventCodes are created by the Master (SOURCE = "Master/Port", see Table A.18, and "application"(APP) or "communication system" (SYS) as INSTANCE, see Table A.17). EventCode identifiers 0xFF21 to 0xFFFF are internal system information and shall not be visible to users. The following rules apply:

- Port Events referring to SDCI communication are mandatory (exceptions 0xFF26/0xFF27) and are specified in detail (Event INSTANCE = SYS). The other Port Events (Event INSTANCE = APP) are optional.

- Each appearing Port Event of Type "Error" requires a disappearing Port Event whenever the cause of the Error has been fixed.

- Occurring PortStatusInfo "PORT_DIAG" leads to an appearing EventCode 0x180x or 0x600x depending on "SYS" Error (see Table 126).

- Leaving PortStatusInfo "PORT_DIAG" to others leads to disappearing EventCodes for each pending Error (0x180x).

- Every appearing/disappearing Event leads to an update of the DiagEntry section in the PortStatusList (see Table E.4).

Table D.2 – EventCodes for Ports

EventCode ID	Definition and recommended maintenance action	Event INSTANCE	Type
0x0000 to 0x17FF	Reserved		
0x1800	No Device (communication) - Occurring PortStatusInfo "NO_Device" leads to an appearing EventCode 0x1800 - Appearing EventCode 0x1800 causes disappearing of all pending EventCodes of INSTANCE "SYS". - Leaving PortStatusInfo "NO_DEVICE" to others leads to a disappearing EventCode 0x1800	SYS	Error
0x1801	Startup parametrization error – check parameter	APP	Error
0x1802	Incorrect VendorID – Inspection Level mismatch	SYS	Error
0x1803	Incorrect DeviceID – Inspection Level mismatch Trigger: SM_PortMode (COMP_FAULT)	SYS	Error
0x1804	Short circuit at C/Q – check wire connection	APP	Error
0x1805	Overtemperature – check Master temperature and load	APP	Error

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EventCode ID	Definition and recommended maintenance action	Event INSTANCE	Type
0x1806	Short circuit at L+ – check wire connection	APP	Error
0x1807	Overcurrent at L+ – check power supply (e.g. L1+)	APP	Error
0x1808	Reserved		
0x1809	Backup inconsistency – memory out of range (2048 octets)	SYS	Error
0x180A	Backup inconsistency – identity fault	SYS	Error
0x180B	Backup inconsistency – Data Storage unspecific error	SYS	Error
0x180C	Backup inconsistency – upload fault	SYS	Error
0x180D	Parameter inconsistency – download fault	SYS	Error
0x180E	P24 (Class B) missing or undervoltage	APP	Error
0x180F	Short circuit at P24 (Class B) – check wire connection (e.g. L2+)	APP	Error
0x1810	Short circuit at I/Q – check wiring	APP	Error
0x1811	Short circuit at C/Q (if digital output) – check wiring	APP	Error
0x1812	Overcurrent at I/Q – check load	APP	Error
0x1813	Overcurrent at C/Q (if digital output) – check load	APP	Error
0x1814 to 0x1EFF	Reserved		
0x1F00 to 0x1FFF	Vendor specific		–
0x2000 to 0x2FFF	Safety extensions		See [10]
0x3000 to 0x3FFF	Wireless extensions		See [11]
0x4000 to 0x5FFF	Reserved		
0x6000	Invalid cycle time	SYS	Error
0x6001	Revision fault – incompatible protocol version	SYS	Error
0x6002	ISDU batch failed – parameter inconsistency?	SYS	Error
0x6003 to 0xFF20	Reserved		
0xFF21 [a]	DL: Device plugged in ("NEW_SLAVE") – PD stop		Notification
0xFF22 [a]	Device communication lost ("DEV_COM_LOST")		Notification
0xFF23 [a]	Data Storage identification mismatch ("DS_IDENT_MISMATCH")		Notification
0xFF24 [a]	Data Storage buffer overflow ("DS_BUFFER_OVERFLOW")		Notification
0xFF25 [a]	Data Storage parameter access denied ("DS_ACCESS_DENIED")		Notification
0xFF26 [b]	Port status changed – Use "SMI_PortStatus" service for Port status in detail. Each change of "PortStatusInfo" causes this Event via SMI_PortEvent	SYS	Notification
0xFF27 [b]	Data Storage upload completed and new data object available. Each completion of a Data Storage upload causes this Event via SMI_PortEvent	SYS	Notification
0xFF28 to 0xFF30	Reserved		
0xFF31 [a]	DL: Incorrect Event signalling ("EVENT")		Notification
0xFF32 to 0xFFFF	Reserved		
a) No more required due to SMI Event concept. Not recommended for implementations. b) These Events are optional			

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89 **4.5 Ambiguous transitions in Device PM state machine**

90 This problem report refers to change request ID 218 in the database.

91 Table 5 shows the problem report and the solution.

92 **Table 5 – Ambiguous transitions in Device Parameter Manager**

Problem	In Figure 86, the internal item "DownloadBreak" is true when receiving a "ParamBreak" or "ParamUploadStart" SystemCommand. For example, when receiving a "ParamUploadStart" SystemCommand in state "Download_2", two transitions T18 [UploadStart] and T8 [Downloadbreak or UploadEnd] are activated. Thus, it is not defined to which destination the PM state machine should switch (Idle_0 or Upload_3).
Solution	The only destination of trigger ParamUploadStart (in [UploadStart]) shall be state "Upload_3". Thus, transitions T11 and T20 shall not include the "DownloadBreak" as this internal item also contains ParamUploadStart. Replace all instances of "DownloadBreak" in Figure 86 by new internal item "ParamBreak" (see T8, T11, T20). The internal item "DownloadBreak" is removed. See new state machine in Figure 86 and new transitions in Table 96 below.
Clauses	Clause 10
Subclauses	10.3.2 (Figure 86, Table 96)
Impact on	–
Remark	See SP-CR-IDs 219, 226

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94 New Figure 86 – "The Parameter Manager (PM) state machine" with colored corrections:

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97 New Table 96 – "State transition tables of the PM state machine" with colored corrections:

STATE NAME	STATE DESCRIPTION
Idle_0	Waiting on parameter transmission
ValidityCheck_1	Check of consistency and validity of current parameter set.
Download_2	Parameter download active; local parameterization locked (e.g. teach-in). All Read services to Indices other than 3 (DataStorageIndex) shall be rejected (ISDU ErrorType 0x8022 – "Service temporarily not available – Device control")
Upload_3	Parameter upload active; parameterization globally locked. All write accesses for parameter changes not covered in the state machine shall be rejected (ISDU ErrorType 0x8022 – "Service temporarily not available – Device control")

TRANSITION	SOURCE STATE	TARGET STATE	ACTION
T1	0	1	-
T2	0	1	Set "StoreRequest" (= TRUE)
T3	0	1	Set "StoreRequest" (= TRUE)
T4	1	0	Mark parameter set as valid; invoke DS_ParUpload.req to DS; enable positive acknowledge of transmission; reset "StoreRequest" (= FALSE)
T5	1	0	Mark parameter set as valid; enable positive acknowledge of transmission
T6	1	0	Mark parameter set as invalid; enable negative acknowledgment of transmission; reset "StoreRequest" (= FALSE); discard parameter buffer
T7	0	2	Lock local parameter access
T8	2	0	Unlock local parameter access; discard parameter buffer
T9	2	0	Unlock local parameter access; discard parameter buffer
T10	0	3	Lock local parameter access
T11	3	0	Unlock local parameter access
T12	3	0	Unlock local parameter access

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TRANSITION	SOURCE STATE	TARGET STATE	ACTION
T13	2	1	Unlock local parameter access
T14	2	1	Unlock local parameter access; set "StoreRequest" (= TRUE)
T15	3	3	Lock local parameter access
T16	2	2	Discard parameter buffer, so that a possible second start will not be blocked.
T17	3	1	Unlock local parameter access; set "StoreRequest" (= TRUE)
T18	2	3	Discard parameter buffer, so that a possible second start will not be blocked.
T19	3	2	–
T20	0	0	Return ErrorType 0x8036 – *Function temporarily unavailable* if Block Parameterization supported or ErrorType 0x8035 – *Function not available* if Block Parameterization is not supported.
T21	2	0	Unlock local parameter access; discard parameter buffer
T22	3	0	Unlock local parameter access

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INTERNAL ITEMS	TYPE	DEFINITION
DownloadStore	Bool	SystemCommand "ParamDownloadStore" received, see Table B.9
DataValid	Bool	Positive result of conformity and validity checking
DataInvalid	Bool	Negative result of conformity and validity checking
DownloadStart	Bool	SystemCommand "ParamDownloadStart" received, see Table B.9
DownloadEnd	Bool	SystemCommand "ParamDownloadEnd" received, see Table B.9
DS_StoreRequest	Bool	Flag for a requested Data Storage sequence, i.e. SystemCommand "ParamDownloadStore" received (= TRUE)
ParamBreak	Bool	SystemCommand "ParamBreak" received, see Table B.9
SysCmdReset	Bool	One of the parameter reset SystemCommands received, see Table 101
UploadStart	Bool	SystemCommand "ParamUploadStart" received, see Table B.9
UploadEnd	Bool	SystemCommand "ParamUploadEnd" received, see Table B.9
Single Parameter	Bool	In case of "single parameter" as specified in 10.3.4
Local Parameter	Bool	In case of "local parameter" as specified in 10.3.3
NOTE "Parameter access locking" shall not be confused with "Device access locking" in Table B.12		

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101   **4.6   Term "StoreRequest" in Device PM state machine is misleading**

102   This problem report refers to change request ID 219 in the database.

103   Table 6 shows the problem report and the solution.

104   **Table 6 – Term "StoreRequest" misleading**

Problem	Term "StoreRequest" in PM state maschine (Figure 86) is rather misleading or unclear when only looking at the state maschine logic.
Solution	Replace the misleading internal item "StoreRequest" by "DS_StoreRequest". See new state machine in Figure 86 and transitions in Table 96 in 4.5.
Clauses	Clause 10
Subclauses	10.3.2 (Figure 86, Table 96)
Impact on	–
Remark	See SP-CR-ID 218

105

106 **4.7   Timing constraints for appearing/disappearing Events are unclear**

107 This problem report refers to change request ID 224 in the database.

108 Table 7 shows the problem report and the solution.

109   **Table 7 – Timing constraints for appearing/disappearing Events**

Problem	The specification in clause 10.10.2 ("anti flooding" requirements) states that any Event action shall be one second apart from a previous action. This also includes the action "disappear" because the mode is not restricted in the first bullet. However, this conflicts with the second bullet "The Event Dispatcher shall not issue an "Event disappears" less than 50 ms after the corresponding "Event appears".
Solution	The EventQualifier indicates MODEs "Event appears" and "Event disappears". Thus, change second sentence in first bullet to " That means, the Event Dispatcher shall not invoke the AL_Event service with the same EventCode and EventQualifier more often than once per second. This measure avoids frequent repetitions of Events".
Clauses	Clause 10
Subclauses	10.10.2 (third bullet list)
Impact on	–
Remark	–

110

111   **4.8   PM state machine does not consider reset SystemCommands**

112   This problem report refers to change request ID 226 in the database.

113   Table 8 shows the problem report and the solution.

114   **Table 8 – PM state machine does not consider reset SystemCommands**

Problem	Device Parameter Manager state machine does not consider the occurrence of a reset System-Command during block parameterization.
Solution	As stated in Table 101, all reset SystemCommands result in a discarding of any ongoing block parameterization. Thus, insert two new transitions T21 (corresponding to T9) and T22 (corresponding to T12), triggered by any reset SystemCommands (internal item: guard "SysCmdReset"). See new Figure 86 and Table 96 in 4.5.
Clauses	Clause 10
Subclauses	10.3.2 (Figure 86, Table 96)
Impact on	
Remark	See SP-CR-ID 218

115

116 4.9 EMI – Influence of signal slew rate

117 This problem report refers to change request ID 228 in the database.

118 Table 9 shows the problem report and the solution.

119 **Table 9 – EMI – Influence of signal slew rate**

Problem	In Table 9, a minimum value of "0" for signal rise and fall time (slew rate) is assigned. This value can lead to conflicts while testing radiated emission of Devices according to IEC 61000-6-4.
Solution	Insert in column "Remark" in row T_{DR} and t_{DF} in table 9: "The minimum values could be critical to meet the requirements in Annex H.1.5".
Clauses	Clause 5, Annex H
Subclauses	5.3.3.2 (Table 9), Annex H.1.5
Impact on	–
Remark	–

120

121   **4.10   Incomplete M-sequence definitions**

122   This problem report refers to change request ID 231 in the database.

123   Table 10 shows the problem report and the solution.

124   **Table 10 – Incomplete M-sequence definitions**

Problem	In Table A.9, Devices with PDin = 2 octets, PDout = 1 or 2 octets and PDin = 1 or 2 octets, PDout = 2 octets are missing.
Solution	Replace rows in Table A.9 containing "TYPE_1_1/1_2 (interleaved)" by one row with: don't care, 2, "PDin + PDout length > 2 octets", TYPE_1_1/1_2 (interleaved).
Clauses	Annex A
Subclauses	Annex A.2.6 (Table A.9)
Impact on	–
Remark	–

125

126

127 **4.11 T18 of Master System Management state machine can freeze Port**

128 This problem report refers to change request ID 232 in the database.

129 Table 11 shows the problem report and the solution.

130 **Table 11 – T18 of Master System Management state machine**

Problem	T18 of the Master System Management sets a Port into inactive state and indicates cycle fault to the Configuration Manager. This behavior freezes the Port until a new Port configuration is set.
Solution	Port switches to OPERATE as defined in T5 (COMP_FAULT) but with a best matching cycle time (scan mode). This way, the Configuration Manager can restart Port when COMLOST is detected. Change T18 in Table 85 to "SM_PortMode.ind (CYCTIME_FAULT), DL_SetMode.req (OPERATE, ValueList), ValueList.M-SequenceTime = MinCycleTime of Device"
Clauses	Clause 9
Subclauses	9.2.3.2 (Table 85)
Impact on	–
Remark	–

131

132

133   **4.12   Reduce complexity for parameters with "write only" access rights**

134   This problem report refers to change request ID 233 in the database.

135   Table 12 shows the problem report and the solution.

136   **Table 12 – Reduce complexity for "write only" parameters**

Problem	Usage of parameters with "write only" access rights is not defined precisely, for example with respect to data types and structures. In practice they are used as a command to change state.
Solution	Insert additional bullet to list in 10.8.5: "Parameters with attribute write-only (W) shall be treated like a SystemCommand. Only basic data types are permitted".
Clauses	Clause 10
Subclauses	10.8.5 (bullet list)
Impact on	–
Remark	–

137

138

4.13 Rules for MasterID classes not defined yet

139

This problem report refers to change request ID 235 in the database.

140

Table 13 shows the problem report and the solution.

141

Table 13 – Rules for MasterID classes not defined yet

142

Problem	There are no definitions for the usage of MasterIDs. For example, if a Master has 8 instead of 4 Ports, is there a need to use a new masterID?
Solution	Insert sentence in 11.2.4 at the end of the first paragraph, before "Table 106...": "A class of Masters with a certain MasterID and VendorID shall not deviate in communication and functional behavior (Master type identification)".
Clauses	Clause 11
Subclauses	11.2.4
Impact on	–
Remark	–

143

144

145

146

147 **4.14 Coding of empty Data Storage objects missing**

148 This problem report refers to change request ID 236 in the database.

149 Table 13 shows the problem report and the solution.

150 **Table 14 – Coding of empty Data Storage objects missing**

Problem	Especially for test purposes, it is important to check if the DS content is empty or invalid. Annex G shows the coding of Data storage objects but not the coding of empty DS data.
Solution	Insert after Table G.2: "In case of DS empty the header shall be set to "0" and ArgBlockLength shall be set to 12".
Clauses	Annex G
Subclauses	–
Impact on	–
Remark	–

151

152

153 **4.15 Inconsistent DS objects or PortMode at SMI_ParServToDS**

154 This problem report refers to change request ID 237 in the database.

155 Table 13 shows the problem report and the solution.

156 **Table 15 – Inconsistent DS objects or PortMode at SMI_ParServToDS**

Problem	Reaction of SMI_ParServToDS not defined when errors occur, for example in case of incorrect PortMode or inconsistent identification.

Solution	1. Create new SMI related ErrorType in Table C.3:
	   Incident Inconsistent DS data
	   Error Code 0x40
	   Additional Code 0x39
	   Name INCONSISTENT_DS_DATA
	2. Change second paragraph in 11.2.9 to:
	"In case Data Storage is not supported or not activated on this Port, the service will be replied with Result(-) "INCONSISTENT_DS_DATA". The same applies if Data Storage is not consistent with Port configuration, e.g. VendorID does not match".
	3. Insert "INCONSISTENT_DS_DATA" in section Result(-) of 11.2.9.

Clauses	Annex C, Clause 11
Subclauses	Annex C.4 (Table C.3), 11.2.9
Impact on	–
Remark	–

157

158

159

160   **4.16   Minimum Port C/Q current at COM or DI mode**

161   This problem report refers to change request ID 238 in the database.

162   Table 13 shows the problem report and the solution.

163   **Table 16 – Minimum Port C/Q current at COM or DI mode**

Problem	Minimum Port C/Q current is 5 mA instead of 2 mA as required by IEC standard. With 2 mA, power dissipation of a Master could be reduced dramatically if Ports are configured for DI.
Solution	1. Change in Table 6, row "ILL_M" at 5 V…15 V, Minimum: 5/2 2. Change NOTE 1 at the bottom of the table: "A minimum current of 2 mA for DI mode is compatible with the definition of type 1 digital inputs in IEC 61131-2. In communication mode, for the range 5 V…15 V, the minimum current is 5 mA instead of 2 mA to achieve short enough slew rates for pure p-switching Devices".
Clauses	Clause 5
Subclauses	5.3.2.3 (Table 6)
Impact on	–
Remark	–

164

165 **4.17 Missing compatibility check of CRID for Device V1.0**

166 This problem report refers to change request ID 239 in the database.

167 Table 13 shows the problem report and the solution.

168 **Table 17 – Missing compatibility check of CRID for Device V1.0**

Problem	Objective of the Master compatibility check is to detect mismatches between the connected real Device and the Port configuration. This check also comprises the revision. However, the activity chart "CheckCompV10" in Figure 74 does not include check of the configured revision ID (CRID).
Solution	Change first decision in D5 to [CVID=RVID and CDID=RDID and CRID=1.0] and change second decision in D5 to [CVID<>RVID or CDID<> RDID or CRID>1.0]
Clauses	Clause 9
Subclauses	9.2.3.3 (Figure 74)
Impact on	–
Remark	See new Figure 74 below

169

170 New Figure 74 – "Activity for state "CheckCompV10"" with colored corrections

171
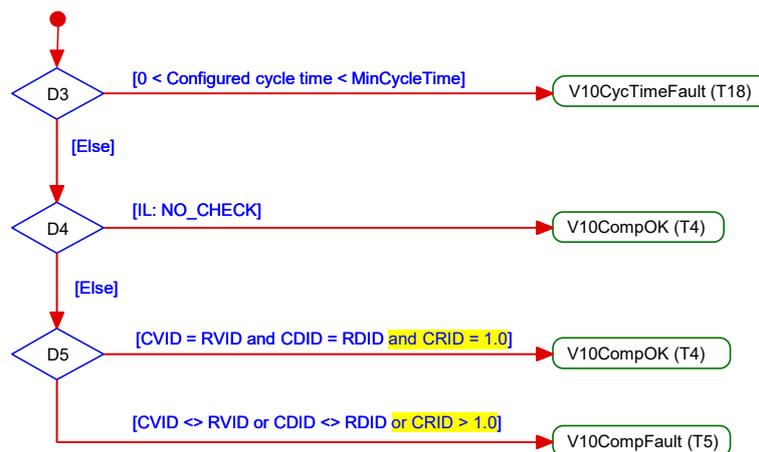
172

173

174   4.18   Permitted coding of "TRUE/FALSE" (Boolean) is misleading

175   This problem report refers to change request ID 240 in the database.

176   Table 13 shows the problem report and the solution.

177   **Table 18 – Permitted coding of "TRUE/FALSE" (Boolean) is misleading**

Problem	In F.2.2 (BooleanT) a receiver can interpret the range from 0x01 through 0xFF as "TRUE" and shall interpret 0x00 as "FALSE". Which values shall the Device return in such a case? Why is this necessary?
Solution	The Device shall always return "0xFF" in case it receives values from 0x01 to 0xFF as it is a sender. Currently, there is no possibility to reach upper-level tool manufacturers since no test specification exists. Thus, change as follows: "Since some upper-level software tools are not used to this restricted use of Booleans, a receiver can interpret the range from 0x01 through 0xFE as "TRUE" or reject with error message".
Clauses	Annex F
Subclauses	F.2.2
Impact on	–
Remark	–

178

179

180 **4.19 List of patents not up to date**

181 This problem report refers to change request ID 241 in the database.

182 Table 13 shows the problem report and the solution.

183 **Table 19 – List of patents not up to date**

Problem	List of patents in clause 0.2 are not up to date.
Solution	1. 3 new SK patents to be inserted; the existing one remains 2. 1 "old" SI patent to be removed 3. 1 "old" AB patent to be removed 4. 1 "old" FE patent to be removed 5. SK to send patent statement to IEC Central Office
Clauses	Introduction
Subclauses	0.2
Impact on	–
Remark	See new patent table below.

184

185

DE 102 119 39 A1 US 2003/0200323 A1	[SK]	Coupling apparatus for the coupling of devices to a bus system
DE102011002038B3	[SK]	Filling level sensor for determination of filling level in toroidal container, has evaluation unit determining total filling level measurement value, and total filling level output outputting total filling level measurement values
DE102016114600B3	[SK]	IO-Link capable sensor and method of communication
DE202016104342U1	[SK]	IO-Link-capable sensor

186

187

188

189   **4.20   Status of Port_Power_Off**

190   This problem report refers to change request ID 242 in the database.

191   Table 13 shows the problem report and the solution.

192   **Table 20 – Status of Port_Power_Off**

Problem	Service SMI_PortStatusList (E.4) provides in PortStatusInfo a state called PORT_POWER_OFF that is only activated if communication stops due a SMI_PowerPowerOffOn service. The explanation for this state is misleading when using Figure 101 (Configuration Manager) and the associated transition Table 126.
Solution	1. At first, transition T3 in Table 126 is changed: "PortStatusInfo = NOT_AVAILABLE" instead of "PortStatusInfo = PREOPERATE" 2. Then, PortStatusInfo in Annex E.4 is changed: "3: Reserved" instead of "3: PREOPERATE" 3. Then, PortStatusInfo in Annex E.4 is changed: Definition of 254: PORT_POWER_OFF is now: "Shutdown of Port is active caused by SMI_PortPowerOffON"
Clauses	Annex E
Subclauses	Annex E.4 (Table E.4, PortStatusinfo)
Impact on	–
Remark	See SP-CR-ID 216 (Table 126)

193

194

195 # Annex A
196 (normative)

197
198 # Conformity

199 ## A.1 Package 2020

200 Package 2020 comprises everything required to achieve conformity of Masters and Devices. It
201 is based on the current versions of the IO-Link specifications together with the Corrigendum
202 2020 (this document). As soon as the test tools are available, the Master and Device manu-
203 facturers can type-test their products and achieve the necessary preconditions for a Manufac-
204 turer Declaration. A corresponding form can be downloaded from the Internet (see Figure
205 A.1).
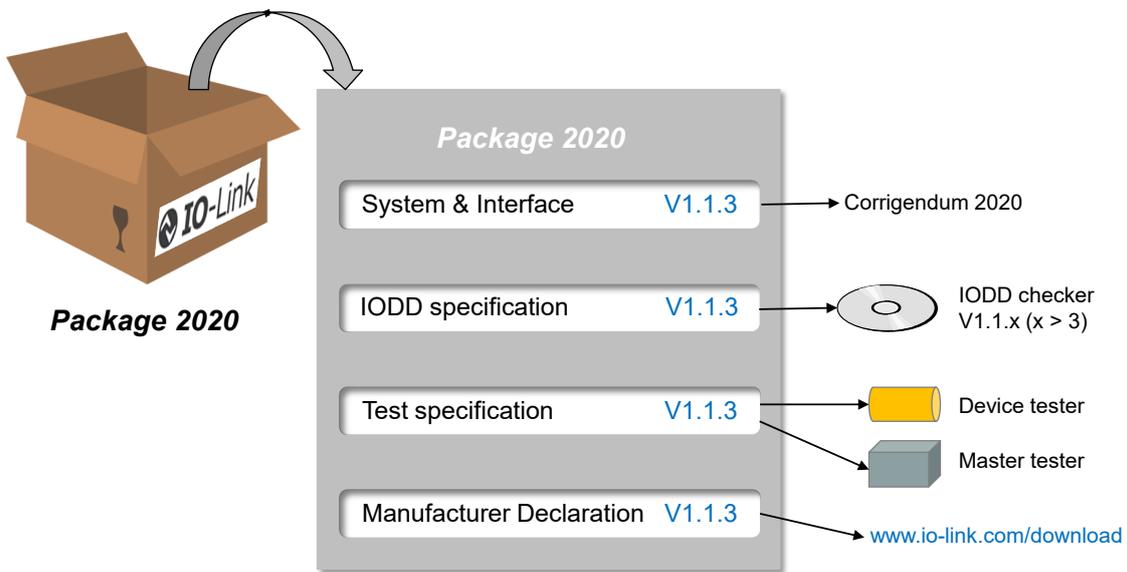
206
207 **Figure A.1 – Ensemble of package 2020**

208 ## A.2 Transitions

209 Figure A.2 shows the relationship between the IEC standard and possible packages.
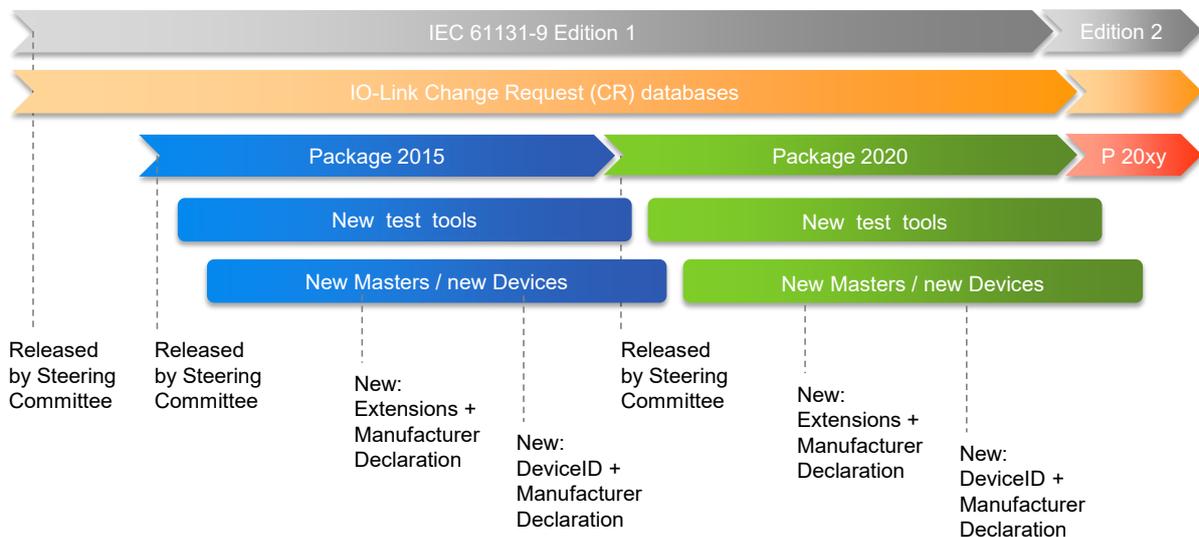
210
211 **Figure A.2 – Transitions**

212 While the IEC standard remains constant for some years, the IO-Link Community reacts as
213 soon as possible on problem reports (CRs) posted in the change request database.

214 Major functional steps can cause the IO-Link Community to create a consistent package for
215 Master and Devices using important CRs to achieve correct interoperability between Masters
216 and Devices through conformity.

217 The following transition rules apply (see [6] for details):

218 • Masters and Devices can operate in non-conformity under a variance or continuation per-
219   mit from the IO-Link Community upon request ("godfathering").

220 • Legacy Devices according to [4] shall not be put on the market after January 1st, 2017.

A.3   Manufacturer Declaration

222 Figure A.3 shows the basic layout of the Manufacturer Declaration. The currently valid version
223 can be downloaded from the Internet (www.io-link.com).

224

225 **Figure A.3 – Form of the "Manufacturer Declaration"**

226
Annex B
227
(informative)

228

229
Reference tables

230
B.1 References for the Interface and System Specification

231
Table B.1 shows the Interface and System Specification reports sorted by clauses.

232
Table B.1 – Interface and System Specification reports sorted by clauses

Clauses/Figures/Tables	Title	SP CR-ID
0.2	List of patents not up to date	241
2	Undated references of EMC standards are causing confusion	214
5.3.2.3, Table 6	Minimum Port C/Q current at COM or DI mode	238
5.3.3.2, Table 9	EMI – Influence of signal slew rate	228
9.2.3.2, Table 85	T18 of Master System Management state machine can freeze Port	232
9.2.3.3, Figure 74	Missing compatibility check of CRID for Device V1.0	239
10.3.2, Figure 86, Table 96	Ambiguous transitions in Device PM state machine	218
10.3.2, Figure 86, Table 96	Term "StoreRequest" in Device PM state machine is misleading	219
10.3.2, Figure 86, Table 96	PM state machine does not consider reset SystemCommands	226
10.8.5	Reduce complexity for parameters with "write only" access rights	233
10.10.2	Timing constraints for appearing/disappearing Events are unclear	224
11.2.4	Rules for MasterID classes not defined yet	235
11.2.9	Inconsistent DS objects or PortMode at SMI_ParServToDS	237
A.2.6, Table A.9	Incomplete M-sequence definitions	231
Annex D.3, Table D.2	Triggers of Events "0xFF2x" are incorrect	215
Annex D.3, Table D.2	How to inform about Device readiness via SMI service?	216
Annex E.2, Table E.2	Rules for MasterID classes not defined yet	235
Annex E.4, Table E.4	Status of Port_Power_Off	242
F.2.2	Permitted coding of "TRUE/FALSE" (Boolean) is misleading	240
Annex G	Coding of empty Data Storage objects missing	236

233

234   **Annex C**
235   (informative)
236
237   **How to use the IO-Link change-request (CR) database?**

238   **C.1   Access CR database**

239   Figure C.1 demonstrates the access to the CR database of a particular specification.

240

241   **Figure C.1 – Access the CR database**

242   On second page (behind the title sheet) you will find the link (URL) to the database to be en-
243   tered in a web browser.

244   **C.2   Access CR project associated with the specification**

245   The browser will display the entry to the database with its Login (Name) and Password, which
246   can be copied from the second page of the PDF document (see Figure C.1). In this case you
247   will be first an anonymous user for the system.

248   Members of working groups, who are already registered within the IO-Link Community and
249   assigned to the related project, should use their personal account provided by the business
250   office.

251

252   **Figure C.2 – Access CR project**

253 ## C.3 Projects view

254 After login, the system will display either one particular project or several of them as shown in
255 Figure C.3. The specification related project can be found in third blue row.

256

257 **Figure C.3 – Projects view**

258 In menue "Actions" (red circle) you will find three icons allowing for a new entry of a CR (see
259 Annex C.4), for a view on all existing CRs within this project (see Annex C.5), and a view on
260 the project information (see Annex C.6) as shown in Figure C.4.
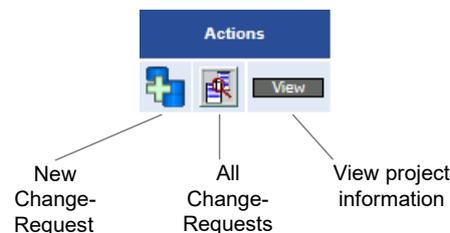
261

262 **Figure C.4 – Possible actions on the project**

263 Members of the working group can get access to intermediate working draft documents or
264 meeting minutes via the view on the project information.

265 ## C.4 CR entry

266 Figure C.5 demonstrates the entry fields of a new CR.

267 First, it is necessary to enter at least one of your identifications, preferably the E-Mail ad-
268 dress. This allows the working group to send you an E-Mail in case of an inquiry.

269 In the *Priority* field you can overwrite "*n/a*" and chose one of three other levels: *low*, *medium*,
270 or *high*.

271 In the *Cause* field you can overwrite "*New Feature*" and chose one of five other levels:
272 *Change feature*, *Layout change*, *Bug*, *Optimization*, or Management.

273 In the *Type of comment* field, you can overwrite "*General*" and chose one of two other levels:
274 *Technical* or *Editorial*.

275 The field *Precedent CR* can be skipped.

276 In field *Abstract* you should enter a brief description characterizing best your problem. This is
277 very import since many readers rely on a quick and comprehensible idea of this problem when
278 scrolling through the CRs before reading the details within the description field.

279 In field *Description* you should enter a comprehensive description as precise as possible us-
280 ing references to the specification such as Figures, Tables, etc.

281 The new release of the database supports upload (see field *Upload File*) of any commonly
282 readable file of limited size such as scans of handwritten papers as PDF, or WORD or POW-
283 ERPOINT documents.

284

Create CR No. 244 for Project	"02_IO-Link Interface and System V1.1.x" (CC/PG1)
*First Name	
*Last Name	
*Company	
*E-mail	
Priority	n/a
Cause	New Feature
Type of comment	General
*Abstract	
*Description	
Context / Constraint	
Test	
Compatibility	no impact
Found in Version	V1.1.3 (file: IOL-Interface-Spec_10002_V113_Jun19.pdf)
*Line	
*Clause / Subclause	
*Page	
Upload File (Max size: 250 MB)	Choose File No file chosen
Create more CRs	☐ (check to report more CRs)
Send Mail	☐ Send Mails
* required * at least one	Submit CR

285

286
Figure C.5 – Entry of a new CR

287 In field *Context/Constraints* you may enter information on used hardware or software for your
288 particular problem.

289 Field *Found in Version* shows you the current valid specification you can refer to. It is not
290 possible to enter a CR for older versions of the specification.

291 The database system will only allow you to submit the CR if you provided at least a number in
292 field *Line*, or the related number (e.g. 6.2) in field *Clause/Subclause*, or a related number in
293 field *Page.* Usually, the working group prefers the Line indication. The IO-Link Community de-
294 cided to also publish all released specifications with line numbers.

295 In case you want to enter more than one CR you can check the box in *Create more CRs* sav-
296 ing you time by omitting the entry of the identification repeatedly.

297 In case you want to alert all members of the working group you can check the box in *Send*
298 *Mail*. The members will receive a standardized e-mail from the database system.

299 ## C.5   View of all project CRs

300 Figure C.6 shows only one out of the posibble list of several CRs in the project as an exam-
301 ple.

302 The system assigned ID numbers automatically when the CR was entered (here: *41*). Next to
303 the ID you will find the state of this CR (here: *Closed*), which means, the working group de-

cided already, and the result is shown in the field *Responses*. Other possible states you may encounter are: *Created, FAQ, Implementation, Review, ReOpened, Deferred, Closed, and Refused.*

Figure C.6 – View of all project CRs

With the help of the selection box within the red circle you can filter the view by one of the listed states or optionally show *All* CRs (as in Figure C.6) or all *Not closed* CRs.

C.6   View of the project information

Figure C.7 shows the project information. An anonymous user cannot see and access intermediate documents of the working group.

Figure C.7 – Project information

Bibliography

317

318 [1]   IO-Link Community, *IO-Link Interface and System*, V1.1.3, June 2019, Order No.
319   10.002

320 [2]   IEC 61131-9, *Programmable controllers – Part 9: Single-drop digital communication
321   interface for small sensors and actuators (SDCI)*

322 [3]   IO-Link Community, *IO Device Description (IODD)*, V1.1.3, January 2021, Order No.
323   10.012

324 [4]   IO-Link Community, *IO-Link Communication*, V1.0, January 2009, Order No. 10.002

325 [5]   IO-Link Community, *IO-Link Test Specification*, V1.1.3, January 2021, Order No.
326   10.032

327 [6]   IO-Link Community, *IO-Link Product Quality Policy*, V1.2, January 2021, Order No.
328   10.132

329   _____

330

IO-Link