

PROFIBUS - PROFINET user conference 2010 Gelebrating 20 Years of PROFIBUS

Everything you ever wanted to know about DPV1 diagnostics ... but were afraid to ask!

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# **PROFIBUS** Device Diagnostics

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#### Agenda

Introduction Start up diagnostics Cyclic diagnostics Standard vs Condensed status byte Acyclic Diagnostics What happens when an error occur Demo User's perspective – how to manage this information!



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# Introduction

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An Alarms occurs.

What do you do?

Panic?

Call for help?

Look at the right diagnostics to solve the problem!



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### Startup Cycle

- The Master powers up and begins to poll the network
- When it encounters a Slave, it will ask the Slave about itself
- If appropriate, it will parameterize the Slave and check the configuration
- It will do one last check and if the device is ready, the Master and Slave will enter data exchange



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## **Get Diagnostics**

- The Master sends the first of two 'Get Diagnostics' telegrams during startup
- The first Get Diagnostics is to determine if the Slave is powered and on the network and not assigned to another Master



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### **Set Parameters**

- The Master then sends a 'Parameterization' telegram to the device
- This message configures the slave for bus communication
  - Sets the minimum response time
  - Sets the watchdog time
  - Assigns the slave to a group
  - Locks the Slave to this Master
- The slave will respond with a short acknowledge to indicate that it has received the message



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### **Check Configuration**

- The Master then sends a 'Check Config' telegram to the device
- This message tells the Slave what I/O configuration the Master expects
- The slave will respond with a short acknowledge to indicate that it has received the message



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# **Get Diagnostics**

 The Master sends the second 'Get Diagnostics' telegram to find out if the Slave was properly parameterized and configured

 The Slave will respond if it is ready for Data Exchange or not



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#### Data Exchange

 If Parameterization and Configuration were successful, the Master and Slave will enter Data Exchange mode

- The Slave sends inputs and receives outputs from the Master
- Data exchange happens in a cyclic manner



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# Start up procedure



2->5	SRD_HIGH	Get Diagnostics	Req	62->60	0															
2<-5	DL	Get Diagnostics	Res	62<-60	14	0A	05	00	FF	81	OF	08	FE	00	01	00	00	01	80	
2-≻5	SRD_HIGH	Set Parameters	Req	62->61	15	88	OD	OF	0B	81	OF	00	80	00	00	05	41	00	00	01
		Short acknowledge	Res																	



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# Start up procedure

2->5	SRD_HIGH	Check Config Short acknowledge	Req Res	62->62	2	94 00
2->5	SRD_HIGH	Get Diagnostics	Req	62->60	0	
2<-5	DL	Get Diagnostics	Res	62<-60	14	08 0C 00 02 81 OF 08 FE 00 01 00 00 01 80
2->5	SRD_HIGH	Data Exchange	Req			
2<-5	DL	Data Exchange	Res		5	40 68 B2 90 80





## **Get Diagnostics**





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Diagnostic Request Reply = Diagnostic message + extended diagnostic message

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 DEFINED BY PROFIBUS STANDARD (DPV0)

 BYTE 1
 BYTE 2
 BYTE 3
 BYTE 4
 BYTE 5
 BYTE 6

<u>Diagnostic Message</u> (PROFIBUS International defined):
Wrong cyclic data configuration
Wrong data sizes
Incorrect module
Wrong identification number

Diagnostic Request Reply = Diagnostic message + extended diagnostic message

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Extended Diagnostic Message (Profile and Device Vendor defined): •Electronic failure

- •Configuration invalid
- •Electronic temperature too high
- Restart carried out
- •Measurement failure
- •More diagnostics available

Extended Diagnostic is also called Device related diagnostics

# Defined in the GSD file:

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;----- Description of device related diagnosis: ------Unit\_Diag\_Bit(16)="Error appears" Unit\_Diag\_Bit(17)="Error disappears" Unit\_Diag\_Bit(24)="Hardware failure electronics" Unit Diag Bit(25)="Hardware failure mechanics" Unit\_Diag\_Bit(26)="Motor temperature too high" Unit\_Diag\_Bit(27)="Electronic temperature too high" Unit\_Diag\_Bit(28)="Memory error" Unit\_Diag\_Bit(29)="Measurement failure" Unit Diag Bit(30)="Device not initialized" Unit Diag Bit(31)="Device initialization failed" Unit\_Diag\_Bit(32)="Zero point error" Unit Diag Bit(33)="Power supply failed" Unit\_Diag\_Bit(34)="Configuration invalid" Unit\_Diag\_Bit(35)="Restart" Unit\_Diag\_Bit(36)="Coldstart" Unit\_Diag\_Bit(37)="Maintenance required" Unit\_Diag\_Bit(38)="Characteristics invalid" Unit\_Diag\_Bit(39)="Ident\_Number violation" Unit Diag Bit(55)="Extension Available"

# Defined in manual for decoding

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0	8 FE 00 01 00 00 01 80
	↑
Byte	•
4	Field device diagnostics byte 0
5	Field device diagnostics byte 1
6	Field device diagnostics byte 2
7	Field device diagnostics byte 3

			Indication
Byte	Bit	Description	class <sup>a</sup>
	0	Electronics failure	R
	1	Mechanical failure	R
	2	Motor Temperature too high	R
0	3	Electronics temperature too high	R
0	4	Memory error	R
	5	Measurement failure	R
	6	Device not initialized (no calibration)	R
	7	Self calibration failed	R
	0	Zero point error (limit position)	R
	1	Power supply failure (electrical, pneumatic)	R
	2	Configuration invalid	R
	3	New startup carried out (Warm Start)	Α
	4	Restart carried out (Cold Start)	Α
1	5	Maintenance required	R
	6	Characterization invalid	R
	7	Set to 1 (one), if the Ident_Number of the running cyclic data transfer and the value of Physical Block IDENTNUMBER_SELECTOR parameter are different.	R
2	0 to 7	Reserved for use within the PNO	
3	0 to 6	Reserved for use within the PNO	
	7	More diagnosis information is available	
	Byte 0 1 2 3	Bit         0         1         2         3         4         5         6         7         0         1         2         3         4         5         6         7         3         4         5         6         7         6         7         2         3         4         5         6         7         2         3         4         5         6         7         2       0 to 7         3       0 to 6         7	ByteBitDescription0Electronics failure1Mechanical failure2Motor Temperature too high3Electronics temperature too high4Memory error5Measurement failure6Device not initialized (no calibration)7Self calibration failed0Zero point error (limit position)1Power supply failure (electrical, pneumatic)2Configuration invalid3New startup carried out (Warm Start)4Restart carried out (Cold Start)5Maintenance required6Characterization invalid3Set to 1 (one), if the Ident_Number of the rrunning cyclic data transfer and the value of Physical Block IDENTNUMBER_SELECTOR parameter are different.20 to 7Reserved for use within the PNO30 to 6Reserved for use within the PNO30 to 6Reserved for use within the PNO7More diagnosis information is available

Cyclic Data – Diagnostic Request (DPV0)

Slave has an error Set a flag during cyclic I/O read (1) Next scan Master reads (2): •Cyclic diagnostics •Cyclic extended diagnostic

Red light on link module

Applies to all PROFIBUS devices

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# **Cyclic Diagnostics**

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#### What does the controller see?

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EXTENDED + DIAGNOSTICS



Extended diagnostic (Device defined): electronic failure configuration Invalid electronic temperature too high restart carried out measurement failure more diagnostics available

Device Failure Device configuration

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# Cyclic Data – Status byte (DPV1)

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Every scan slave sends back status byte

An error occurs

Status byte changes:

Red light on link module

Alert in controller



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### Status Byte

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Standardized set of codes for all instruments:

- ■Hex 80 = OK
- Hex 00 = no communications
- Non Hex 8x = some sort of problem

Status o	codes for good quality
Values in hex notation	Description
0x80	Data is GOOD.
0x84	A parameter in the function block has been changed: status active for 10 s.
0x89	Active low warning.
0x8A	Active high warning.
0x8D	Active low alarm.
0x8E	Active high alarm.

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# Status byte (non-OK status)

Status coo	des for uncertain quality
Values in hex notation	Description
0x4B	Value is a substituted value (normally used in Failsafe).
0x4C/0x4F	Initial value.
0x47	Last usable value.
Status	codes for bad quality
Values in hex notation	Description
0x10	The LOE timer has expired: this could be caused by LOE or by sensor malfunc- tion: value is BAD.
0x01	There is an error in the configuration of the function blocks in PROFIBUS PA.
0x1F	The function block, or the transducer block, has been placed out of service.

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### **Condensed Status**



Profile 3.01 and above introduced 'condensed status' which is simply a remapping and reduction in the 'error' codes.

Good status codes are the same for both Introduced the concept of maintenance levels

Also introduced the ability to change alarm levels (make a warning into an alarm, or make an alarm into a warning or even non-event).



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# Condensed Status – OK status

	Condensed sta	itus (GOOD)
Hex value	Status — GOOD	Description
0x80	GOOD – ok	No error or special condition is associated with this value
0x84	GOOD – update event	Set if the value is good and the block has an active Update event. (This status remains active for 20 seconds.)
0x86	GOOD – activate advisory alarm	Set if the value is good and the block has an active Alarm.
0x800x8E	GOOD – limit check / update event	Same as the original status codes.
0xA40xA7	GOOD – maintenance required	Value is valid. Maintenance is recommended within a medi- um-term period.
0xA80xAB	GOOD – maintenance demanded	Value is valid. Maintenance is recommended within a short-term period.
0xBC0xBF	GOOD – function check	Device performs internal function check without influ- encing the process. Value is valid.

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# Condensed Status non-OK codes

	Condensed statu	s (UNCERTAIN)
Hex value	Status — GOOD	Description
0x45	UNCERTAIN – substitute set	Output of Failsafe logic only.
0x4F	UNCERTAIN – initial value	Default value as long as no measured value is available or until a diagnosis is made that affects the value and the sta- tus accorded to it.
0x680x6B	UNCERTAIN – maintenance demanded	Usability of the process value depends on the application. Value is potentially invalid. Cause can be determined by reading the extended diag- nostics. Maintenance is demanded within a short- term period.

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#### Two Masters need to know!

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# **Acyclic Diagnostics**



Each DPV1 slave contains:

Acyclic Diagnostic = Cyclic Extended diagnostic (so the Eng. Station can see it) Acyclic Extended Diagnostic = more detailed information





# What can you see with Diagnostic Software?

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Communication       Good         Device Status       Good         Device in test mode       Device write         Diverse Status       Good         Device write       Simulation or substitute value         Dut of service       Device type mismatch         Device type mismatch       Maintenance alarm         Device type mismatch       Maintenance alarm         Configuration studied       Configuration studied         Configuration warning       Configuration warning         Configuration warning       Process value alarm         Process value tolerance       Process value tolerance         exast Check       \$V24/2006 11:49:21 AM         Message Text       >> M a in ten an ce required <<         - More information available.       -         - Loss of Echo       The device was unable to get a measurement within the Failsafe Timer period. Possible causes: faulty linstallation, material buildup, and/or presence of foam.         -> Ensure installation details are correct. Ensure no material buildup. Adjust process conditions to minimize foaming. If problem persists, contact your local Siemens representative.         >> Process value al arm <       -         - FB1 - Analog Input - Current State Alarm Sum: Upper Limit Alarm	Device Statu Functio	s General Physical Block Extended Diagnostics Transducer Block 1 n Block 1 - Analog Input Function Block 2 - Analog Input Diagnostics	
Device Status       Good         Device in test mode       Cocal override         Device type mismatch       Device type mismatch         Configuration changed       Configuration changed         Devices value alarm       Process value alarm         Process value tolerance       Process value tolerance         Process value tolerance       Statuscolerance         Asst Check       Statuscolerance         Asst Check       Statuscolerance         Process value tolerance       -         Asst Check       Statuscolerance         Asst Check       <	Communication	In Good □Failed	]
Aessage Text >> M a in ten an cere quired << - More information available. - Loss of Echo The device was unable to get a measurement within the Failsafe Timer period. Possible causes: faulty installation, material buildup, and/or presence of foam. -> Ensure installation details are correct. Ensure no material buildup. Adjust process conditions to minimize foaming. If problem persists, contact your local Siemens representative. >> Process value alarm << - FB1 - Analog Input - Current State Alarm Sum: Upper Limit Alarm	Device Status	Good Device in test mode Local override Out of service Device type mismatch Maintenance alarm Maintenance required Configuration failure Configuration warning Configuration warning Process value alarm Process value alarm Process value tolerance	
<ul> <li>Maintenance required &lt;&lt;         <ul> <li>More information available.</li> <li>Loss of Echo</li> <li>The device was unable to get a measurement within the Failsafe Timer period. Possible causes: faulty installation, material buildup, and/or presence of foam.</li> <li>Ensure installation details are correct. Ensure no material buildup. Adjust process conditions to minimize foaming. If problem persists, contact your local Siemens representative.</li> <li>Process value alarm &lt;</li> <li>FB1 - Analog Input - Current State Alarm Sum: Upper Limit Alarm</li> </ul> </li> </ul>	ast Check	8/24/2006 11:39:21 AM	
	Aessage Text	<ul> <li>&gt;&gt; M a intenance required &lt;&lt;         <ul> <li>More information available.</li> <li>Loss of Echo</li> <li>The device was unable to get a measurement within the Failsafe Timer period. Possible causes: faulty installation, material buildup, and/or presence of foam.</li> <li>&gt;&gt; Ensure installation details are correct. Ensure no material buildup. Adjust process conditions to minimize foaming. If problem persists, contact your local Siemens representative.</li> <li>&gt;&gt; Process value alarm &lt;</li> <li>-FB1 - Analog Input - Current State Alarm Sum: Upper Limit Alarm</li> </ul> </li> </ul>	
Update diagnostics		Update diagnostics	

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What happens when an error occurs?





What happens when an error clears?

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# Live Demo

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#### Using:

ProfiCaptain
SIMATIC PDM
SITRANS PROBE LU
DP/PA Link/Coupler

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From a Users Perspective

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Monitor status byte changes

Check PLC fault table for diagnostic requests. Use PDM to see what is really going on in the instrument!



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Everything you ever wanted to know about DPV1 diagnostics ... but were afraid to ask!

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