

IO -Link / V1.0

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1 IO-Link Diagnostics with PROFINET in the Siemens Environment

1.1 Introduction

IO-Link basically provides a powerful diagnostics system that can transport detailed diagnostics information and, in this way, give optimum support to users when troubleshooting.

This document describes the structure of the IO-Link diagnostics. This document also answers the following questions:

- How is the IO-Link diagnostics information displayed in the higher level PROFINET on an S7-CPU?
- What are the options for accessing the diagnostics data?

1.2 IO-Link Diagnostics

The IO-Link master provides diagnostics results of the IO-Link device or of the IO-Link port. The diagnostics events are identified by an EventQualifier and an IO-Link EventCode.

The EventQualifier includes the following information about the diagnostics event:

- Source of the event: IO-Link or IO-Link port
- Diagnostics type: Fault or warning
- Incoming or outgoing event

The EventCode references with a number the actual diagnostics event that is defined in Appendix D of the IO-Link specification; for example, EventType 0x7711 - Ground fault - Check installation.

In addition to the standardized diagnostics there are also manufacturer-specific diagnostics; for example, EventType 0x8CA0 - Vendor specific diagnosis.

Detailed information is available in the system manual entitled "IO-Link System".

https://support.industry.siemens.com/cs/ww/en/view/65949252

The concrete meaning of the manufacturer-specific diagnostics is available in the IODD or in the operating instructions of the IO-Link device.

The IO-Link specification is available at the following link in the "Downloads" area. https://io-link.com

1.3 IO-Link Diagnostics in the System Environment

The IO-Link master makes the IO-Link diagnostics available in complete detail in the automation system via PROFINET in order to enable targeted troubleshooting by the operating personnel.

The following diagnostics mechanisms are provided to access the IO-Link diagnostics information:

• System diagnostics:

Using PROFINET diagnostics interrupts all the IO-Link diagnostics events are imported into the Siemens system diagnostics and are automatically visible in the diagnostics buffer of the S7-1200 / S7-1500 CPU or in the diagnostics tree of the controller. All diagnostics clients (online diagnostics with TIA Portal, HMI, etc.) have access to this diagnostics tree. This happens automatically without further effort by the user (system-integrated diagnostics).

• Diagnostics status:

Based on the Port Qualifier Information (PQI) you can identify the validity of the measured values or the presence of a diagnosis and reacting to it in the program, group error, for example. Each port has a PQI with the following properties:

- The PQI provides information about the status of the port and of the IO-Link device (value status).
- The PQI is transferred cyclically with the process data.
- Active reading of the diagnostics (on demand) of the IO-Link device: Using the integrated system functions of the library blocks "IO_LINK_DEVICE" and "IoIIdentAndDiag" you can have direct access to the active IO-Link diagnostics data of the IO-Link device.
- **Note** The "IoIIdentAndDiag" function is only supported by the IO-Link device if the common profile or another IO-Link profile is integrated in the IO-Link device.

Information about the IO-Link profiles is available in the IO-Link specification at the following link in the "Download" area.

https://io-link.com/

An application example for using the IO-Link profiles is available at the following link:

https://support.industry.siemens.com/cs/ww/en/view/109766016

PLC IO-Link Master

The following figure shows the IO-Link diagnostics mapping. Figure 1-1

1.4 Examples

The diagnostics mechanisms described in section $\underline{1.4.2}$ are shown based on an IO-Link device that is set into a fault state.

The following faults are triggered on the IO-Link device:

• EventType 0x7711 - Ground fault - Check installation

In the following we show how the fault has an effect on the diagnostics mechanisms described in section 1.3.

1.4.1 System Diagnostics

The fault shown is reported automatically to the system diagnostics. This results in the following behaviors.

In the following we show the diagnostics from 2 different IO-Link masters (Version A and Version B):

Version A: Diagnostics Mapping IO-Link EventType 0x7711

Version A is valid for the following IO-Link masters:

Table 1-1

IO-Link master	Article number
ET 200SP CM 4xIO-Link	6ES7137-6BD00-0BA0
ET 200AL CM 4xIO-Link	6ES7147-5JD00-0BA0
ET 200pro EM 4 IO-Link HF	6ES7147-4JD00-0AB0
S7-1200 SM 1278 4 IO-Link	6ES7278-4BD32-0XB0
ET 200MP CM 8xIO-Link	6ES7547-1JF00-0AB0

The following figure shows how the fault on the ET 200SP IO-Link master is displayed in the diagnostics buffer of a S7-1500 CPU.

Figure 1-2 1511F-1 PN Online access Diagnostics buffer Diagnostics General Events Diagnostic status Diagnostics buffer Display CPU Time Stamps in PG/PC local time Cycle time Memory Display Date and time 1/1/2012 4:56:02.350 AM Error 1 PROFINET interfa 1/1/2012 4:55:50 296 AM Communication initiated request: WARM RESTART - CPU changes from STOP to STARTUP mode 1/1/2012 4:55:47.895 AM Communication initiated request: STOP - CPU changes from RUN to STOP mode 1/1/2012 4:55:45.004 AM Communication initiated request: WARM RESTART - CPU changes from STARTUP to RUN mode Functions 1/1/2012 4:55:44.931 AM Communication initiated request: WARM RESTART - CPU changes from STOP to STARTUP mode 1/1/2012 4:55:42.329 AM Communication initiated request: STOP - CPU changes from RUN to STOP mode 11/1/2012 4:55:40.192 AM Communication initiated request: WARM RESTART - CPU changes from STARTUP to RUN mode 11/1/2012 4:55:40.123 AM Communication initiated request: WARM RESTART - CPU changes from STOP to STARTUP mode 8 Freeze display Details on event 16# 08:0009 41 Module: io device_1 / CM 4xiO-Link_1 Rack/slot: Rack 0 / Slot 1 Error: Error on Input/Output channel 1 IO Device_1 / CM 4xIO-Link_1. An error has occurred. The possible causes depend on the module type you are using. Additional information is available in the module manual. Solution: Refer to the module manual. Incoming even

The following figure shows the channel diagnostics in the TIA Portal in the "Online&Diagnostics" view of the ET 200SP IO-Link master.

Figure 1-3

Diagnostics General Diagnostic status Channel diagnostics	el diagnostics		
Functions	Channel type	Channel no.	Error
	Input/output	1	Error
		d. The possible ca	auses depend on the module type you are using the module manual.

Version B: Diagnostics Mapping IO-Link EventType 0x7711

Version B is valid for the following IO-Link masters:

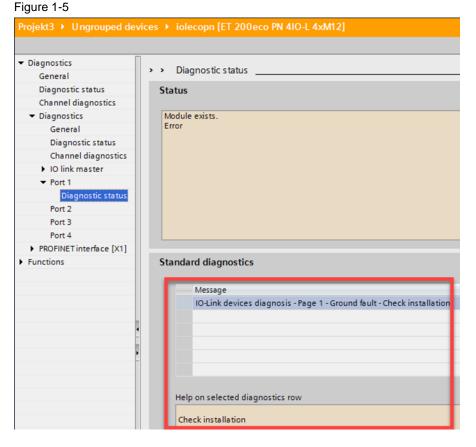
Table 1-2

IO-Link master	Article number
ET 200ecoPN IO-Link master	6ES7148-6JD00-0AB0

The following figure shows how the fault on the ET 200ecoPN IO-Link master is displayed in the diagnostics buffer of a S7-1500 CPU.

ccess Diago	ostics bu	Hor				
tics	ostics bu	mer				
al Eve	nts					
ostic status						
	🛃 Display	CPU Time Stamps	in PG/PC lo	cal time		
time	No.	Date and time		Event		
ory iy	1	1/1/2012 1:04:19	9.303 AM	IO-Link devices diagno	sis - Page 1 - Ground fault - C	heck installation
NET interf	2	44420424-01-0		- Commentation in the second		
s	3	1/1/2012 1:04:00	6.435 AM	Communication initiat	ed request: WARM RESTART -	CPU changes from S 🔽
,	4	1/1/2012 1:04:03	3.834 AM		ed request: STOP - CPU char	and the second
	5	1/1/2012 1:03:55	5.491 AM	Communication initiat	ed request: WARM RESTART -	CPU changes from S 🔽
	6	1/1/2012 1:03:55	5.425 AM	Communication initiat	ed request: WARM RESTART -	CPU changes from S 🗹
	7	1/1/2012 1:03:52	2.423 AM	Communication initiat	ed request: STOP - CPU char	ges from RUN to STOP 🗹
	8	1/1/2012 1:03:40	6.637 AM	Communication initiat	ed request: WARM RESTART -	CPU changes from S 🗹
Del	Freeze	display e vent :				
Det		event	1	of 20	Event	ID: 16# 1AB9:FE3B
Del		event: Details on event:			Event	ID: 16# 1AB9:FE3B
Del		event	iolecopn	/ 4 IO-L.Port_1	Event	ID: 16# 1AB9:FE3B
Det		event: Details on event: Module:	iolecopn Rack 0 / S	/ 4 IO-L.Port_1 5lot 1.2	Event Page 1 - Ground fault - Check	
Det		event Details on event: Module: Rack/slot:	iolecopn Rack 0 / S Error: IO-	/ 4 IO-L.Port_1 5lot 1.2		
Det		event Details on event: Module: Rack/slot:	iolecopn Rack 0 / S Error: IO-	/ 4 IO-L.Port_1 Slot 1.2 Link devices diagnosis -		
Del		event Details on event: Module: Rack/slot:	iolecopn Rack 0 / S Error: IO-	/ 4 IO-L.Port_1 Slot 1.2 Link devices diagnosis -		
Det		event Details on event: Module: Rack/slot:	iolecopn Rack 0 / S Error: IO-	/ 4 IO-L.Port_1 Slot 1.2 Link devices diagnosis -		
Del		event Details on event: Module: Rack/slot:	iolecopn Rack 0 / S Error: IO- iolecopr	/ 4 IO-L.Port_1 Slot 1.2 Link devices diagnosis - i / 4 IO-L.Port_1		
Del		Details on event: Module: Rack/slot: Description:	iolecopn Rack 0 / S Error: IO- iolecopr	/ 4 IO-L.Port_1 Slot 1.2 Link devices diagnosis -		
Del		Details on event: Module: Rack/slot: Description:	iolecopn Rack 0 / S Error: IO- iolecopr	/ 4 IO-L.Port_1 Slot 1.2 Link devices diagnosis - i / 4 IO-L.Port_1		
Del		Details on event: Module: Rack/slot: Description:	iolecopn Rack 0 / S Error: IO- iolecopr	/ 4 IO-L.Port_1 Slot 1.2 Link devices diagnosis - i / 4 IO-L.Port_1		
Del		Details on event: Module: Rack/slot: Description:	iolecopn Rack 0 / S Error: IO- iolecopr	/ 4 IO-L.Port_1 Slot 1.2 Link devices diagnosis - i / 4 IO-L.Port_1		
Del	tails on o	Details on event: Module: Rack/slot: Description:	iolecopn Rack 0 / S Error: IO- iolecopr	/ 4 IO-L.Port_1 Slot 1.2 Link devices diagnosis - i / 4 IO-L.Port_1		installation

The following figure shows the channel diagnostics in the TIA Portal in the "Online&Diagnostics" view of the ET 200ecoPN IO-Link master.



1.4.2 Diagnostics Status

Each port has a Port Qualifier Information (PQI). This PQI provides information about the port and IO-Link device status and about the validity of the process data (value status). You have to enable the sending of the PQI when you parameterize the IO-Link device and the PQI is transferred cyclically with the process data of the IO-Link device.

Example

The PQI of the EventType 0x7711 (Ground fault – Check installation) delivers the following information:

- Device availability (Bit 5) =1, this means active communication with the IO-Link device.
- Device fault (Bit 6) = 1, this means an active fault is present on the IO-Link device - "Ground fault".
- PortQualifier (PQ) (Bit 7) = 0, this means the measured values of the IO-Link device are not valid.

The figure below shows the structure of the PQI. Figure 1-6 Port Qualifier Information (PQI) 6 5 4 3 2 1 0 7 Input byte max.+1 Reserved Reserved Reserved Reserved Reserved Device availability (IO-Link communication available) Device error Port Qualifier (value status)

1.4.3 Active Reading of the Diagnostics (on demand) of the IO-Link Device

Using the blocks "IO_LINK_DEVICE" and "IoIIdentAndDiag" you can read out the available diagnostics information directly from the IO-Link device.

Detailed information about using the blocks is available in the following application examples.

- "IO_LINK_DEVICE": Acyclic reading and writing with the IO-Link library <u>https://support.industry.siemens.com/cs/ww/en/view/82981502</u>
- "IoIIdentAndDiag": Common and Smart Sensor Profiles for IO-Link: <u>https://support.industry.siemens.com/cs/ww/en/view/109766016</u>
- **Note** IO-Link devices with integrated IO-Link profiles return the current diagnostics status. Diagnostics feedback from the IO-Link device without IO-Link profile depends on the device.