

IO-Link Exceptions

Change and Exception Management

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This document has been prepared by the technology working groups of the IO-Link community. It shall be observed by all users of IO-Link documents.

Any comments, proposals, and requests on this document are appreciated through the IO-Link CR database www.io-link-projects.com. Please provide name and e-mail address.

Login: *IO-Link-Except*

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 devices shall provide an associated manufacturer declaration on the conformity of the device. A corresponding form with reference to relevant documents is available per download from www.io-link.com.


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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.

Publisher:

IO-Link Community

c/o PROFIBUS Nutzerorganisation

Haid-und-Neu-Str. 7

76131 Karlsruhe

Germany

Phone: +49 721 / 98 61 97 0

Fax: +49 721 / 98 61 97 11

E-mail: info@io-link.com

Web site: www.io-link.com

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1 0 Introduction

2 **0.1 General**

3 If necessary, the IO-Link Community elaborates new versions of the "IO-Link Interface and
4 System" specification in combination with the associated versions of the "IO-Link Test Specifi-
5 cation" and "IODD Specification". Afterwards these specifications are combined in a so-called
6 "Package X", to which the conformity of a device can be declared.

7 The "IO-Link Test Specification" covers only a very small area of exceptions that may occur
8 within IO-Link business. Clauses 4.4. and 4.5 contain the following statements:

9 *If a Device did not pass a certain test case due to measurement values close to the tolerance*
10 *limits or similar situations it is possible to send an informal request to the organization listed in*
11 *Annex D. This request shall be comprehensive enough for the experts to allow for an exception*
12 *under certain conditions or clarification of the specifications. If an exception applies, it shall be*
13 *documented in the user manual mentioning the possible implications.*

14 *Instead of pursuing such a time-consuming and uncertain way, it is highly recommended for the*
15 *applicant to rather strive for a robust implementation and conformity of the Device."*

16 Growing worldwide success of IO-Link has shown that these statements are not sufficient and
17 therefore cause the Community to define a comprehensive strategy and a set of rules as well
18 as to establish stringent procedures.

19 This document is presumed to be a general policy that is used for change management within
20 the Community as well as handling any exception requests for specific devices.

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IO-Link Change and Exception Management – Organization and Processes

1 Scope and purpose

Subject matter of the IO-Link Community is a single-drop digital communication interface technology and associated system support and extensions for sensors and actuators in factory automation, starting from the smallest devices up to complex mechatronics elements.

The community is responsible for

- Investigation and evaluation of new requirements,
- Development of technology specifications,
- Development of test specifications and quality assurance policies,
- Information dissemination and marketing,
- International awareness through organizational measures and standardization, and
- Cooperations.

A set of documents, available for download from the IO-Link website, allows for maintaining a high degree of product quality and system interoperability. However, practice shows that even very well-designed specifications and policies may not lead to 100 % success.

There are always deviations in expectations from "Providers" of such documents and from their Users. Usually, the deviations occur at different phases of a product development. The earlier clarifications take place the better for the manufacturer and the community.

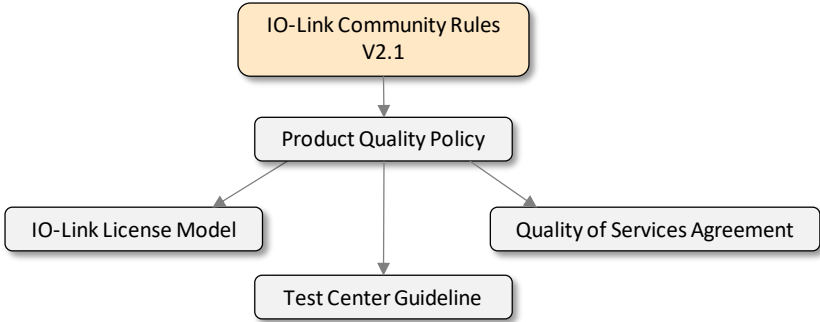
It is the purpose of this paper to identify

- possible classes of deviations,
- responsible IO-Link decision bodies, and
- rules to resolve open issues.

A lot of stress and extra work for the IO-Link Community can be avoided, if Users have easy access to the information in this document and if candidates are informed, when they turn in their IO-Link Community membership application.

2 Overview of documents

The IO-Link Community uses a set of policies to organize work of its members, providers and test centers and to maintain quality assurance (mainly interoperability) of member products as shown in Figure 1.



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Figure 1 – IO-Link's policies

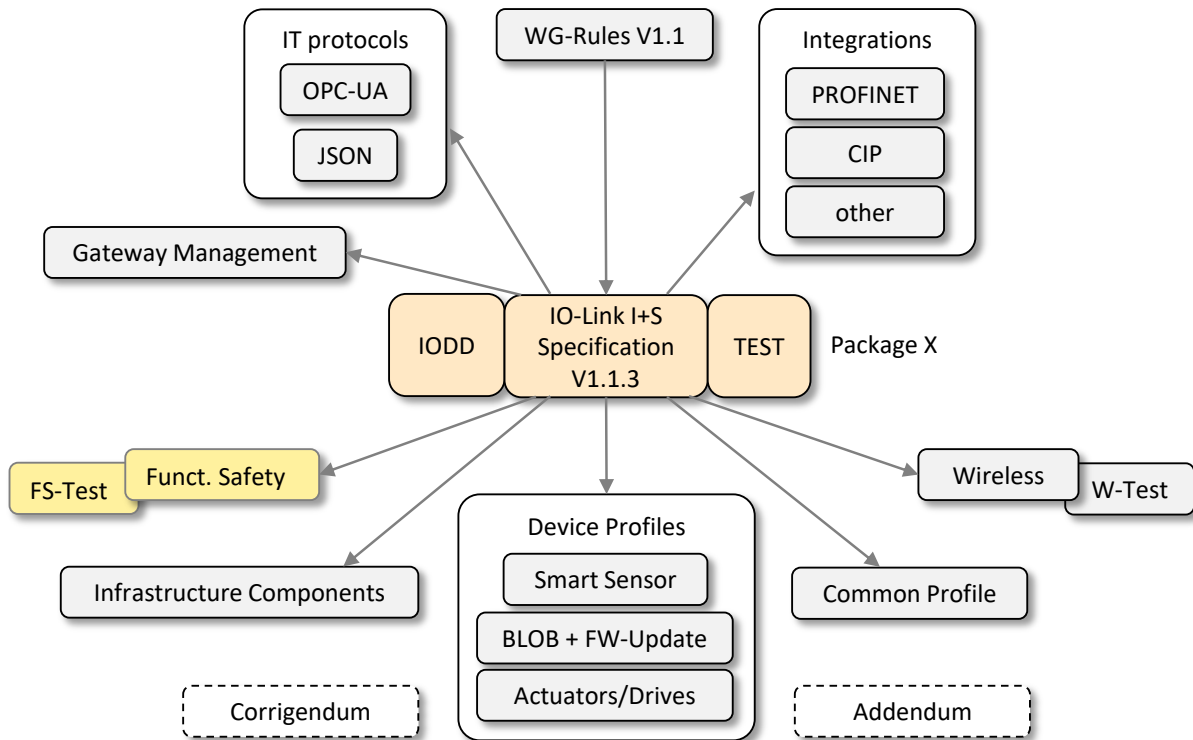
56 Table 1 provides information about IO-Link's policy documents.

57 **Table 1 – Subject of IO-Link's policy documents**

Title of document	Subject	Reference
IO-Link Community Rules (Body of rules between IO-Link members and the PNO)	This document governs the cooperation between IO-Link members or licensees and the PNO and describes the rights and obligations of the partners.	[1]
Product Quality Policy	This policy describes the procedures necessary for the attainment of a manufacturer declaration for an IO-Link Master and Device. Furthermore, in sections 4 and 5 it gives hints for the successful preparations for the tests as well as describing procedures for brand labelling and dealing with equipment variants.	[2]
IO-Link License Model	This document describes the license model for non-IO-Link Members.	[3]
Quality of Services Agreement	The purpose of this agreement is to establish a quality assurance system between IO-Link Community and the IOL-Competence Centers (IOLCC) for the technologies of IO-Link.	[4]
Test Center Guideline	This document describes the preconditions for becoming a test laboratory accredited by IOLink community. It additionally describes the rules for the performance of such an IOL Test Center (IOLTC).	[5]

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59 The worldwide fast-growing acceptance of the IO-Link technology causes an also growing number of technical specifications as shown in Figure 2.
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62 **Figure 2 – IO-Link's specification portfolio**

63 Table 2 provides information about IO-Link specifications and the WG Rules.

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Table 2 – Subject of IO-Link specifications and the WG Rules

Title of document/group	Subject
Specification Validity Periods	Definition of validity periods for the IO-Link community specifications and phasing out of versions. Definition of packages of interconnected specifications as base for Manufacturer Declarations [6].
Device Profiles	Profile specifications can be elaborated for Device families as soon as there are enough supporting member companies (≥ 3). Characteristics of profiles are so-called FunctionClasses and ProfileIdentifiers (combined FunctionClasses).
Common Profile	Common rules for Device profile design and common FunctionClasses for Identification and Diagnosis.
Infrastructure Components	Specified characteristics of components between Master Port and Device (in progress).
Functional Safety	System extensions for functional safety, test and assessment
Wireless	System extensions for wireless connections and test
Gateway Management	Coordination of client accesses to SMI (in progress)
IT protocols	Data formats for data exchange in IT networks (OPC-UA, JSON)
Integrations	Mappings of IO-Link from and to fieldbus networks (PN, CIP, etc.)
Corrigendum	It is up to the "owner" (working group) of a document to publish a document with important error corrections.
Addendum	It is up to the "owner" (working group) of a document to announce important features planned for next official release.
Working group rules	How to write a specification, change request (CR) database management, and processing of CRs

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3 Deviations

3.1 Possible classes of deviations

Most of the work within the IO-Link Community is on a voluntary basis and thus it is organized in an efficient manner. Since different groups exist with particular expertise, typical and/or imaginable incidents are described and sorted in "classes of deviations" for the purpose of directing issues to the right place for resolution.

Table 3 includes possible classes of deviations but is not limited to these classes nor to the listed cases.

Worst situation for the Community is, when companies try to gain advantages against the competition using intended deviations, that are violating specifications/standards. These deviations are reported at a late time, when e.g. ASICs are produced, and devices are already in production such that the Community is forced to agree.

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Table 3 – Possible classes of deviations

Class of deviation	Case description
Change requests	Any bug report or request regarding a particular specification
	Any bug report or request regarding a particular policy document
Specification interpretation	It was unclear whether a feature is mandatory or optional
	It was unclear whether a feature can be used manufacturer specific
	Feature was not specified clearly or detailed enough (gap)
	Description/wording was misleading
	Referenced standards and specifications were outdated/not correct
	Behavior descriptions were ambiguous
	Conflicts with IEC 61131-9

Class of deviation	Case description
Implementation & test	Value ranges are not correct (physical layer, levels, timings)
	Behavior is incorrect (sequences, error handling)
	Feature is missing (e.g. ISDU, M-sequence TYPES, etc.)
	Service is missing (e.g. SMI)
	Incorrect manufacturer specific feature (e.g. service)
	Inappropriate integration (e.g. access conflicts)
	Inappropriate infrastructure component
	Inappropriate port extension or function
IODD issues	Schema modifications
	Inappropriate extensions
	Inappropriate omissions
	Inappropriate embeddings (e.g. other device descriptions)
Manufacturer declaration	Missing or incorrectly described constraints
	Incorrect references
Policy interpretation	Incorrect brand labelling
	Patent issues
	Membership issues

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80 **3.2 Discovery of deviations**

81 The time of discovery of deviations is important for the management of exceptions. All measures
82 of change and exception management are considering these phases.

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Table 4 – Discovery of deviations

Usage phase	Types of detected deviations
Reading	Usually, during first reading or later, focus is on typos, wording, comprehension, structure, missing items, inconsistencies, etc.
Planning	In this phase, focus is for example on mandatory/optional, and inconsistencies.
Design	This could occur while working on hardware or software design of a Master or Device. It could also be while elaborating a specification for IO-Link system extensions.
Implementation	This could occur while implementing software (state machines, sequence charts, etc.)
Test	Systematic detection of deviations is the purpose of tests. Test equipment shall be obtainable for anybody at any time (technology provider).
Deployment	The Community strives for a high degree of product quality. Thus, detection of deviations shall be very unlikely.

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85 **4 Related IO-Link bodies**

86 The related IO-Link bodies for the given subjects are listed in Table 5.

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Table 5 – Related IO-Link bodies

IO-Link body	Related responsibilities
Working Group	Group of experts to specify a particular technology, or profile, or test cases, or policy, or an adhoc issue. Group maintains and processes one or more related change request database projects. Group can perform marketing issues.
Competence Center	Group of experts of technology providers, or consultants, or institutes, etc.
Test Center	Group of experts of companies performing tests and/or assessments

IO-Link body	Related responsibilities
CoreTeam	Group of experts responsible for the core IO-Link technology (Package) and for system coordination in addition to WG responsibility. This group can be enlarged by additional experts to resolve particular deviations.
Marketing Requirements Team	Any new major system feature shall be checked by this team for market relevance/acceptance prior to incorporation into existing specifications via the Core Team or responsible Working Group.
Clearing Group	Serious deviations of products discovered either upon request or during testing or upon deployment are to be investigated by the group of experts defined in Annex A.
Steering Committee	This elected group of member representatives is responsible for IO-Link Community strategies, partnerships, technology approval, information dissemination, marketing activities, organizational issues, and conflict resolution ("last resort").
User	Anybody in the world who downloaded a document related to IO-Link with the purpose of implementing an IO-Link Master or Device, or system integrations.

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89 **5 Management processes**

90 **5.1 Escalation concept**

91 The IO-Link Community is striving for an early alert system, where any deviation is reported as
92 soon as possible.

93 All Users shall be informed about this document, its change and exception strategy on www.io-link.com.
94

95 **5.2 Document handling**

96 In the early stage of developing new specifications, reviewing these or interpret new specifica-
97 tions the following interactions are defined.

98 **5.2.1 Design of documents**

99 On document level ("Design"), for example development of documents for IO-Link system ex-
100 tensions or integration into fieldbus, IT, or embedded systems, the IO-Link Community refers
101 those developers to its system coordinator, the CoreTeam. It shall be informed by working
102 groups in case of intended system deviations. The CoreTeam together with the related Working
103 Group shall elaborate solutions/compromises to be approved by the Steering Committee. Any
104 such system deviation shall be described in an appropriate way in the corresponding specifica-
105 tion.

106 **5.2.2 Review/Maintenance of documents**

107 On document level ("Reading" or "Planning"), the IO-Link Community is operating a Change
108 Request database. Anybody in the world can download IO-Link specifications and policies.
109 Whenever such a User discovers a deviation, he/she is entitled to enter a report in form of a
110 "change request". See Annex B for detailed description of the database and identifying valid
111 change requests.

112 **5.2.3 Interpretation of documents**

113 On document level ("Design" and/or "implementation"), the IO-Link Community refers Users to
114 Competence Centers directly, or to the business office that forwards the request to the associ-
115 ated Competence Centers, see publisher information.

116 **5.3 Test concept**

117 A certification is not required. Manufacturers shall use the appropriate manufacturer declaration
118 forms [7] provided for download at www.io-link.com.

119 This manufacturer declaration states conformity to the mentioned specifications. Test specifi-
120 cations accompanied to the specifications provide sets of uniform tests created by the working
121 group.

122 Large companies can afford to organize for an internal test and assessment center. The Com-
123 munity took care for independent IO-Link Test Centers that can be contracted by non-members
124 or smaller companies or businesses to perform test and certification.

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126 **5.3.1 Deviating test implementations (between tester or against specifications)**

127 On quality assurance level ("Test"), the IO-Link Community demands for each project test spec-
128 ifications or annexes to technical specifications as a precondition. The Community refers Users
129 to Technology Providers for test equipment, and to Test Centers. In case of deviations, the
130 Technology Providers and Test Centers are in charge to resolve issues together with the cor-
131 responding (test) working group.

132 In order to prevent from surprises at the end of a device development, the IO-Link Community
133 promotes and sponsors quality test tools available at the developer's site and in test centers.
134 The Technology Providers for test equipment are responsible for the frequency of updates, the
135 quality level, and an error/bug fix information system.

136 **5.3.2 Implementation exceptions (omission of highly recommended features)**

137 On implementation level, when a company decides not to implement highly recommended fea-
138 tures, the company is obliged to state the omission in the corresponding Manufacturer Decla-
139 ration of the device together with an appropriate reasoning.

140 **5.3.3 Implementation exception (omission of mandatory features)**

141 In cases, where companies are not willing to fit their devices with features they think their cus-
142 tomers do not need and they are not willing to pay for, the IO-Link Community established the
143 Clearing Group to be addressed, that is responsible to analyze and manage processing with
144 appropriate bodies in IO-Link (see Table 5). This team suggests a conflict resolution or excep-
145 tions with constraints on manufacturer declaration, user manual, and period of validity or inser-
146 tion in specifications. Approved exceptions shall be archived in the project database within the
147 project "Implementation exceptions".

148 **5.3.4 Test exceptions (violation of tests)**

149 In cases, where despite all precautions a deviation has been discovered that cannot be fixed at
150 reasonable cost and time, the Clearing Group is in charge suggesting a proposal for conflict
151 resolution or exceptions with constraints on manufacturer declaration, user manual, and period
152 of validity. Approved exceptions shall be archived in the project database within the project
153 "Test exceptions".

154 It is the responsibility of the Clearing Group to ensure the integrity of the system. A validity
155 period enables the vendor to fix the issue in an appropriate time schedule.

156 **5.3.5 Field issues**

157 On machine or in the field level ("Deployment"), the IO-Link Community refers to the the Com-
158 petence Centers for initial clarification. If no agreement can be settled the Clearing Group can
159 be called, which prepares a decision proposal to be handled by the Steering Committee.

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Annex A
(informative)
Contact information of the Clearing Group

The Clearing Group represents the technology and quality responsible persons which are

- Head of IO-Link quality (responsible for correct processing of exception requests)
- Technology providers for tester equipment
- Core team
- Head of test WG
- Head of IODD WG

The Clearing Group can be contacted via email to

test@io-link.com

or via the IO-Link Service Center, see publisher information.

Annex B (informative)

Project data base with document types

B.1 Specifications or community documents

For each publicly available IO-Link document, be it a policy or specification, a CR Database project shall be established by the corresponding working group. The document shall carry access information (login, password) on its second page.

B.2 Change requests

Each CR shall be responded within a reasonable time frame. If an immediate answer is not possible, the originator shall at least be informed about the status of the processing. It is not necessary for the working group to inform about all intermediate states due to the complexity and dependencies of many CRs.

Figure B.1 shows the example of CR database projects of the core IO-Link technology, where complexity and dependencies are illustrated.

In a process of continuous improvement for IO-Link products, the following rule has been established for all projects:

In addition to the basic specification, supplemental information 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 in case of functional safety).

B.3 Corrigendum

The working group can decide to publish these CRs through a separate "Corrigendum" document for download on the IO-Link website. However, this measure should be used lightly, since this document cannot be expected to be error-free and would require a CR database project as well, whereas the CR database project for the original document always provides up-to-date information and can be improved directly for immediate access by anybody.

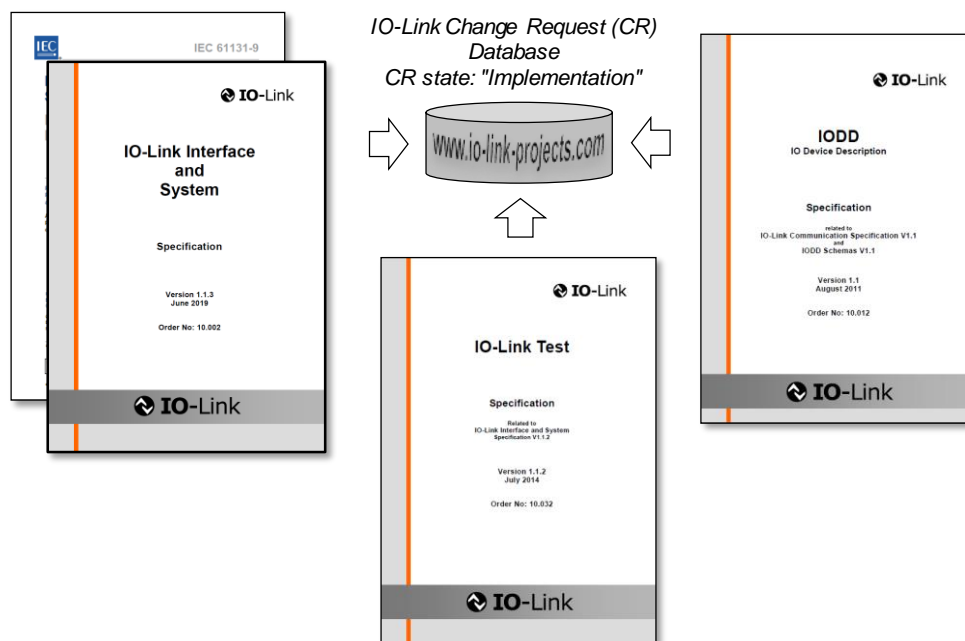
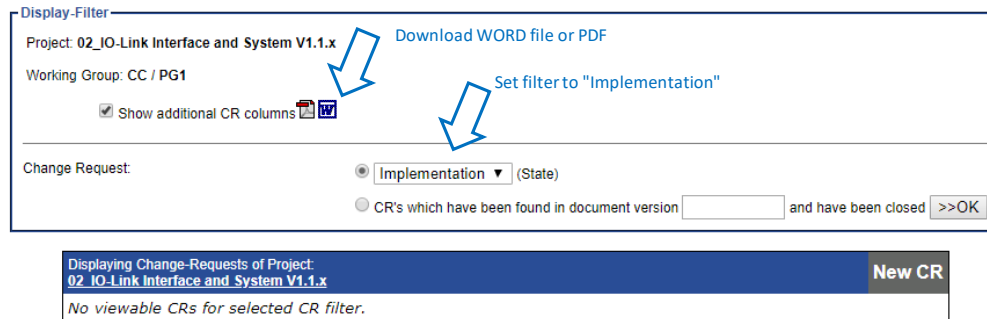


Figure B.1 – Example: Package 2019 specifications and CR database

204 Figure B.2 demonstrates, how easy it is for the user of a CR database project to download an
 205 excerpt of all CRs in state "implementation". After opening the project, all CRs are visible. With
 206 the help of a "Display-Filter" in section "Change Request", a view on CRs in state "Implemen-
 207 tation" can be selected. It is possible to download this view as a WORD or PDF file.



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Figure B.2 – Retrieval of information on relevant Change Requests

210 It is very important for the working groups to focus on precise descriptions of the solutions
 211 within the response field of the CRs. Additional figures, graphs, etc. can be uploaded for ease
 212 of use.

213 **B.4 Addendum**

214 Working groups can decide to publish advance information (Preview) on major changes, best
 215 practice patterns (as it happened with Data Storage), or new features (as it happened with SMI).
 216 This preview allows designers to be prepared for the next release. However, Users can not
 217 raise or enforce a claim, that the content of the Addendum or parts of it will be adopted 100 %
 218 or even at all.

219 **B.5 Intermediate versions**

220 Working groups can decide to publish advance information on handled change requests which
 221 are compiled into an intermediate version of a specification. This version does not represent a
 222 valid version of the specification and no implementation can claim conformity to this intermedi-
 223 ate version, but shows all handled change requests in the context and may be used as measure
 224 of understanding. This publication shall not be used for new change requests.

Annex C (informative)

Guidelines for exception handling

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C.1 General handling of exceptions

In general the exception shall comply to the anti-trust laws in general and shall be as public as possible to avoid advantages or disadvantages for specific participants.

To achieve these goals the following rules are defined

- Exceptions can be requested in private and are handled in private for the first steps to avoid disadvantages by only requesting an exception
- The requester is invited to the discussion meetings on his request
- After discussion and agreement on pursuing the request, the final response of the Clearing Group will be provided to the participants and the community. This decision is public via meeting minutes and by publishing the exception in the data base
- In case of a greater impact on the IO-Link system or IO-Link Community, the request is propagated to the Steering Committee
- As a granted exception is base for subsequent exception requests by other requesters, the proposed response (granted exception) shall contain the judgement on the impacts on or threats to the system "IO-Link" in general as well as the accepted restrictions like time limitation or technical constraints

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- [4] IO-Link Quality of Services Agreement V1.2, December 2018, Order No 10.052
- [5] IO-Link Test Center Guideline V1.0, March 2016, Order No 10.142
- [6] IO-Link Specification Validity Periods (for each package), Order No 10.312
- [7] IO-Link Manufacturer Declaration (for each package)

Revision log

Date	Version	Editor	Description
28-Jan-2020	V1.0	WS	First version released by IO-Link community
25-Mar-2023	V1.1	KH	Minor editorial enhancements, omission of not referenced tags, and insertion of new tags. Updated version handling to "Specification validity periods" Added "User" as IO-Link body Restructured clause 5, removing doubled information, splitting into documentation and implementation phase, and explicit description of actions for each type of issue Moved description of CR database handling to Annex B and added new document type "Intermediate version" Added Annex C with short description of exception request handling

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IO-Link Community

c/o PROFIBUS Nutzerorganisation

Haid-und-Neu-Str. 7

76131 Karlsruhe

Germany

Phone: +49 (0) 721 / 98 61 97 0

Fax: +49 (0) 721 / 98 61 97 11

e-mail: info@io-link.com

<http://www.io-link.com/>

