

IODD

IO Device Description

Guideline

related to
IO-Link Interface and System Specification V1.1.4
and
IO Device Description Specification V1.1.4

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49 shall be possible. It is the responsibility of the IO-Link device manufacturer to test the IODD file with the
50 help of the IODD-Checker tool available per download from www.io-link.com.
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79 requirements to ensure interoperability and to claim conformity with this specification.
80 **should:** indicates flexibility of choice with a strongly preferred implementation.
81 **can:** indicates flexibility of choice with no implied preference (possibility and capability).
82 **may:** indicates a permission.
83 **highly recommended:** indicates that a feature shall be implemented except for well-founded cases. Vendor shall
84 document the deviation within the user manual and within the manufacturer declaration.

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190 1 Introduction

191 This IODD Guideline is intended for the IO-Link developer. It helps to

- 192 • design the device so that it can be effectively described by the IODD
- 193 • write a standards conformant IODD for the device
- 194 • release the IODD in a way that is convenient for the user
- 195 • design and test IO-Link Tools

196 It contains explanations of concepts, best practice examples and advices. The knowledge of
197 the IO-Link Interface and System Specification and the IO Device Description Specification is
198 indispensable – this guideline does neither replace nor amend these specifications.

199 2 Related documents

200 Related documents are listed in the Bibliography at the end of this document.

201 3 Things to consider when designing an IO-Link Device

202 3.1 Assigning Device ID / Product ID

203 When creating a device that is similar to an existing device it must be decided whether the new
204 device is just a new DeviceVariant of the existing device (same Device ID, different Product ID)
205 or a new device (different Device ID).

206 The prerequisite of treating the new device as a DeviceVariant of an existing device is that the
207 device only differs in things which are not "seen" by the IO-Link Tool (see chapter 7.4.1 of the
208 IO Device Description Specification).

209 But even if this is the case, it is not always wise to do so. Imagine a device that comes in either
210 stainless steel or plastics body. For e.g. food and drug processing, the two variants might not
211 be interchangeable because the material is mandated. In this case it may be better to choose
212 different Device IDs for the two materials so that an automation solution is able to reject an IO-
213 Link Device with the wrong body material.

214 3.2 Floating point values

215 The IODD supports the data type Float32T. When you write a floating point value into the IODD,
216 e.g. as @defaultValue or SingleValue/@value or ValueRange/@lowerValue or @upperValue,
217 don't expect a specific bit pattern in your device!

218 You should only expect a value that is very close to the value in the IODD. There are several
219 reasons for this:

- 220 • There are separate bit patterns for 0 and -0. Tools usually accept both but write only the
221 pattern for 0.
- 222 • Tools usually process the values internally in double (64 bit) precision and convert to
223 float (32 bit) just before writing, leading to rounding.
- 224 • This effect is increased when @gradient and/or @offset is used.

225 [Interesting reading on this topic:

226 David Monniaux. The pitfalls of verifying floating-point computations, ACM Transactions on
227 Programming Languages and Systems (TOPLAS), 30(3):12, May 2008, <http://hal.archives-ouvertes.fr/docs/00/28/14/29/PDF/floating-point-article.pdf>.]

229 3.3 Process Data

230 It is possible to design IO-Link devices whose process data has several different layouts. The
231 only constraint being that all layouts must have the same size.

232 These different layouts are usually the consequence of different modes that the Device is in.
233 Also, the menus will usually be adapted according to that mode.

234 For each direction of the process data (in / out) there shall be only a single mode parameter
235 (Variable or RecordItem) controlling the layout of the process data. The menus appropriate for
236 the modes shall be switched by exactly the same mode parameter. There may be additional
237 parameters switching menus, but these are not allowed to influence the process data layout.

238 It is possible to specify ‘subindexAccessSupported’ on the data type of the process data. This
239 seems superfluous, as the process data is always transferred completely over the process data
240 channel. But it is not! If the Device supports Service PDU 40 (V_ProcessDataInput) or 41
241 (V_ProcessDataOutput), and the process data has a complex type, you have to support
242 subindex access according to this attribute specified at the data type of the process data.

243 **3.4 Conditions**

244 Conditions are used for switching process data and menus. They should be used sparingly.
245 Instead of one Device with a lot of modes, consider making more than one Device with different
246 characteristics. Instead of a lot of parameters controlling detailed aspects of menus consider
247 using less parameters using more states, even if some menu entries must be duplicated.

248 **3.5 Default values**

249 The default values of parameters (Attribute @defaultValue) shall match those values that the
250 device returns in the condition as delivered (or after the Restore-To-Factory-Settings or Back-
251 To-Box command was performed).

252 **3.6 Parameters without a value until written**

253 Sometimes there are parameters which do not have a real value until initialized (written for the
254 first time). When the parameter is read without prior initialization, the device should return a
255 vendor specific ErrorType. Alternatively, if there exists a value that does not occur during
256 normal operation, it could return this value. This value should be described in the IODD as a
257 SingleValue.

258 **3.7 Parameters influencing other parameters**

259 When writing to a parameter leads to a change in other parameters, this parameter must be
260 marked with the attribute @modifiesOtherVariables set to “true” in the IODD. Because it can’t
261 be specified in the IODD which other parameters are influenced, IO-Link Tools have to upload
262 all parameters after each write to such a parameter.

263 In order to avoid long delays use such parameters with caution and as little as possible.

264 **3.8 Replicating a device**

265 There are two methods for replicating the parameters of a device to another device of the same
266 or compatible type:

- 267 1. With the IO-Link Tool:
268 Read all read-write parameters from one device, then write to the other device.
- 269 2. With the parameter server:
270 In the field, just replace the device. On startup of the device, the parameter server will
271 write the parameters formerly read from the previous device.

272 The list of indices/subindices which are to be replicated is taken from the IODD in case of the
273 IO-Link Tool and is taken from ISDU index 3 in case of the parameter server. Note that these
274 two lists are not necessarily identical. The device may offer a multitude of small parameters in
275 its IODD, each on its own ISDU index for convenient access, and a single parameter record
276 (compact storage object), whose ISDU index is not published in the IODD, for efficient access
277 by the parameter server.

278 Variables, which are not part of the IO-Link data storage object can be marked with the attribute
279 @excludedFromDataStorage="true", but this shall only be applied in exceptional cases, see
280 chapter 4.14 Dos and Don'ts.

281 In any case, it is very important that replicating the device with the IO-Link Tool must lead to
282 the same result as replicating the device with the parameter server.

283 **4 Things to consider when writing an IODD**

284 **4.1 XML Hints**

285 Although any text editor may be used for writing an IODD, it is recommended to use an XML
286 editor that is schema-aware. While editing, such editors use the IODD schemas to suggest
287 required / allowed elements and attributes. They also do schema validation with one mouse
288 click.

289 A small selection of XML Editors: (This does not constitute an endorsement by the working
290 group.)

- 291 • Xml Editor - Free download and install on Windows | Microsoft Store (free, see
292 <https://apps.microsoft.com/detail/9nbrwqbwl7k?hl=en-us&gl=US>)
- 293 • Altova XMLSpy (commercial, see <https://www.altova.com/xmlspy-xml-editor>)
- 294 • XMLFox (free, see <https://xmlfox.com/>)
- 295 • XML Copy Editor (free, see <https://xml-copy-editor.sourceforge.io/>)
- 296 • <oXygen/> XML Editor (commercial, see <https://www.oxygenxml.com/>)
- 297 • Easy XML Editor (commercial, see <https://www.edit-xml.com/>, <https://easy-xml-editor.de/>)
- 299 • Notepad++ (free, see <https://notepad-plus-plus.org/>) with the XML Tools plugin (install
300 via the built-in plugin admin)

301 **4.2 Encoding**

302 UTF-8 encoding is mandatory for the IODD. This ensures that characters needed for non-
303 english text can be represented.

304 But even an editor that supports UTF-8 can only display characters when there is a font installed
305 on that computer that contains these characters. The fonts that come with an English / European
306 Microsoft Windows contain characters for European languages only. To display characters from
307 far-eastern languages, it may be necessary to download and install a unicode font that includes
308 CJK (Chinese, Japanese and Korean) and tell the editor to use this font.

309 **4.3 Different types of IDs**

310 An IODD contains several IDs, whose meaning and using is explained here.

311 The attribute id is always used as a definition for texts, variables, data types, menus... on which
312 those IODD-parts can reference. The IDs are often used as identifiers in the firmware of IO-
313 Link Devices and Masters and also in IoT application. Therefore, in contrast to the definition in
314 [2], they should follow the following restricted regular expression pattern: "[A-Za-z][A-Za-z0-
315 9_]*[A-Za-z0-9]".

316 • **Text IDs**

317 Definition

318 Text IDs are defined in the language specific part of the IODD.

319

```

320 <ExternalTextCollection>
321   <PrimaryLanguage xml:lang="en">
322     <Text id="TN_V_X_ExampleParameter" value="Example Parameter"/>
323     <Text id="TD_V_X_ExampleParameter" value="Just an example."/>
324   </PrimaryLanguage>
325   <Language xml:lang="de">
326     <Text id="TN_V_X_ExampleParameter" value="Beispielparameter"/>
327     <Text id="TD_V_X_ExampleParameter" value="Nur ein Beispiel."/>
328   </Language>
329   <Language xml:lang="zh">
330     <Text id="TN_V_X_ExampleParameter" value="样本参数"/>
331     <Text id="TD_V_X_ExampleParameter" value="只是一个例子。"/>
332   </Language>
333 </ExternalTextCollection>
334

```

335 Reference

336 Text IDs can be referenced from any other element which contains the attribute 'textId'.

```

337 <Name textId="TN_V_X_ExampleParameter"/>
338 <Description textId="TD_V_X_ExampleParameter"/>
339

```

340 • Variable IDs

341 Definition

342 Variable IDs are defined in the VariableCollection element.

```

343
344 <VariableCollection>
345   <Variable index="67" id="V_X_AdjustValue" accessRights="rw" defaultValue="500">
346     <Datatype xsi:type="UIntegerT" bitLength="16">
347       <SingleValue value="0">
348         <Name textId="TN_SV_X_AdjustValue_minvalue"/>
349       </SingleValue>
350       <ValueRange lowerValue="1" upperValue="999"/>
351       <SingleValue value="1000">
352         <Name textId="TN_SV_X_AdjustValue_maxvalue"/>
353       </SingleValue>
354     </Datatype>
355     <Name textId="TN_V_X_AdjustValue"/>
356     <Description textId="TD_V_X_AdjustValue"/>
357   </Variable>
358 <VariableCollection>
359

```

360 Reference

361 Variable IDs can be referenced from menus by elements VariableRef or RecordItemRef, attribute 'variableId'.

```

363 <MenuCollection>
364   <Menu id="M_MSR_Param_Sample">
365     <VariableRef variableId="V_X_AdjustValue"/>
366   </Menu>
367 </MenuCollection>
368

```

369 • **Menu IDs**

370 Definition

371 Menu IDs are defined in the MenuCollection element.

```

372 <MenuCollection>
373   <Menu id="M_MR_SR_SwitchingOutputs">
374     <Name textId="TN_SwitchingOutputs"/>
375     <VariableRef variableId="V_SP1" gradient="0.001" offset="0" unitCode="1137"/>
376   </Menu>
377 </MenuCollection>
378

```

379 Reference

380 Menu IDs can be referenced from other menu from elements MenuRef, attribute 'menuId'.

```

381 <MenuCollection>
382   <Menu id="M_MSR_X_Param_DeviceParam">
383     <Name textId="TN_M_X_Param_DeviceParam"/>
384     <RecordItemRef variableId="V_X_ParamChannel1" subindex="1"/>
385     <RecordItemRef variableId="V_X_ParamChannel1" subindex="2"/>
386   </Menu>
387 </MenuCollection>
388

```

389 • **ProcessData IDs**

390 Definition

391 ProcessData IDs are defined in the ProcessDataCollection element.

```

392 <ProcessDataCollection>
393   <ProcessData id="P_ProcessData">
394     <ProcessDataIn id="PI_PDin" bitLength="32">
395       <Datatype xsi:type="RecordT" bitLength="32">
396         <RecordItem subindex="1" bitOffset="16">
397           <SimpleDatatype xsi:type="IntegerT" bitLength="16"/>
398           <Name textId="TN_PI_X_PDin_DetectionValue"/>
399           <Description textId="TD_PI_X_PDin_DetectionValue"/>
400         </RecordItem>
401         <RecordItem subindex="2" bitOffset="8">
402           <SimpleDatatype xsi:type="IntegerT" bitLength="8">
403             <ValueRange lowerValue="-50" upperValue="125"/>
404           </SimpleDatatype>
405           <Name textId="TN_PI_X_PDin_TemperatureValue"/>
406           <Description textId="TD_PI_X_PDin_TemperatureValue"/>
407         </RecordItem>
408         <RecordItem subindex="3" bitOffset="0">
409           <DatatypeRef datatypeId="D_X_PDin_Status_LowHigh"/>
410           <Name textId="TN_PI_X_PDin_StatusSig1"/>
411           <Description textId="TD_PI_X_PDin_StatusSig1"/>
412         </RecordItem>
413         <RecordItem subindex="4" bitOffset="1">
414           <DatatypeRef datatypeId="D_X_PDin_Status_LowHigh"/>
415           <Name textId="TN_PI_X_PDin_StatusSig2"/>
416           <Description textId="TD_PI_X_PDin_StatusSig2"/>
417         </RecordItem>
418       </Datatype>
419       <Name textId="TN_PI_PDin"/>
420     </ProcessDataIn>
421   </ProcessData>
422 </ProcessDataCollection>

```

423

424 **Reference**425 The ProcessDataIn and ProcessDataOut IDs can be referenced from elements
426 ProcessDataRef, attribute 'processDataId'.

427 The ProcessData ID cannot be referenced from within the IODD.

428 • **Datatype IDs**

429 Definition

430

431 Datatype IDs are defined in the DatatypeCollection element.

432

```

433 <DatatypeCollection>
434     <Datatype id="D_X_AdjustValue" xsi:type="IntegerT" bitLength="16">
435         <ValueRange lowerValue="1" upperValue="1000"/>
436         <SingleValue value="0">
437             <Name textId="TN_SV_X_AdjustValue_minvalue"/>
438         </SingleValue>
439     </Datatype>
440 </DatatypeCollection>
441

```

442 Reference

443 Datatype IDs can be referenced from Variables, ProcessData or other Datatypes by elements
444 DatatypeRef, attribute 'datatypeId'.

```

445 <Datatype id="D_X_ParamChannel" xsi:type="RecordT" bitLength="32">
446     <RecordItem subindex="1" bitOffset="16">
447         <DatatypeRef datatypeId="D_X_AdjustValue"/>
448         <Name textId="TN_V_X_ParamChannel_AdjustValue1"/>
449         <Description textId="TD_V_X_ParamChannel_AdjustValue1"/>
450     </RecordItem>
451     <RecordItem subindex="2" bitOffset="0">
452         <DatatypeRef datatypeId="D_X_AdjustValue"/>
453         <Name textId="TN_V_X_ParamChannel_AdjustValue2"/>
454         <Description textId="TD_V_X_ParamChannel_AdjustValue2"/>
455     </RecordItem>
456 </Datatype>
457
458 <Variable index="64" id="V_X_ParamChannel1" accessRights="rw">
459     <DatatypeRef datatypeId="D_X_ParamChannel"/>
460     <RecordItemInfo subindex="1" defaultValue="5000"/>
461     <RecordItemInfo subindex="2" defaultValue="500"/>
462     <Name textId="TN_V_X_ParamChannel1"/>
463     <Description textId="TD_V_X_ParamChannel1"/>
464 </Variable>
465

```

466 • **Definition of StandardVariable IDs**

467 Definition

468

469 StdVariable IDs are defined in the VariableCollection element of the IODD-
470 StandardDefinitions1.1.xml File.

471

```

472 <Variable id="V_VendorName" index="16" accessRights="ro" mandatory="true"/>
473 <Variable id="V_SerialNumber" index="21" accessRights="ro">
474

```

475 Reference

476 StdVariable IDs will be referenced from StdVariableRef elements, attribute 'id', with or without
 477 additional attributes.

478 <StdVariableRef id="V_VendorName" defaultValue="IO-Link Community"/>
 479 <StdVariableRef id="V_SerialNumber"/>

480

481 • **ProductIDs**

482 Definition

483 Product IDs are defined in the DeviceVariant and in the Connection element.

```
484 <DeviceVariantCollection>
485   <DeviceVariant productId="SampleDev1"
486     deviceSymbol="IO-Link-DeviceAB-pic.png"
487     deviceIcon="IO-Link-Device-icon.png">
488     <Name textId="TN_SampleDev1_Name"/>
489     <Description textId="TD_SampleDev1_Descr"/>
490   </DeviceVariant>
491   <DeviceVariant productId="SampleDev2"
492     deviceSymbol="IO-Link-DeviceC-pic.png"
493     deviceIcon="IO-Link-Device-icon.png">
494     <Name textId="TN_SampleDev2_Name"/>
495     <Description textId="TD_SampleDev2_Descr"/>
496   </DeviceVariant>
497 </DeviceVariantCollection>
498
```

499 Reference

500 DeviceVariant/@productId is a plain text which is referenced from the Connection/ProductRef
 501 element, attribute 'productId'.

```
502 <PhysicalLayer>
503   <Connection xsi:type="OtherConnectionT" connectionSymbol="SD1-con-pic.png">
504     <ProductRef productId="SampleDev1"/>
505     <Description textId="TD_SampleDev1_Connection"/>
506   </Connection>
507   <Connection xsi:type="OtherConnectionT" connectionSymbol="SD2-con-pic.png">
508     <ProductRef productId="SampleDev2"/>
509     <Description textId="TD_SampleDev2_Connection"/>
510   </Connection>
511 </PhysicalLayer>
512
```

513 **4.4 Recommended prefixes of IDs**

514 The defined prefixes in general are intended to provide a harmonized structure of an IODD.
 515 Additional rules for prefixes help to build unique, but still readable identifiers showing as well
 516 the type and relationship of IDs.

- | | |
|-------------------|---|
| 517 Texts: | use prefix "T_" for text IDs |
| 518 Names: | use prefix "TN_" for text IDs of names |
| 519 Description: | use prefix "TD_" for text IDs of descriptions |
| 520 Menus: | use prefix "M_" for menu IDs |
| 521 Data types: | use prefix "D_" for data type IDs |
| 522 Variables: | use prefix "V_" for variable IDs |
| 523 Process data: | use prefix "P_" for process data IDs |

524 Process data in: use prefix “PI_” for process data in IDs

525 Process data out: use prefix “PO_” for process data out IDs

526 4.4.1 Structure of text IDs

527 IDs related to a main element should be composed by the prefix and the complete ID of the
528 main element. Text IDs are related to a main element such as a variable, a menu, an event or
529 a single value. In order to better identify the type of name or description, auxiliary prefixes are
530 defined.

531 Single value: use prefix “SV_” for the name of a single value

532 Event: use prefix “EV_” for the name and description of a vendor-specific event code

533 Error: use prefix “ER_” for the name and description of a vendor-specific error code

534 Text IDs therefore always start with:

535 Text ID for variable name: “TN_V_”

536 Text ID for variable description: “TD_V_”

537 Text ID for single value name: “TN_SV_”

538 Text ID for menu name: “TN_M_”

539 Text ID for specific event name: “TN_EV_”

540 Text ID for specific event description: “TD_EV_”

541 Text ID for specific error name: “TN_ER_”

542 Text ID for specific error description: “TD_ER_”

543 Exception to these rules are System Commands. Although being single values, the command
544 values are not marked with the “SV_” prefix.

545 Examples:

```
546 <Text id="TN_V_CP_FunctionTag" value="Function Tag"/>
547 <Text id="TD_V_CP_FunctionTag" value="Possibility to mark a device with function-specific
548 information."/>
549 <Text id="TN_CP_SystemCommand_LocatorStart" value="Locator Start"/>
550 <Text id="TN_SV_SSP_CSC_SensorCtrl_enable" value="Enabled"/>
551 <Text id="TN_ER_XTBD_Eval_MVOffset" value="Invalid combination of setpoint and measurement
552 offset values."/>
553 <Text id="TN_EV_XTBD_Warn_SensorDisabled" value="Sensor operation disabled"/>
```

555 4.4.2 Context of IDs

556 The standardization of functionalities and parameter representations, for example in profiles,
557 requires additional distinction possibilities for IDs. The additional “Context Identifier” assures
558 unique IDs when implementing different profiles.

559 The context identifier may consist of a unique code with 2 to 5 characters, identifying profiles
560 or specific technologies. This identifier can be seen as a namespace for the IDs within an IODD.

561 It is generally not recommended to use predefined context identifiers outside of the assigned
562 scope. Context identifiers may be used for testing and plausibility checks by standardized test
563 tools, such as the IODD checker.

564 Context identifiers with a leading “X” are reserved for vendor-specific IDs (variables, text, ...).

565 In conjunction with profiles the context identifier is used as a profile prefix.

566 Examples for already existing context identifiers are:
567 Common Profile "CP_"
568 Smart Sensor Profile: "SSP_"
569 Firmware Update Profile: "FU_"
570 BLOB Transfer: "BT_"
571 IO-Link Safety: "FSP_" and "FST_"
572 Vendor-specific: "Xn_" – "n" may be empty or multiple characters [a-zA-Z0-9]

573 4.4.3 Structure of menu IDs

574 Menus generally have two relationships: the user role and a menu context. Both relationships
575 should be visible in the menu ID.

576 The menu prefixes for user roles are:

577 Observer role: "OR_"
578 Maintenance role: "MR_"
579 Specialist role: "SR_"

580 The combination of user roles is marked in the following manner:

581 "MSR_" for maintenance and specialist roles
582 "OMSR_" for a menu for all three user roles

583

584 The menu prefixes for menu context are:

585 Identification menu: "Ident"
586 Parameter menu: "Param"
587 Diagnosis menu: "Diag"
588 Observation menu: "Observe"

589 Each menu ID contains these two prefixes in the following structure. In addition the context
590 identifier according to the above rules may be applied:

591 Menu ID: "M_<user role>_<context identifier>_<menu context>"

592 Note, that the user role prefix is omitted (empty) for the text IDs of menu names. The top level
593 menus, which are referenced in the user role sets, never carry a context identifier.

594 Examples for top level menu IDs:

595 "M_OR_Ident", "M_MSR_Param", "M_OMSR_Observe"

596 Note: the top level menus generally do not have a name assigned within the IODD, as the menu
597 name is generated by the interpreter tool.

598 Examples for menu IDs of menus at a lower level of the menu hierarchy:

599 "M_OMSR_CP_Diag_DeviceStatusInfo"

600 *Menu "Device Status Info" in the Diagnosis Menu, defined in the Common Profile, applied in
601 observer, maintenance and specialist user roles.*

602 *The corresponding text id for the menu name is: TN_M_CP_Diag_DeviceStatusInfo*
603 M_MSR_CP_Param_GeneralSettings
604 *Menu “General Settings” in the Parameter Menu, defined in the Common Profile, applied in*
605 *maintenance and specialist user roles.*

606 *The corresponding text id for the menu name is: TN_M_CP_Param_GeneralSettings*

607 **4.5 Menu sets and user roles**

608 The IODD provides a distinction between the user roles ‘Observer’, ‘Maintenance’ and
609 ‘Specialist’.

610 In practice the user roles ‘Maintenance’ and ‘Specialist’ have little or no distinction. Therefore
611 these user roles should show the same content with the same parameters and accessrights.

612 The user role ‘Observer’ mainly addresses one important use case: Getting an insight on the
613 device parameter settings without the risk of unintended changes to parameters. Therefore the
614 ‘Observer’ role should show all parameters with the restriction of read-only access. Commands
615 or menus, which only contain commands, should generally not be displayed if they do affect
616 read-write or read-only variables.

617 The following shows the preferred menu set structure for the three user roles.

```
618 <ObserverRoleMenuSet>
619   <IdentificationMenu menuld="M_OR_Ident"/>
620   <ParameterMenu menuld="M_OR_Param"/>
621   <ObservationMenu menuld="M_OMSR_Observe"/>
622   <DiagnosisMenu menuld="M_OR_Diag"/>
623 </ObserverRoleMenuSet>
624 <MaintenanceRoleMenuSet>
625   <IdentificationMenu menuld="M_MSR_Ident"/>
626   <ParameterMenu menuld="M_MSR_Param"/>
627   <ObservationMenu menuld="M_OMSR_Observe"/>
628   <DiagnosisMenu menuld="M_MSR_Diag"/>
629 </MaintenanceRoleMenuSet>
630 <SpecialistRoleMenuSet>
631   <IdentificationMenu menuld="M_MSR_Ident"/>
632   <ParameterMenu menuld="M_MSR_Param"/>
633   <ObservationMenu menuld="M_OMSR_Observe"/>
634   <DiagnosisMenu menuld="M_MSR_Diag"/>
635 </SpecialistRoleMenuSet>
636
637
```

638 4.6 Device identification in the IODD compared to the Device

639 The Deviceldentity element looks like this:

```

640 <Deviceldentity deviceld="40" vendorId="65535" vendorName="IO-Link Community">
641   <VendorText textId="T_VendorText"/>
642   <VendorUrl textId="T_VendorUrl"/>
643   <VendorLogo name="IO-Link-Logo.png"/>
644   <DeviceName textId="T_DeviceName"/>
645   <DeviceFamily textId="T_DeviceFamily"/>
646   <DeviceVariantCollection>
647     <DeviceVariant productId="SampleDev1" deviceSymbol="SampleDev1-pic.png"
648     devicelcon="SampleDev1-icon.png">
649       <Name textId="TN_Product1"/>
650       <Description textId="TD_Product1"/>
651     </DeviceVariant>
652     <DeviceVariant productId="SampleDev2" deviceSymbol="SampleDev2-pic.png"
653     devicelcon="SampleDev2-icon.png">
654       <Name textId="TN_Product2"/>
655       <Description textId="TD_Product2"/>
656     </DeviceVariant>
657   </DeviceVariantCollection>
658 </Deviceldentity>
659

```

660 Element Deviceldentity

661 @vendorId Corresponds to the mandatory standard parameter DirectParameterPage 1, Subindex 8 (high byte), 9 (low byte), decimal value. The value is assigned by the IO-Link Community, please see www.io-link.com.

664 @deviceld Corresponds to the mandatory standard parameter DirectParameterPage 1, Subindex 10 (high byte), 11 (mid byte), 12 (low byte). Decimal value, vendor specific.

667 With the combination of vendorId and deviceld, an IO-Link device's identification is unique throughout the IO-Link world. Those values are offline values but shall anyway correspond to the information on the designated subindices as described above.

670 @vendorName vendor specific name.

671 VendorText/@textId The element VendorText is used to give language dependant additional information to vendorName.
 672 e. g.: VendorName = "IO-Link Community"
 673 VendorText(en) = "Breakthrough in communication"
 674 VendorText(de) = "Durchbruch in Sachen Kommunikation"
 675 VendorText shall not repeat the vendorName

678 This text does not correspond to any standard parameter of the device, thus it will not be checked in any way. It is only used for displaying.

680 VendorUrl/@textId vendor specific URL, should be applied with prefix "[www.](#)". This text does not correspond to any standard parameter of the device, thus it will not be checked in any way. It is only used for displaying. The IO Device Description Specification Version 1.1.4 allows a maximum of 255 characters for the URL string.

685 VendorLogo/@name see IO Device Description Specification

686

- 687 DeviceName/@textId vendor specific device name
688 This text does not correspond to any standard parameter of the device,
689 thus it will not be checked in any way. It is only used for displaying a
690 naming for the IODD in an device catalogue list. This naming includes
691 all variants in the IODD and can also include device variants in several
692 IODDs with different DeviceIDs.
- 693 DeviceFamily/@textId vendor specific device family text
694 This text does not correspond to any standard parameter of the device,
695 thus it will not be checked in any way. It is only used to group the
696 displayed device variants.
- 697 Note: DeviceFamily/@textId, DeviceName/@textId and @vendorName are often used by tools
698 to create their device catalogues. The vendor should take care on a sensible use of those
699 entries.
- 700 DeviceVariantCollection
- 701 A DeviceVariantCollection can contain IO-Link Devices with the same deviceId. From IO-Link's
702 point of view, those devices are completely the same. They differ only in e.g. mechanical or
703 approval issues and therefore have different orderNumbers or productIds.
- 704 @productId Corresponds to the optional standard device parameter Product ID
705 (index 19).
- 706 Name Corresponds to the mandatory standard device parameter Product Name
707 (index 18).
- 708 Description Corresponds to the optional standard device parameter Product Text
709 (index 20). The IO Device Description Specification Version 1.1.4 allows
710 a maximum of 1024 characters for all Description strings.
- 711 **4.7 DefaultValues**
- 712 It is recommended to provide meaningful default values for read-write parameters. When a new
713 device instance is created, tools may leave read-write parameters without default value in an
714 empty or initial state. The user might be forced to set values, or the parameters might not be
715 written on a subsequent download.
- 716 **4.8 DirectParameterOverlay**
- 717 When using a DirectParameterOverlay to describe a structure layed over the 16 bytes of
718 V_DirectParameters_2, you should only reference the RecordItems from the DirectParameter-
719 Overlay from your menus. Do not reference the RecordItems of V_DirectParameters_2,
720 because IO-Link Tools may not be able to handle both views on the DirectParameter page 2 at
721 the same time.
- 722 **4.9 Types of Texts**
- 723 Texts can either be a 'Name' or a 'Description'. A 'Name' means a common, short term which
724 is often displayed in the tool's table columns. A 'Description' can be a text which describes the
725 issue properly. Tools show descriptions oftenly as tooltips. The only allowed text formatting is
726 the line break using the LineFeed character (encoded as "
").
- 727 **4.10 Specialist role menus**
- 728 All variables required for replicating the Device (usually those with access rights 'rw') shall be
729 referenced from menus visible in the specialist role.
- 730 **4.11 Languages**
- 731 Usually all initially supported languages are included in the main IODD. External language files
732 enable delivering additional languages afterwards without touching the original IODD. This is
733 useful if a company's subsidiary in a foreign country wants to add the local language on their
734 own.

735 The standard definition file IODD-StandardDefinitions1.1.xml currently supports Chinese,
736 English, French, German, Italian, Japanese, Korean, Spanish, Portuguese and Russian,

737 The standard unit definition file IODD-StandardUnitDefinitions1.1.xml currently only supports
738 English. If you plan to support additional languages in your IODD, please contact the PNO
739 CC/PG1 Technology, Team IODD to add these languages to the standard definition files in a
740 joint effort.

741 **4.12 Using StandardVariables**

742 Mandatory standard variables shall always be referenced in the IODD. E.g.

743 For a device using only direct parameters:

```
744 <VariableCollection>
745   <StdVariableRef id="V_DirectParameters_1"/>
746   <StdVariableRef id="V_DirectParameters_2"/>
747   <DirectParameterOverlay id="V_... ">
748     ...
749   </DirectParameterOverlay>
750 </VariableCollection>
```

751 For a device using ISDUs:

```
752 <VariableCollection>
753   <StdVariableRef id="V_DirectParameters_1"/>
754   <StdVariableRef id="V_ProductName"/>
755   ...
756 </VariableCollection>
```

757 All other standard variables are optional, thus they shall only be referenced if the device
758 supports them.

759 If the device supports them, please refer to the IODD-StandardDefinitions1.1.xml file for the
760 correct ID-designation.

761 **4.13 Connection 'NC'**

762 When your device has a connector (the element "Connection" is not of type CableConnectionT),
763 and some pin is not connected, you can specify that pin with the appropriate "Wire<n>" element,
764 setting its attribute "function" to "NC" (not connected). But in case that pin is already not
765 connected in the connector itself, the problem is that the IODD schema forces you to specify a
766 "color" attribute for the wire, but you have none. In addition, there are cases where mandatory
767 "Wire<n>" elements may have "NC" as function: "Wire2" on a "Connection" element of type
768 M5ConnectionT, M8ConnectionT, M12-4ConnectionT or M12-5ConnectionT; and "Wire5" on a
769 "Connection" element of type M12-5ConnectionT.

770 Recommendation:

- 771 • If not mandatory, do not describe this pin, i.e. leave out the "Wire<n>" element
- 772 • Otherwise, select an arbitrary color that is unique in the cable, and describe the situation
773 in the device's documentation. In addition, you may use the optional "Name" element
774 on the "Wire<n>" element to indicate that there is actually no wire here.

775 **4.14 Dos and Don'ts**

- 776 • Never write text directly into attributes textId.
- 777 • When describing an enumeration as a list of SingleValues, do not include the numerical
778 value into the text referenced by Name/@textId. It is up to the engineering tool to display
779 the value in addition to the name (not necessarily as an additional row, but maybe as
780 tooltip or only in a debug mode).

- 781 • @minCycleTime is given in μ s. Don't apply the value from DirectParameterPage 1,
782 Subindex 3
- 783 <TransportLayers>
784 <PhysicalLayer baudrate="COM2" minCycleTime="2300" sioSupported="true"/>
785 </TransportLayers>
- 786 • schemaLocation is given properly
787 OK: xsi:schemaLocation="http://www.io-link.com/IODD/2010/10 IODD1.1.xsd
788 KO: xsi:schemaLocation="http://www.io-link.com/IODD/2010/10 ..\..\IODD1.1.xsd
- 789 • Assign @releaseDate and @version properly. Increase @version for every release.
- 790 • In DirectParameterPage 1 or 2, bitOffsets range from 0 to 127. Take care on reserved
791 areas (DirectParameterPage 1: completely reserved, DirectParameterPage 2: nothing
792 reserved)
- 793 • Menu entries involving floating point values (of type Float32T or implicitly by using
794 gradient and/or offset) should use attribute displayFormat with "Dec.x" instead of just
795 "Dec" to have a better control over the tool behaviour.
- 796 • As DataStorage is a highly recommended IO-Link feature, the attribute
797 Features/@dataStorage shall be set 'true'. IO-Link tools shall implicitly use the
798 SystemCommands ParamUploadStart, ParamUploadEnd, ParamDownloadStart,
799 ParamDownloadEnd, ParamBreak and ParamDownloadStore to encapsulate the up- or
800 downloaded parameter set. A flowchart in Chapter 19 shows the sequence.
- 801 • As DataStorage is a highly recommended IO-Link feature, the attribute
802 Variable/@excludedFromDataStorage should only be set to "true", if it does not make
803 sense to backup and restore this variable. E.g. date of commissioning or date of last
804 maintenance.
- 805 • To cover required format rules for IDs within IODD, please look up the provided snippet
806 files shipped with each profile specification.
- 807 • On ValueRange elements, do not use the child element Name. When Name is given,
808 some tools just display the Name and not the numeric value. This is perfect for
809 SingleValues, but inappropriate for ValueRanges. The intended use case was to have
810 the Name as an additional classification for values "out of range", but the Smart Sensor
811 Profile now defines special fixed values for this purpose, which is a much better solution.

813 **5 Examples**

814 **5.1 General**

815 All example IODDs provide ISDU support as this is the base requirement for Data Storage and
816 implementation of profile functions.

817 In general the reference to V_DirectParameters_2 is omitted in all the example IODDs. As well
818 the reference and implementation of the standard parameter 'Device Access Locks' is not
819 required anymore, as long as none of the features 'Local parameterization' or 'Local user
820 interface' are implemented.

821 Due to the recommended Common Profile as a basic standard for all IO-Link devices, any of
822 the examples listed below, contains profileCharacteristic '16364', which indicates, that 'IO-Link
823 Common Profile – Identification and Diagnosis' is supported.

824 Any IODD contains pictures and logo references. The picture files may be referenced by more
825 than one IODD file. See the vendor logo file as an example.

826 The provided user interface structure and position of variables or commands within the menu
827 hierarchy is intended as a best practice pattern for IODD design. This applies as well for the
828 mapping of variables into the different user roles. Please note, that in 'Observer Role' all
829 variables are visible with access right 'read only'.

830 **5.2 IO-Link-01-BasicDevice**

831 The device in this example supports ISDU access. V_DirectParameters_2 is omitted and only
832 one device specific variable is defined.

833 **5.3 IO-Link-02-DeviceVariants**

834 This examples lists 3 device variants. It focusses on the possibility of giving a general
835 defaultValue for V_ProductName, covering all device variants and the lack of the defaultValue
836 for V_ProductID.

837 The device in this example supports ISDU access. Only one device specific variable is defined.

838 **5.4 IO-Link-03-InternalLangDevice**

839 This device is featuring text resources of the IO Device Description which are localized in
840 English, German and Chinese.

841 **5.5 IO-Link-04-ExternalLangDevice**

842 The example shows the usage of external language files, which are localized in English,
843 German and Chinese. Please note, although belonging to an IODD file, the external language
844 file has its own stamp. Thus, it has to be checked in a separate run of the Checker tool.

845 **5.6 IO-Link-05-CommCharacteristicsDevice**

846 This example shows how the parameters for the communication characteristics of a device are
847 referenced in the Diagnosis section of the IODD menu. Please note, that the specific
848 representation of these values is an optional feature for tools.

849 **5.7 IO-Link-06-EventDevice**

850 This example shows how to reference both standard events and vendor specific events. Please
851 note that all events, which can be triggered by a device shall be referenced (except for events
852 which might be used for Device protocol test purposes). It is good practice for vendor specific
853 events to provide the specific name and a description for the root cause of this event and
854 possible remedial actions. If at all possible use the standard events from the IO-Link
855 specification instead of defining manufacturer specific events.

856 Note: When mapped to upper level system, manufacturer events are only displayed as numbers,
857 while standard events are displayed with name and description.

858 **5.8 IO-Link-07-ErrorDevice**

859 This example shows how to reference both standard errors and vendor specific errors. Please
860 note that all errors, which may occur in a device shall be referenced. It is good practice for
861 vendor specific error types to provide the specific name and a description for the possible root
862 cause of this error. If at all possible use the standard error types from the IO-Link specification
863 instead of defining manufacturer specific error types.

864 **5.9 IO-Link-08-ConnectionVariants**

865 This example shows device variants with different connectors and connection symbols, as well
866 as a cable connection.

867 **5.10 IO-Link-09-AllSimpleDatatypesDevice**

868 This example shows a number of parameters with all possible simple data types. It focuses as
869 well on best practice pattern for description of boolean variables and variables with
870 enumerations or a mix of value ranges and enumerations.

871 **5.11 IO-Link-10-AllComplexDatatypesDevice**

872 This example focuses on the description of parameters with complex data types. Special
 873 emphasis is put on the best practice methods for boolean arrays and differences of records and
 874 array representations in the user interface.

875 **5.12 IO-Link-11-DatatypeSimpleDtDevice**

876 This example shows the use of datatype descriptions within the DatatypeCollection referenced
 877 from variables. Only simple datatypes are described in the DatatypeCollection.

878 **5.13 IO-Link-12-DatatypeComplexDtDevice**

879 This example uses a hierarchical datatype description within the DatatypeCollection consisting
 880 of simple datatypes which are being referenced within a complex datatype. This description
 881 method is especially usefull, if datatypes are being used multiple times by other datatypes or
 882 within variables, as it reduces the repetitions.

883 **5.14 IO-Link-13-DeviceAccessLocksDevice**

884 This example shows a Device with the implemented features ‘Local parameterization’ or ‘Local
 885 user interface’. Thus, the reference of the standard variable Device Access Locks is necessary.
 886 It’s recommended to position this variable in a prominent menu to provide easy access. In the
 887 example it is located in the menu ‘General Settings’.

888 **5.15 IO-Link-14-SysCommandDevice**

889 This example shows the use of a vendor specific system command and reference as a button
 890 in the user interface. Please note, that it is good practice to provide at least a description of the
 891 command at the reference in the user interface.

892 **5.16 IO-Link-15-VariableAttributeDevice**

893 This example shows the use of different attributes in the context of variables. It includes as well
 894 a description of a vendor specific command interface apart from the parameter System
 895 Command.

896 **Table 1 – Variable behaviour**

Attribute name	Behaviour when false (default)	Behaviour when true
dynamic	The value does not change except when it is written from the Master.	The value may change internally in the device, without any external trigger. Note: This option is used by tools for cyclical update of variables in the user interface. The intended use of this option is for read-only variables.
modifiesOtherVariables	Writing to the variable does not influence other variables.	Writing to the variable may change any or even all other variables. Note: The intended use of this option is for command interfaces (write-only variable).
excludedFromDataStorage (only for variables with accessRights = “rw”)	The parameter is part of the Data Storage mechanism.	The parameter is not stored or restored via Data Storage mechanism. Note: This option shall only be used in exceptional cases, e.g. for volatile variables.

5.17 IO-Link-16-SimpleProcessDataDevice

This example focusses on the process data description with simple datatypes. The representation within the user interface is given in the ProcessDataRefCollection with according transformations.

5.18 IO-Link-17-ComplexProcessDataDevice

This example focusses on the process data description with complex datatypes. The representation within the user interface is given in the ProcessDataRefCollection with according transformations.

5.19 IO-Link-20-HierarchicalMenuDevice

This example uses hierarchical menu structures for functional grouping of parameters.

5.20 IO-Link-21-ConditionalMenuDevice

This example is based on the previous example and shows the use of variables for conditional display of parameter menus or submenus.

5.21 IO-Link-22-ConditionalProcessDataDevice

This example shows the use of a condition variable for changing the process data interpretation and the according description of the different representations within the ProcessDataRefCollection.

915

6 Releasing the IODD**6.1 Checker**

When you're done editing your IODD, and the schema validation in your favourite XML editor does not report any errors, you are now ready for the mandatory checking and stamping of the IODD.

The IODD Checker, available from the download section of <http://www.io-link.com/>, is used for this. The Checker is continually improved, so only the latest release shall be used.

The Checker is a console program. Open the Windows Console and use command "cd" (change directory) to change to the directory where the IODD Checker was deployed.

Make sure your graphics files are present in the same directory as your IODD. Then check your IODD using:

927 IODDChecker <IODD path + file name>

In the past, XML parsers did not catch all schema violations. To make sure your IODD is fully schema compliant, it is recommended to use more than one parser.

930 If you have installed the Xerces-C++ XML Parser, you may include this additional parser by:

931 IODDChecker -xe -xp<Xerces path> <IODD path + file name>

932 When the check does not produce any more errors, stamp your IODD. The command line is the same as above, just add -s.

934 If you created external text documents, put them in the same directory as your main IODD. Check and stamp them now using the command line as shown above. The external text documents are checked against the main IODD file. After the external text document was stamped, there could be changes to the main IODD file which make the external text document invalid. To protect against this, the CRC of the main IODD is included in the CRC calculation of the external text files. This means: Everytime you modified and stamped your main IODD, you have to stamp all external text documents again.

941 Using the IODD Checker and Xerces as additional parser, when you notice that Xerces
942 produces an error for each XML element and attribute while the .NET Parser does not produce
943 errors, the likely cause is a schemaLocation that uses a path prefix with the IODD schema
944 name. According to the IODD specification, the header shall look like this for the main IODD:

945 <IODevice xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="http://www.io-
946 link.com/IODD/2010/10" xsi:schemaLocation="http://www.io-link.com/IODD/2010/10 IODD1.1.xsd">

947 And it shall look like this for an external text document:

948 <ExternalTextDocument xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
949 xmlns="http://www.io-link.com/IODD/2010/10" xsi:schemaLocation="http://www.io-
950 link.com/IODD/2010/10 IODD-Primitives1.1.xsd">

951 **6.2 Deployment**

952 For each combination of Vendor ID and Device ID, there shall be exactly one current IODD.
953 There may be older revisions, but only one is current. An IO-Link Tool detects the current IODD
954 by inspecting DocumentInfo/@releaseDate (which must be the same as the date field in the
955 IODD file name).

956 Note that an IO-Link V1.1 device that is backward compatible to IO-Link V1.0
957 (CommNetworkProfile/@compatibleWith="1.0") has an IODD V1.0.1 in addition to its IODD
958 V1.1.

959 During development there may be a multitude of IODD releases on the same day carrying the
960 same release date and version. But when it comes to releasing the IODD to the public, there
961 shall not be multiple IODD releases with the same version or date.

962 **6.2.1 Packaging of the IODD**

963 The recommended way to offer the IODD (e.g. as a download from a web server) is as a single
964 ZIP archive file. The following files shall be added:

- 965 • The main IODD file (XML)
- 966 • The graphics files referenced from the main IODD file (PNG)
- 967 • The external language files (optional, XML)
- 968 • A readme or release notes (optional, e.g. TXT or PDF)
- 969 • PDF document with all Manufacturer Declarations (Note: mandatory for upload to
970 IODDfinder, see naming convention in MD template document)

971 The following files shall not be added:

- 972 • The IODD schemas (IODD1.1.xsd, ...)
- 973 • The W3C standard schemas (xml.xsd)
- 974 • IODD standard XML files (IODD-Standard[Unit]Definitions1.1[language code].xml)
- 975 • The output of the IODD Checker (log file)

976 The following data should be offered as separate files or archives:

- 977 • The device manual, assembly instructions, certificates, ...
- 978 • FDT Device Type Manager or other device specific tools
- 979 • CAD / CAE data
- 980 • Firmware update files

981 **6.2.2 IODDfinder**

982 The IODDfinder (reachable from <https://io-link.com/>) is the central database for access to
 983 IODDs and is maintained and continuously improved by the IO-Link Community. It allows a
 984 manual or automated download via web browser or tools via an API. In addition, the IODDfinder
 985 provides the possibility for viewing IODD features and user interface representations directly in
 986 the web browser. It is recommended to upload the IODDs on the IODDfinder in order to provide
 987 the central access for user and applications.

988 Note that for an IO-Link V1.1 device, which is backward compatible to IO-Link V1.0, it is not
 989 recommended to provide an IODD 1.0.1 on IODDfinder.

990 **7 Things to consider when writing an IO-Link Tool**991 **7.1 IODD Checker releases**

992 According to chapter 5 of the IO Device Description Specification, IO-Link Tools shall compare
 993 the checksum in the Stamp with the checksum calculated from the file contents, and shall reject
 994 IODDs when there is a mismatch.

995 That way, IO-Link Tools can rely on the IODD Checker and do not need to re-implement all the
 996 complex checks that the IODD Checker performs.

997 Over time, the IODD Checker is enhanced and checks are added in newer releases.

998 IO-Link Tools shall accept all IODDs with a correct CRC that were stamped by any officially
 999 released IODD Checker.

1000 This means

- 1001 1. IODDs stamped by a pre-release of the IODD Checker (marked with "beta") do not need
 1002 to be accepted.
- 1003 2. IO-Link Tools can only rely on those checks that were present in the first official release
 1004 of the IODD Checker. All the checks added later must also be implemented in the IO-
 1005 Link Tool.

1006 **7.2 Display Names of User Roles and Menu Names**

1007 The following texts are recommended to be used by IO-Link Tools.

1008 **Table 2 – User Roles**

User Role	ObserverRoleMenuSet	MaintenanceRoleMenuSet	SpecialistRoleMenuSet
English	Operator	Maintenance	Specialist

1011 **Table 3 – Menu Set**

Menu	IdentificationMenu	ParameterMenu	ObservationMenu	DiagnosisMenu
English	Identification	Parameters	Observation	Diagnosis

1013 For translations of the terms, see Tool-MenuUserRole_X113.xml, delivered with the IO Device
 1014 Description Specification Version 1.1.4.

1015

1016 **7.3 Usage of the StandardDefinition files**

1017 Tools should use the IODD-StandardDefinitions1.1*.xml files for creating an internal
 1018 representation of the IO-Link standard variables, standard error types and standard events.
 1019 Those files can be interpreted using the same routines as used for interpreting the IODD.

1020 Tools shall implement the complete list of error types and events provided by the standard
1021 definition files.

1022 The IODD-StandardUnitDefinitions1.1.xml should be used to decode any numerical unit codes
1023 to text.

1024 **7.4 Using the IODD schemas for code generation**

1025 To facilitate tool development, you might consider generating source code from the IODD
1026 schemas.

1027 For C# / .NET read here:

- **CodeXS**

<https://www.codeproject.com/Articles/8433/An-XSD-to-NET-language-code-class-generator-that-a>

- **XML Schema Definition (Xsd.exe) tool**

<https://learn.microsoft.com/en-us/dotnet/standard/serialization/xml-schema-definition-tool-xsd-exe>

1034 Even when writing code by hand, the hierarchy of the complex types in the IODD schemas is
1035 a good prototype for your class hierarchy.

1036 **7.5 Handling of defaults**

1037 Reading an IODD with or without schema validation influences the handling of default values,
1038 so care must be taken:

- With schema validation, optional attributes that have a default value in the schema will
be automatically added with their default value. In case you want to know whether the
attribute actually was in the IODD or was added by the default in the schema, the
post-schema-validation infoset (PSVI) must be consulted.

- Without schema validation, optional attributes that have a default value in the schema
will not be added. All defaults must be programmed in the IO-Link Tool.

- Some attributes have defaults which can't be expressed in XML schema. These have
to be programmed in the IO-Link Tool regardless of schema validation.

1047 **7.6 Variable handling in IO-Link Tools**

1048 Tools shall only read / write the variables accessible in the current role without condition
1049 dependency.

1050 Variables which are not referenced in a menu will not be accessed. If a variable is described in
1051 the IODD but can not be accessed (e.g. Index or Subindex not available), it is up to the IO-Link
1052 Tool, whether it continues uploading with the following variable or whether it stops the upload
1053 process and discards all values. This means the IODD should only reference variables which
1054 are always accessible.

1055 **7.7 Read-write variables without @defaultValue**

1056 An IO-Link Device is instantiated (taken from the catalog and placed into the project). The IODD
1057 contains variables with accessRights="rw" but without a @defaultValue.

1058 In this situation, IO-Link Tools should leave the field for the value of such variables empty and
1059 set the state of the variable to "empty". As long as the state is "empty", the value should not be
1060 written to the device.

1061 If the IO-Link Tool is not able to leave a variable empty, it should select the "natural" default
1062 value according to the data type of the variable (e.g. 0 or the empty string). If the "natural"
1063 default is not included in the allowed values (expressed via SingleValues and ValueRanges),
1064 the IO-Link Tool shall pick one of the allowed values, e.g. the lowest or the first value.

1065 7.8 Handling of variables with datatype Boolean

1066 Tools should take care that variables or record items of type BooleanT are transmitted as 8-bit
1067 values. The boolean value “true” should be transmitted as the value “255” and the boolean
1068 value “false” as “0”.

1069 7.9 Recommendations for alignment

1070 On many systems, it is more efficient if values are aligned according to their size. If it is possible
1071 without introducing gaps, it is recommended to align 16 bit values on even addresses and 32
1072 bit values on 4-byte aligned addresses.

1073 NOTE: Here ‘addresses’ is not related to the bitOffset in the IODD, but byte sequence of
1074 transmission.

1075 7.10 Replicating a device

1076 Tools should implement a function for replicating a device which works independently of the
1077 current user role. This function should upload all variables which are refenced in the
1078 SpecialistRole with access rights ‘rw’ into a temporary storage, prompt the user for device
1079 replacement, and then download those variables to the other device.

1080 7.11 Preparametrization of a device

1081 Use case:

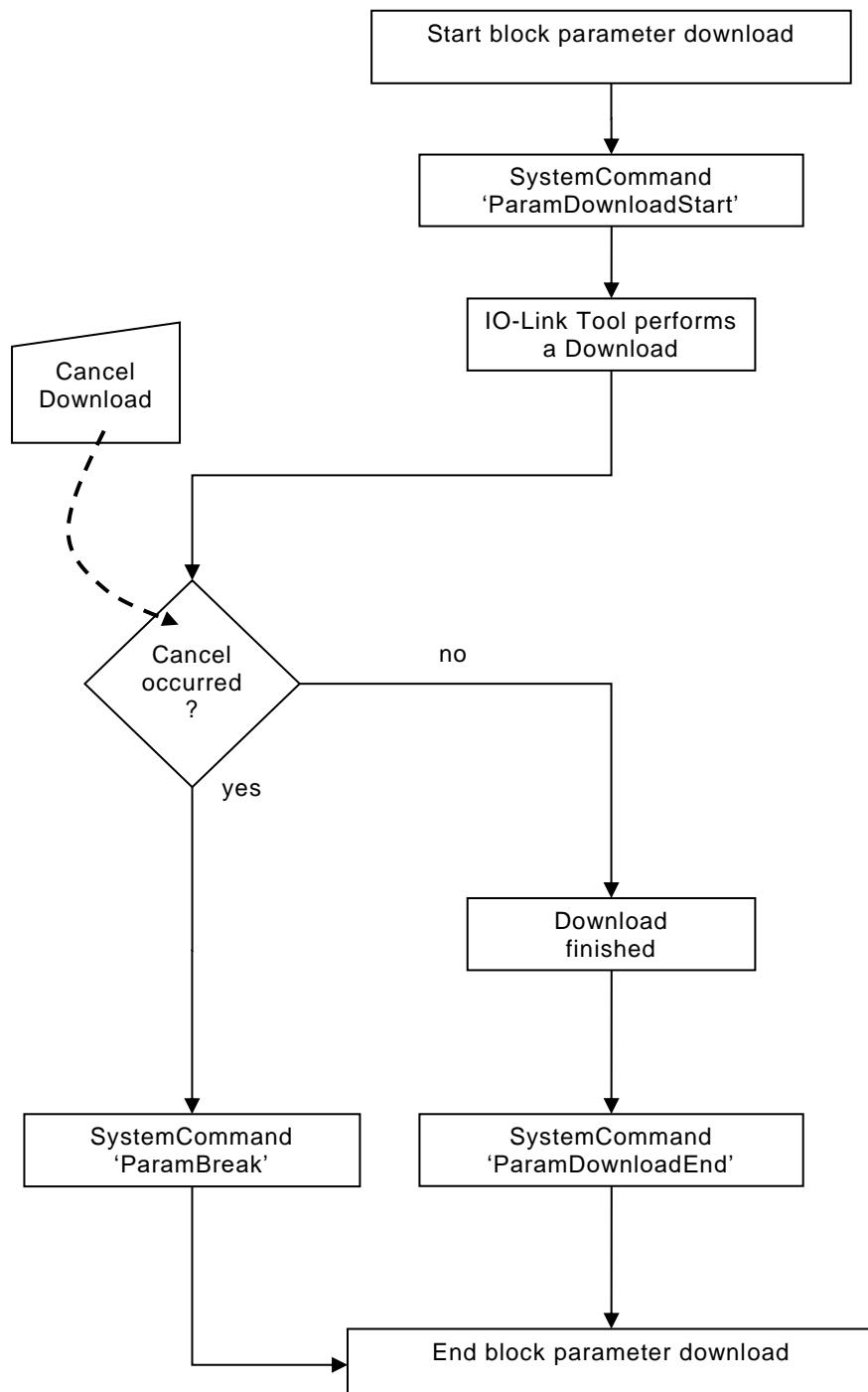
1082 A system has a data storage enabled IO-Link master port. An IO-Link device which is not
1083 connected to the system shall be preparametrized with an external service tool. The data of the
1084 IO-Link device shall be uploaded when the IO-Link device is connected to the IO-Link master
1085 port of the system. Therefore, the external service tool should implement a user command (e.
1086 g. button) which sets the IO-Link device into the required state.

1087 Tool implementation:

1088 If a tool supports this functionality, the tool shall give a warning to the user, if the IO-Link device
1089 is set to the state where the variables would be uploaded from the device, if it is connected to
1090 the master port in the system. The warning shall give a hint for the user to label the device
1091 “preparametrized”.

1092 Caution:

1093 If such a device is used accidentally for a normal device exchange, not the expected behaviour
1094 will appear. Not a download from the data storage will be performed, but an upload from the
1095 device.

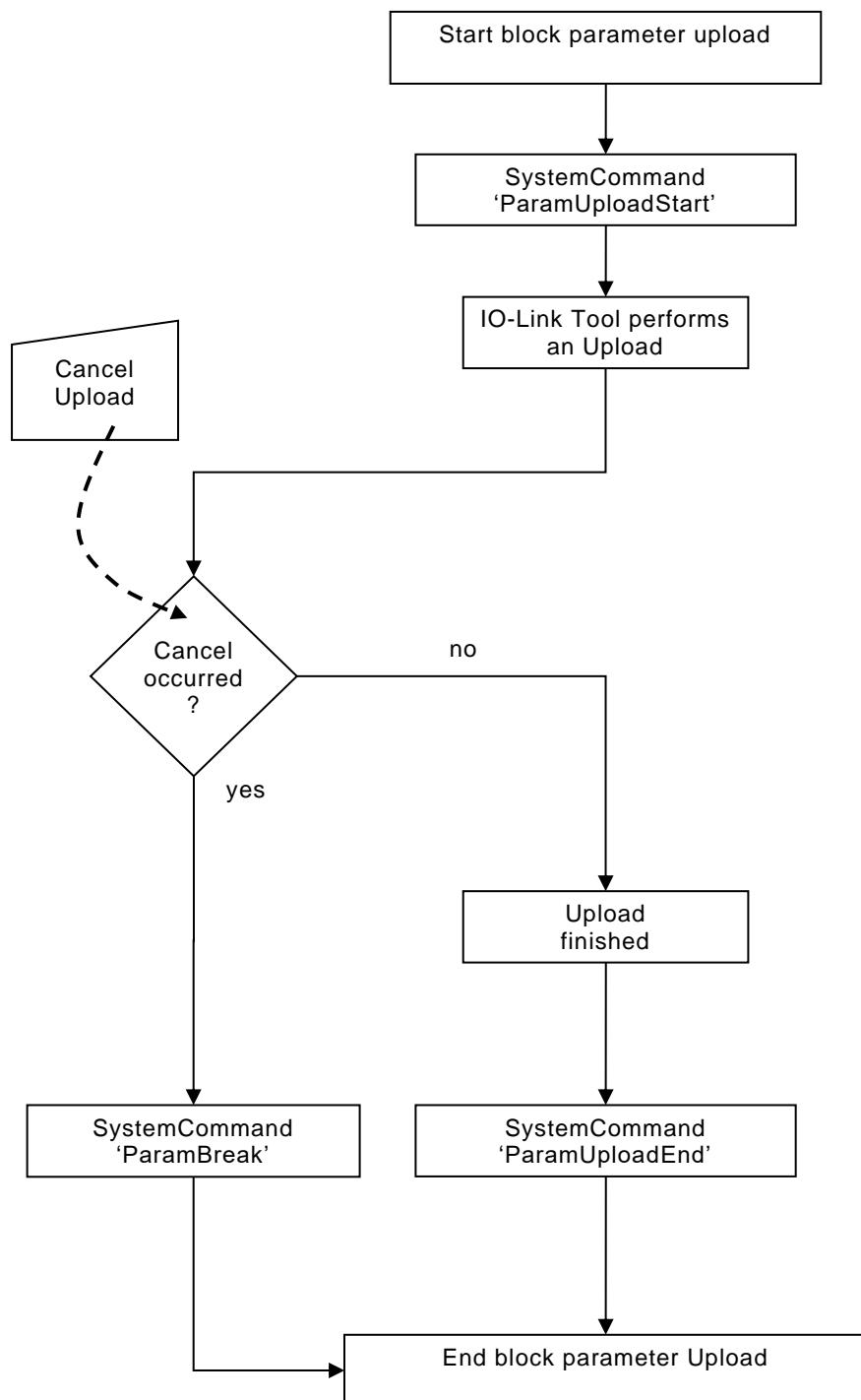
1096 **7.12 Tool behaviour during Up- and Downloading sequence**1097 **7.12.1 Block parameter download**

1098

1099

Figure 1 – Block parameter download

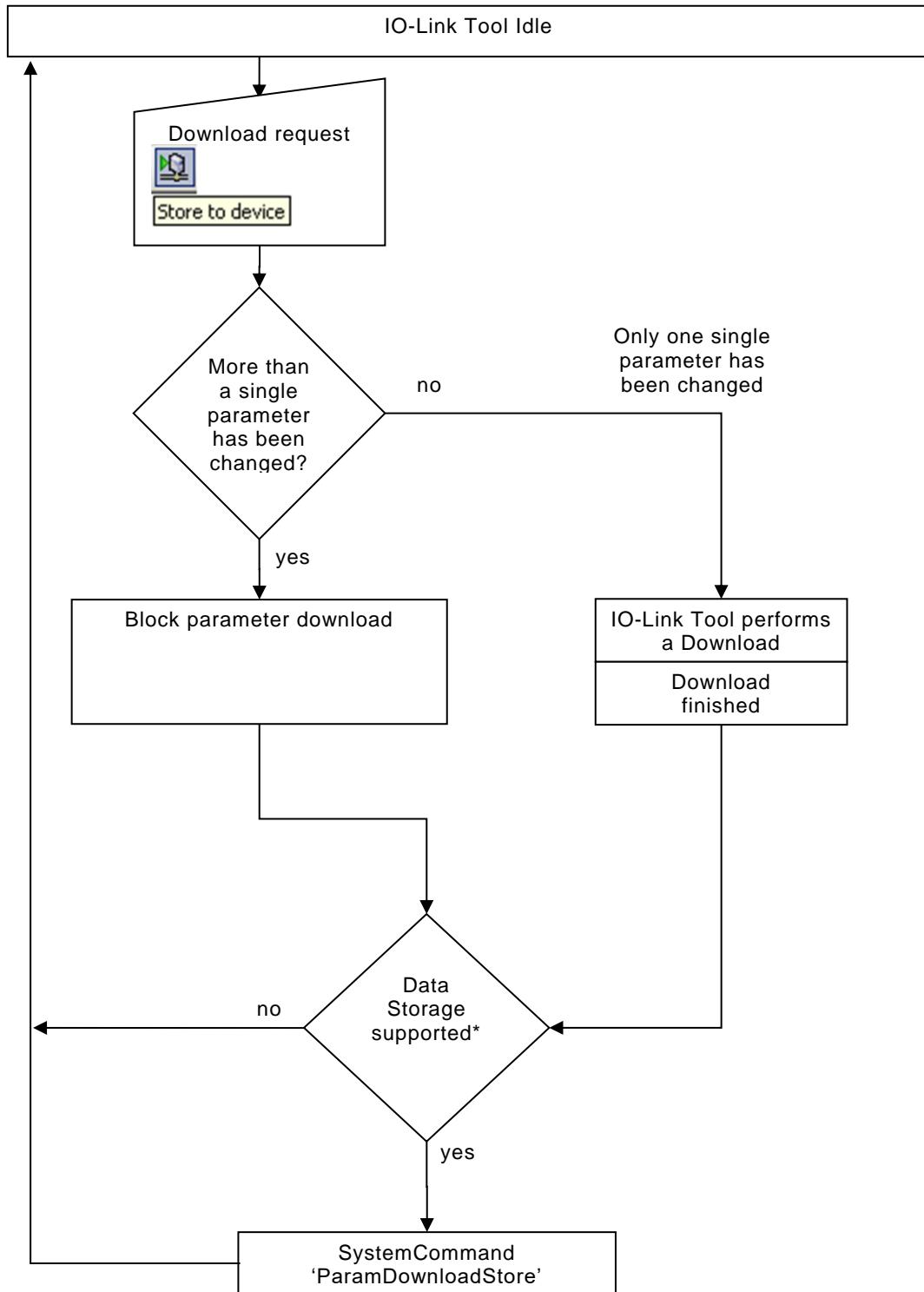
1100 7.12.2 Block parameter upload



1101

1102

Figure 2 – Block parameter upload

1103 **7.12.3 Download with Datastorage (improvement on a single parameter)**

1104

1105

Figure 3 – Download

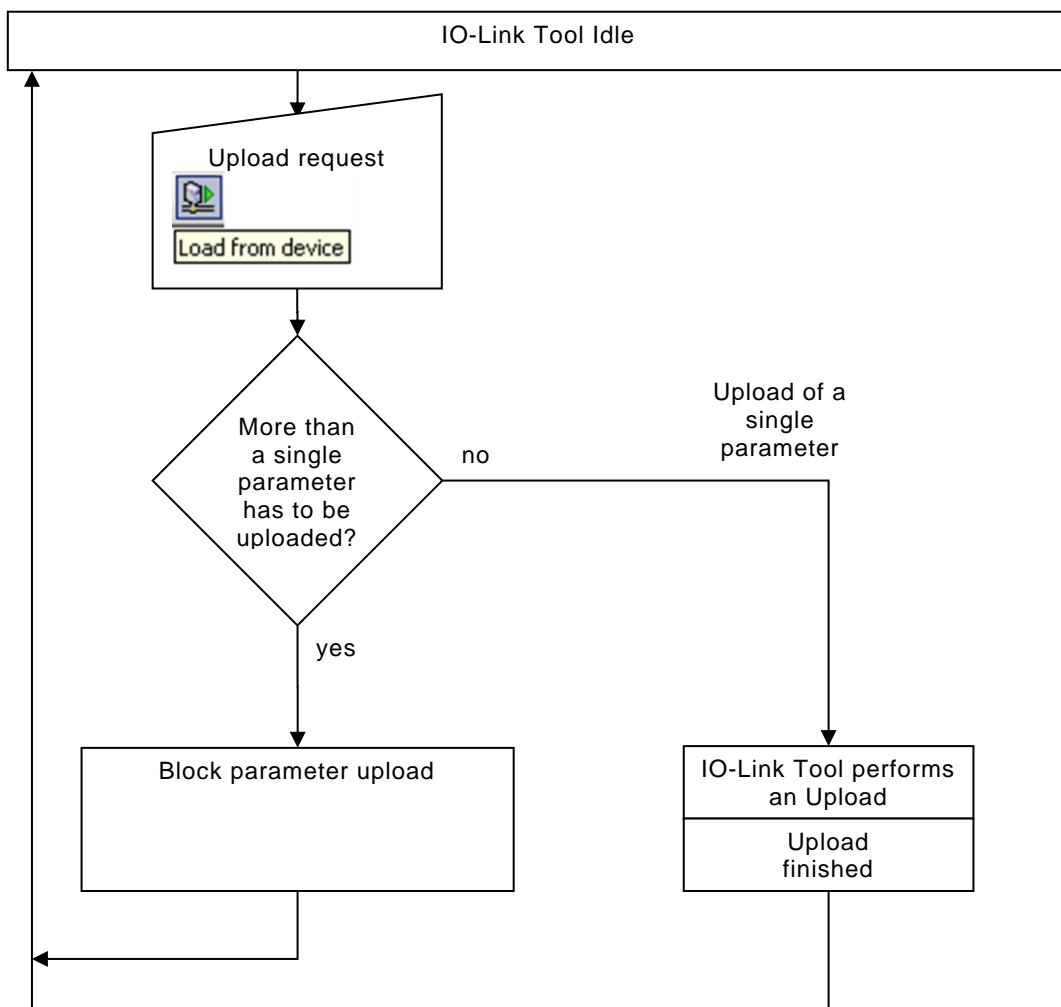
1106 *Variables, which are represented in a menu as button are generally not included in the*
 1107 *download sequence. Instead, when the button is pressed, the associated value is written to*
 1108 *the device immediately as a single parameter download. The same rule applies to variables*
 1109 *with accessRights="write-only". Those variables shall only be written as a single parameter*
 1110 *download.*

1111

1112 DataStorage is supported if the following XPath is set in IODD:
 1113 IODDevice/ProfileBody/DeviceFunction/Features/@dataStorage="true"

1114

1115 7.12.4 Upload improvement on a single parameter



1116

1117

Figure 4 – Upload

1118 7.13 Finding a DeviceVariant or a Connection by its ‘productId’

1119 Finding the correct DeviceVariant after reading V_ProductID from the device, or finding the
 1120 corresponding Connection for a DeviceVariant is done by searching the appropriate element by
 1121 the value of the ‘productId’ attribute.

1122 This is the only reference within the IODD that uses the type ‘xsd:string’ instead of ‘RefT’. When
 1123 navigating, do not use the value of ‘productId’ directly in an XPath expression. This would result
 1124 in a security hole (XPath Injection).

1125 7.14 additionalDeviceIds

1126 The attribute DeviceIdentity/@additionalDeviceIds contains a list of device IDs which are
 1127 supported by this device. For an IO-Link Tool, the only use of this list is to display it to the user.
 1128 There is no action connected with it.

1129 7.15 Testing an IO-Link Tool

1130 The manufacturer of an IO-Link Tool shall of course test it, but the IO-Link Community currently
 1131 has no test specification and no manufacturer declaration for tools.

1132 As an aid for testing the IODD import, there is a set of interpreter test IODDs available on
www.io-link-projects.com. These cover the quantity structure, the different data types, plus
 1133 more. Over time this set will be enlarged.

- 1135 All the IODDs from this set use a different deviceId, so they may be imported in parallel.
- 1136 It is recommended to test the import of IODDs by automatically importing all of these IODDs,
1137 and to selectively use some of these IODDs for more thorough (probably manual) tests.

1138 **7.16 Tool behaviour on Buttons**

1139 Variables, which are described as Buttons might be accompanied by a Description and an
1140 ActionStartedMessage. The following rules shall be applied.

- 1141 1. if */Button/Description is available, tools shall apply the same rules to Button
1142 Descriptions as for Variable Description.
- 1143 2. if */VariableRef or */RecordItemRef is a Button, tools shall substitute the *variable
1144 name with the button text. As a consequence, button text appears twice within one
1145 variable representation.

1146

1147 Example:

1148 Normative
1149 SystemCommand Press-This-Button This is the Press-This-Button Description

1150

1151

1152 Recommendation
1153 Press-This-Button Press-This-Button This is the Press-This-Button Description

1154

1155

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- 1161
- 1162

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