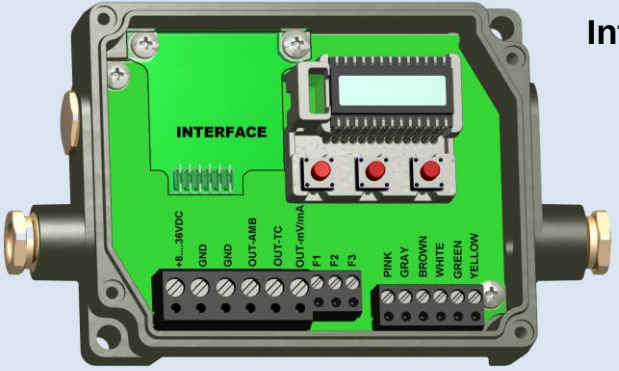
Operator‘s Manual

optris® PROFIBUS



Interface for optris CT infrared thermometers

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optris
infrared measurements

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1 General Information

1.1 Description

Thank you for choosing optris® PROFIBUS-DP-V1 interface.
The PROFIBUS (Process Field Bus) is a fieldbus communication which is used for data exchange in the field plane.

Read the manual carefully before the initial start-up. The producer reserves the right to change the herein described specifications in case of technical advance of the product.

1.2 Warranty

Each single product passes through a quality process. Nevertheless, if failures occur contact the customer service at once. The warranty period covers 24 months starting on the delivery date. After the warranty is expired the manufacturer guarantees additional 6 months warranty for all repaired or substituted product components. Warranty does not apply to damages, which result from misuse or neglect. The warranty also expires if you open the product. The manufacturer is not liable for consequential damage or in case of a non-intended use of the product.
If a failure occurs during the warranty period the product will be replaced, calibrated or repaired without further charges. The freight costs will be paid by the sender. The manufacturer reserves the right to exchange components of the product instead of repairing it. If the failure results from misuse or neglect the user has to pay for the repair. In that case you may ask for a cost estimate beforehand.

1.3 Scope of supply

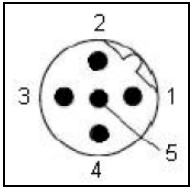
- PROFIBUS-DP-V1 interface
- M12 device socket
- Cable connection M12x1,5
- 2 screws M3x5
- Software CD (operators manual, GSD file)
- Brief instruction

2 Installation / Interfaces

Please install the M12 device socket onto the lower left and the cable connection onto the upper left position of the CT box.
Plug the PROFIBUS-DP-V1 interface into the intended plug at the CT which is right next to the display.
Push down the PROFIBUS-DP-V1 interface and adjust it with the supplied screws M3x5 within the electronic box.
Please connect the device socket with the screw terminal at the PROFIBUS-DP-V1 interface (table).

The optris CT mainboard is operated with +8 to +36 VDC supply voltage.

Wire color M12	Profibus-Board	Meaning
1 Green	A	Data Minus
2 Brown	VCC	VP
3 Red	B	Data Plus
4 Blue	GND	DGND
5 Gray	-	-



2.1 Setting PROFIBUS address at optris CT

After mounting the PROFIBUS-DP-V1 interfaces, the optris CT will be supplied with voltage and the MODE button is pressed until the entry “SL001” appears. Afterwards the favored slave address will be chosen with the „UP” and “DOWN” buttons – this will be taken over after six seconds. Then the optris CT has to be removed from the voltage for three seconds. This procedure must always be carried out when a new slave address is set.

2.2 Information regarding GSD file

File name:	IT010A90.gsd
Producer:	Sensor Manufacturer
Slave name:	Infrared Thermometer
Identity number:	0x0A90
GSD revision:	1.00

Please make settings via the Profibus configuration program (e.g.: SIMATIC MANAGER or Hilscher SyCon).

2.3 Operation of optris CT with the PROFIBUS-DP-V1 interface

After the GSD file (IT010A90.gsd) has been read into the configuration tool and transferred to the master, the optris CT with PROFIBUS-DP-V1 interface is ready for data exchange. This can also be seen on the green LED on the Profibus-DP-V1 interface, if the cover was removed from the optris CT (open only for testing purposes).

2.4 Data conversion

The cyclic received data of the “object temperature” and the “internal sensing head temperature” are shown in a 2 byte hex format. In this context the 1. byte is the high byte and the 2. byte is the low byte.

They are converted as following:
Hex format converts into decimal format, minus 1000 and divided by ten

Example: 0x04EB → 1259 – 1000 / 10 = 25,9 °C

3 Operation of CT mainboard

The sensor configuration will be done with the three control keys Mode, Up and Down.

Display example					Mode					Explanation
	3	5.	2	C					C	Object temperature ref. to signal (here: 35,2 °C)
2	6.	3	C	H				C	H	Head temperature (here: 26,3 °C)
	3	8	C	B				C	B	Temperature electronic box (here: 38,0 °C)
	3	4	C	A				C	A	Effective object temperature (here: 34,0 °C)
		M	V	5	o					Signal output entrance cable 1 (here: 0-5 V)
E	0.	9	7	0	E					Emissivity (here: 0,970)
T	1.	0	0	0	T					Transmission ratio (here: 1,000)
A			0.	2	A					Signal output average (here: 0,2 s)
P	--	--	--	--	P					Signal output maximum (here: inactive)
V	--	--	--	--	V					Signal output minimum (here: inactive)
u			0.	0	u					Lower limit of temperature scale (here: 0 °C)
n	5	0	0.	0	n					Maximum limit of temperature scale (here: 500 °C)
[		0.	0	0	[					Lower limit output signal (here: 0 V)
]		5.	0	0	]					Maximum limit output signal (here: 5,00 V)
U			°	C	U					Temperature unit °C /°F (here: °C)
|		3	0.	0	|					Lower alarm limit (here: 30,0 °C)
||	1	0	0.	0	||					Maximum alarm limit (here: 100,0 °C
x	H	E	A	D	x	H	E	A	D	Surrounding temperature compensation (here: sensing head)
S	L	0	0	1	S	L				Slave address (here: SL001)

4 PROFIBUS DP

Within PROFIBUS DP systems, the master (PLC, PC, etc.) generally communicates with many slaves (IO, drive, etc.) whereas only the master can access the bus (sent unasked telegrams) while a DP slave only sends telegrams if it has been requested by a master.

4.1 DP startup

Before master and slave cyclically exchange data with each other, the parameter and configuration data are transferred from the master to the slaves during the DP startup. After sending the parameter and configuration data, the master interrogates the diagnostic data of the slave until the slave signals its readiness for data exchange. Depending on the amount of calculations that the slave has to perform by receiving parameter and configuration data until it is ready for data exchange, this may take several seconds. The slave therefore has the following states:

4.1.1 Parameter data

The parameter data are sent from the master to the slaves with the SetPrmLock request telegram; the SetPrmLock response telegram contains no data and therefore consists of only one byte, the short acknowledgment. The parameter data consists of DP parameters (e.g. setting of the DP watchdog, checking of the IdentNumber (unique for each DP device)), of DP-V1/DP-V2 parameters and of application-specific parameters that occur only once during the startup must be transferred. If an error occurs in the parameter data, this is indicated in the diagnostic data and the slave remains in the state WAIT-PRM.

4.1.2 Configuration data

The configuration data are sent from the master to the slaves with the ChkCfg request telegram; the ChkCfg response telegram contains no data and therefore consists of only one byte, the short acknowledgment. The configuration data describe the assignment of the DP modules to the cyclic IO data that is exchanged with the Data_Exchange telegram during the cyclic data exchange between master and slave. The order of the DP modules attached to a slave in the DP configuration tool determines the sequence of the associated IO data in the Data_Exchange message frame.

4.1.3 Diagnosis data

The diagnostics data is requested by the master with a SlaveDiag request telegram without data, the slave sends the diagnostics data with a SlaveDiag response telegram. The diagnostic data consists of the standard DP diagnostics (for example, state of the slave, IdentNumber) and application-specific diagnostics data.

4.2 Cyclic data transfer

Core piece of the DP record is the cyclic data transfer. During the DP cycles the master exercises an IO data transfer with each slave. The master send each slave the outputs with a DataExchange request telegram and the slave answers with the inputs in a DataExchange response telegram. All output and input data are transmitted each with a telegram in which the DP configuration (sequence of the DP module) defines the assignment of the output or input data to the real process data of the slave.

4.2.1 Diagnosis during cyclic data transfer

During cyclic data exchange, a slave can report a diagnosis to the master. In this case, the slave sets a flag in the DataExchange response telegram; whereupon the master recognizes that the slave has new diagnostics data, which he then picks up with the SlaveDiag telegram. The diagnostic data is therefore not in real time with the cyclic IO data in the controller, but at least one DP cycle later.

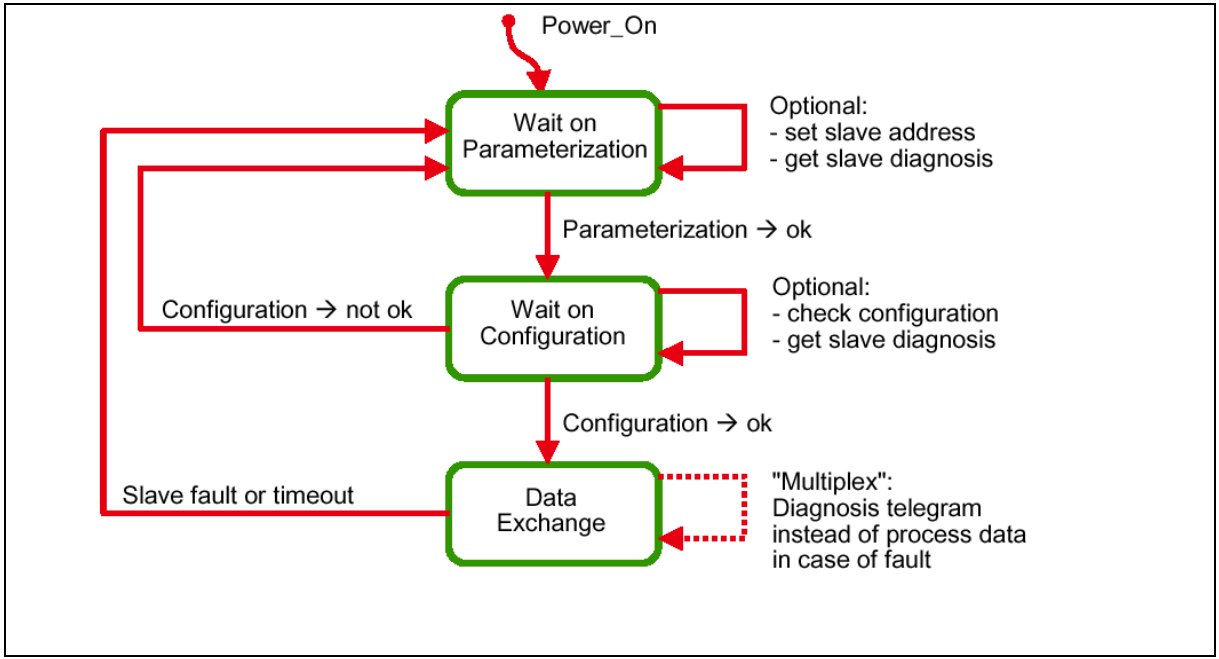
4.3 Synchronization of sync and freeze

With the sync and freeze commands in the GlobalControl request telegram (broadcast telegram), the master can synchronize the output of the outputs (sync) or the input of the inputs (freeze) for several slaves. When the sync command is used, the slaves are first switched to the sync mode (acknowledged in the diagnostics data), then the IO data is exchanged sequentially with the slaves via the DataExchange telegram, a transmission of the sync command in the GlobalControl telegram then results in the slaves outputting the last received outputs.
In freeze mode, a freeze command is first sent in the GlobalControl telegram, whereupon all slaves take over the signals at their inputs and are then sequentially requested by the master with the DataExchange telegram.

4.4 State of things within the master

The master distinguishes the status CLEAR (all outputs on the Fail_Safe value) and OPERATE (all outputs have the process value). Typically, the master is switched to the CLEAR mode when e.g. the PLC goes to STOP.

4.5 State machinery within the slave



4.6 DP master class 1 and class 2

The class 1 master refers to the controller that performs cyclic I/O data exchange with the slaves, while a class 2 master is a B&B device that generally only reads the slaves IO data in a read-only manner.

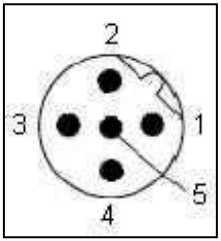
PROFIBUS-DP-V1 essentially refers to the acyclic read and write telegrams used to acyclic access data records in the slave. With DP-V1 as well, a distinction is made between class 1 and a class 2 master. The acyclic class 1 (C1) or class 2 (C2) connection differ in that the acyclic C1 connection is established with the DP startup of the cyclic DP operation. From the state WAIT-CFG of the slave, acyclic DP-V1-C1 read and write telegrams can be sent from the master to the slave, while the C2 connection has a separate connection independent of the cyclic DP connection, which is usually is performed by a second (C2) master, so that e.g. a manufacturer-specific configuration and diagnostics tool can access the data of the slave. When using two masters, however, it must always be remembered that they share the bus access (a token is exchanged), so that the time relationships are less favorable than with a mono-master system.

4.7 PROFIBUS access

M12 device socket

The M12 device socket is coded inversely and has 5 pins. Pin 1 and pin 2 transmit the signals of the Profibus. These must under no circumstances be exchanged, otherwise the communication is disturbed. Pin 2 transmits +5 VDC and Pin 4 transmits GND for the active terminator. These may under no circumstances be used for other functions as this may destroy the device. Pin 5 has no function.
The thread carries the shield, which is capacitive connected to the base of the housing box.

Pin assignment



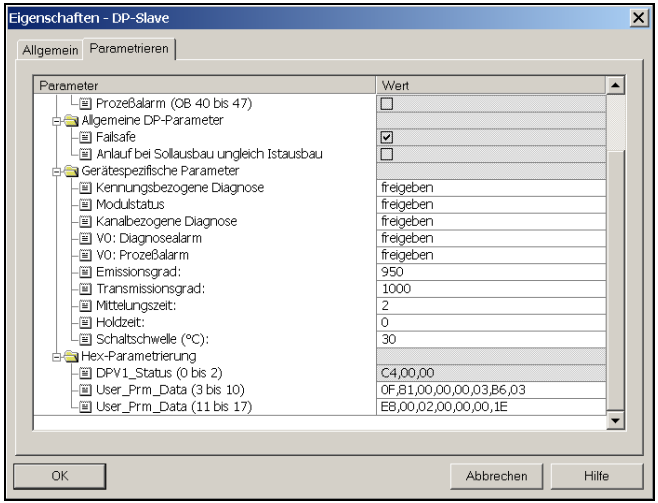
1	A
2	+ 5V DC
3	B
4	GND
5	

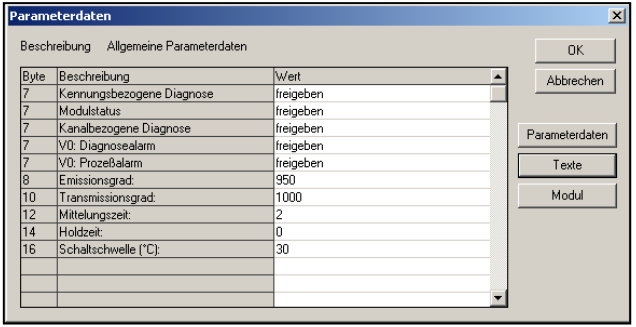
4.8 UserPrmData in head station

Within the UserPrmData of the head station, the following settings can be done:

Byte	Bit	Data	Description
0	7	0	DP-V1-operation logged
		1	DP-V1-operation free for use
	6	0	Fail-Safe-Mode is not supported
		1	Fail-Safe-Mode is supported
	5	0	Publisher-Mode is not supported
		1	Publisher-Mode is supported
	3	0	WD-Time-Base 10ms
		1	WD-Time-Base 1ms
1	6	0	DP-V1: process alarm is not supported
		1	DP-V1: process alarm is supported
	5	0	DP-V1: Diagnoses alarm is not supported
		1	DP-V1: Diagnoses alarm is supported
2		0x00	Fix
Byte	**Bit**	**Data**	**Description**
3		0x0F	Fix
4		0x81	Fix
5		0x00	Fix
6		0x00	Fix
7	6	0	DP-V0: Process alarm is not supported
		1	DP-V0: Process alarm is supported
	5	0	DP-V0: Diagnoses alarm is not supported

		1	DP-V0: Diagnoses alarm is supported
	2	0	Release channel-related diagnostics
		1	Disable channel-related diagnostics
	1	0	Release module status
		1	Disable module status
	0	0	Release identifier-related diagnostics
		1	Disable identifier-related diagnostics
8	0	0	Status alarm clear
		1	Status alarm locked
9,10			Emissivity
11,12			Transmission ratio
13,14			Averaging time
15,16			Hold time
17,18			Threshold level 1

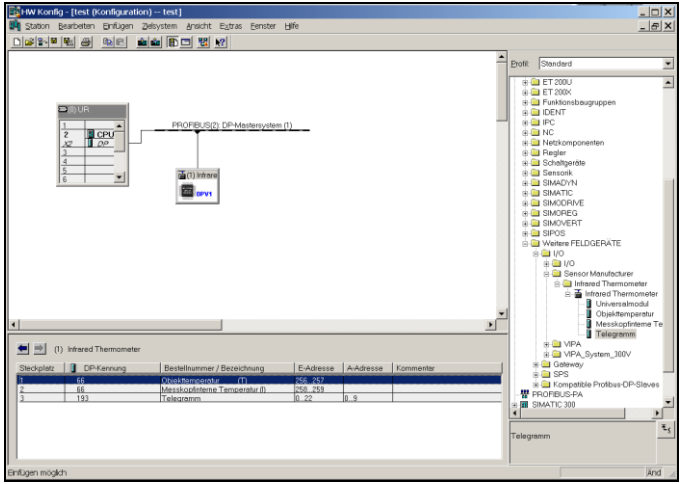

Eigenschaften - DP-Slave
Allgemein
Parametrieren
Parameter
Wert
Prozeßalarm (OB 40 bis 47)
Allgemeine DP-Parameter
Failsafe
Anlauf bei Sollausbau ungleich Istausbau
Gerätespezifische Parameter
Kennungsbezogene Diagnose freigeben
Modulstatus freigeben
Kanalbezogene Diagnose freigeben
V0: Diagnosealarm freigeben
V0: Prozeßalarm freigeben
Emissionsgrad: 950
Transmissionsgrad: 1000
Mittelungszeit: 2
Holdzeit: 0
Schaltschwelle (°C): 30
Hex-Parametrierung
DPV1_Status (0 bis 2) C4,00,00
User_Prm_Data (3 bis 10) 0F,81,00,00,00,03,B6,03
User_Prm_Data (11 bis 17) E8,00,02,00,00,00,1E
OK
Abbrechen
Hilfe


Parameterdaten
Beschreibung
Allgemeine Parameterdaten
OK
Abbrechen
Parameterdaten
Texte
Modul
Byte
Beschreibung
Wert
7 Kennungsbezogene Diagnose freigeben
7 Modulstatus freigeben
7 Kanalbezogene Diagnose freigeben
7 V0: Diagnosealarm freigeben
7 V0: Prozeßalarm freigeben
8 Emissionsgrad: 950
10 Transmissionsgrad: 1000
12 Mittelungszeit: 2
14 Holdzeit: 0
16 Schaltschwelle (°C): 30

4.9 Configuration – CfgData

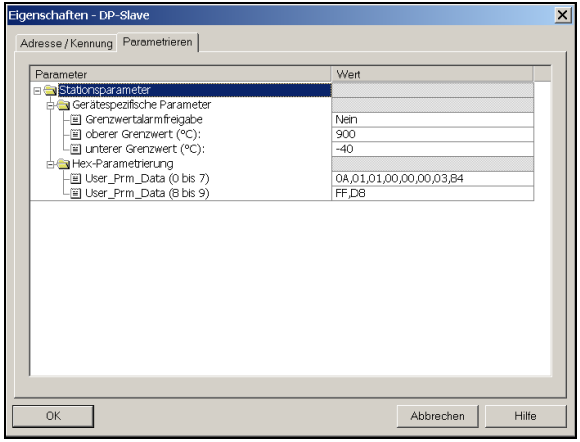
The CfgData are formed from the modules added in the DP configuration tool. When attaching the modules, the following rules must be observed:

- each module is allowed to be plugged only once
- the sequence of the module is unimportant
- at least one module needs to be plugged



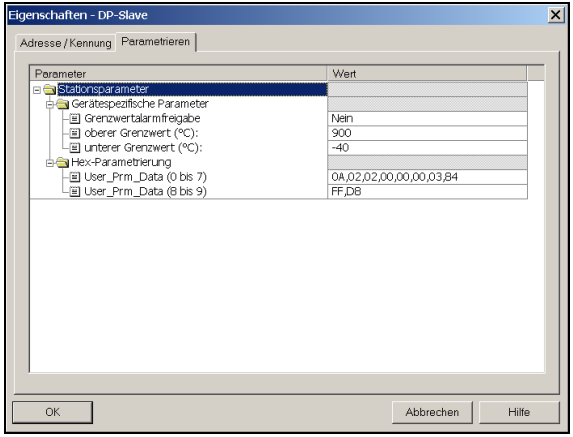
4.9.1 Module object temperature

Byte	Bit	Data	Description
0		0x0A	Parameter data length
1			Slot number
2		0x01	Module identification
3	6	0	DP-V0: Process alarm not supported
		1	DP-V0: Process alarm supported
4,5			Reserved
6,7			Maximum boundary value
8,9			Minimum boundary value



4.9.2 Module internal sensing head temperature

Byte	Bit	Data	Description
0		0x0A	Parameter data length
1			Slot number
2		0x02	Module identification
3	6	0	DP-V0: Process alarm not supported
		1	DP-V0: Process alarm supported
4,5			Reserved
6,7			Maximum boundary value
8,9			Minimum boundary value



4.9.3 Module telegram

Used for transferring the Optris special commands:

Data from Master → Slave	
Byte	**Description**
0	Handshake
1	Data0
2	Data1
3	Data2
4	Data3
5	Data4
6	Data5
7	Data6
8	Data7
9	Data8

Data from Slave → Master	
Byte	**Description**
0	15hex: length of telegram, receive telegram F1hex: Timeout – no telegram received
1	Handshake
2	Data0
3	Data1
4	Data2
5	Data3
6	Data4
7	Data5
8	Data6
9	Data7
10	Data8
11	Data9
12	Data10
13	Data11
14	Data12
15	Data13
16	Data14
17	Data15
18	Data16
19	Data17
20	Data18
21	Data19
22	Data20

4.10 DP-V1 – Acyclic data transfer

4.10.1 DP-V1 interface

By default, one MSAC_C1 and three MSAC_C2 connections each with 244 bytes of data (4 bytes DPv1 header plus 240 bytes of user data) are supported. The MSAC_C1 connection is established together with the cyclic connection and must be activated via the UserPrmData:

Byte	Bit	Data	Description
0	7	1	MSAC_C1 connection will be activated

The MSAC_C2 connection can be used by a C2 master (which then communicates only acyclically with the slave) and has its own connection setup. The parameters during MSAC_C2 connection setup (Feature_Supported, Profile_Feature_Supported, Profile_Ident_Number, etc.) are not checked, the parameters of the request are mirrored in the response. Slot_Number = 0 addresses data of the coupler, Slot_Number> 0 addresses the data of the function module(s).

4.10.2 Data of the couple (Slot_Number = 0)

The data of the coupler are addressed via an index.

Index	Access	Data length	Description
0	R/W	10	Parameter: Emissivity Transmission ratio Average time Hold time Signal threshold
1	R/W	2	Emissivity
2	R/W	2	Transmission ratio
3	R/W	2	Averaging time
4	R/W	2	Hold time
5	R/W	2	Signal threshold 1
6	R/W	1	Status alarm
10	W	9	Optris special commands Data0 Data1 Data2 Data3 Data4 Data5 Data6 Data7 Data8

	R	21	Data0 Data1 Data2 Data3 Data4 Data5 Data6 Data7 Data8 Data9 Data10 Data11 Data12 Data13 Data14 Data15 Data16 Data17 Data18 Data19 Data20
255	R	64	I&M-data record 0

4.10.3 Data for function modules

Object temperature:

Index	Access	Data length	Description
0x00	R/W	7	Module parameter: Byte0: Process alarm Byte1: Reserved Byte2: Reserved Byte3,4: maximum boundary value Byte5,6: minimum boundary value
0x01	R	2	Byte0,1: Measurement value

Internal sensing head temperature:

Index	Access	Data length	Description
0x00	R/W	7	Module parameter: Byte0: Process alarm Byte1: Reserved Byte2: Reserved Byte3,4: maximum boundary value Byte5,6: minimum boundary value
0x01	R	2	Byte0,1: Measurement value

4.11 DP diagnosis

DP diagnosis data (DiagData)

The DP diagnostics data consists of 6 bytes DP standard diagnostics and up to 33 bytes of device-specific diagnostics data. If the DP diagnostic data changes, the slave reports this to the master, which then automatically fetches the changed diagnostic data automatically.

The device supports the following diagnosis:

Norm diagnosis	Diagnosis alarm
Identification orientated diagnosis	Process alarm
Module status	

4.11.1 Identification oriented Diagnosis

The identifier-related diagnosis indicates whether assembly group are faulty or not. The identifier-related diagnosis starts at byte 6 and comprises 2 bytes.

The identifier-related diagnosis for Optris0A90 is structured as follows:

Byte	Data	Description
0x00	0x41	Header

0x01		Bit 0: Entry for sensing head module Bit 1: Entry for module at slot 1 Bit 2: Entry for module at slot 2 Bit 3: Entry for module at slot 3

4.11.2 Module status

The module status reflects the status of the configured assembly group and represents a detail of the identifier-related diagnostics with regard to the configuration. The module status begins after the identifier-related diagnostics and comprises 5 bytes.

The module status for Optris0A90 is set up as following:

Byte	Data	Description
0x00	0x06	Header
0x01	0x82	Module status
0x02	0x00	Fix
0x03	0x00	Fix
0x04		Bit 0,1: assembly group at slot 1 Bit 2,3: assembly group at slot 2 Bit 4,5: assembly group at slot 3

Bit combinations:

00 B : Assembly group ok; valid data
01 B : Assembly group bug; invalid data (assembly group defect)
10 B : Wrong assembly group; invalid data
11 B : No assembly group; invalid data

4.11.3 Channel-related diagnosis

The channel-related diagnostics provide information about channel errors of modules and provide a detail of the identifier-related diagnostics. The channel-related diagnostics starts after the module status. The channel-related diagnosis does not influence the module status.
A maximum of 4 channel-related diagnostics are supported.

The channel-related diagnoses for Optris0A90 is set up as following:

Byte	Data	Description
0x00	0x80	Header
0x01	0x40 0x41 0x42 0x43	Box Sensing head Target Status
0x02	0x00	0xA0 + Error-Code

The following Error-Codes are supported (defined in the GSD file):

Channel_Diag(16) = "Target: Temperature too high"
Channel_Diag(17) = "Target: Temperature too low"
Channel_Diag(18) = "Box: Temperature to low"
Channel_Diag(19) = "Box: Temperature too high"
Channel_Diag(20) = "Error Statusbyte 24"
Channel_Diag(21) = "Error Statusbyte 28"
Channel_Diag(22) = "Sensing head: Temperature to low"
Channel_Diag(23)= "Sensing head: Temperature too high"
Channel_Diag(24)= "Sensing head: cable defect"
Channel_Diag(25)= "Sensing head: Short circuit"
Channel_Diag(26)= "Error 10 Status alarm“

4.11.4 Process alarm

The process alarm for Optris0A90 is set up as following:

Byte	Data	Description
0x00	0x07	Header
0x01	0x02	Process alarm
0x02		Plug in position number 0x00: Status alarm 0x01 – 0x03 : Module
0x03	0x00	Fix
0x04		Bit 0: exceed of maximum boundary value
0x05		Bit 0: below boundary value
0x06,0x07		Current value

4.11.5 Diagnoses alarm

The diagnoses alarm for Optris0A90 is set up as follows:

Byte	Data	Description
0x00	0x06	Header
0x01	0x01	Diagnoses alarm
0x02	0x00	Head station
0x03	0x00	0x01 : Coming result 0x02 : Leaving result
0x04		Error Bit 0: Assembly group disruption Bit 1: Internal error Bit 2: External error Bit 3: Channels
0x05	0x03	Number of channels
0x06		Bit 0: Diagnoses result at channel 0 Bit 1: Diagnoses result at channel 1 Bit 2: Diagnoses result at channel 2
0x07		Channel 0 – Box
0x08		Channel 1 – Sensing head
0x09		Channel 2 – Target

Appendix A – Declaration of Conformity

EU Declaration

CE

The product meets the provisions of the EMC Directive **2014/30/EU** and the General Product Safety Directive **2001/95/EC**.

EMC General Requirements:
EN 61326-1:2013 (Basic requirements)
EN 61326-2-3:2013
Safety of measurement devices:
EN 61010-1:2010

This product is in conformity with Directive **2015/863/EU** (RoHS) of the European Parliament and of the Council of 4 June 2015 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

optris PROFIBUS-MA-E2021-03-A