



RT416-PB



PROFIBUS Communications Specification

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1 Overview

This document details the data contained within RT416 Profibus messages.

Note: Index values are zero based. **Temperature values are signed 16 bit values with units of 1/32 °C.**

2 PROFIBUS Messages

2.1 Parameterization Message:

The Parameterization Message data (DU) has the following format:

Mandatory bytes: The first 7 data bytes of the parameterization message are mandatory Profibus flags and variables and not user data. No user parameter data is defined. Only the 7 mandatory parameter bytes are implemented.

Table 1, Parameterization Message

index	parameter	description
0 thru 6	PB mandatory	Mandatory Profibus DP bytes. See DP spec for details.

2.2 Data Exchange Message from Master to Slave (Dout):

Data Exchange Dout data begins with a group of 6 registers used as a mailbox to set up the reading and writing of most slave parameters. As in other messages, **temperature values have units of 1/32 °C.**

Following the parameter mailbox registers in the Dout data are slave parameters zone temperature setpoints and control flags.

The Data Exchange Message data from Master to Slave (Dout) has the following format:

Table 2, Data Exchange Dout Message

index	value	description
0	Parameter Mailbox Handshake and Control bits	Parameter mailbox handshake and control bits. b7 – toggling handshake bit b6 – parameter R/W bit, 1 is read b5 down to b0 – unused.
1	Parameter ID code	Parameter ID code (see section 4).
2	Parameter data LB	Lowest Byte of parameter data, not used for reads.
3	Parameter data HB	High Byte of parameter data, not used for reads.
4	Parameter data HLB	High Low Byte of 32 bit parameter data, not used for reads.
5	Parameter data HHB	High High Byte of 32 bit parameter data, not used for reads.
6	zone1setpoint HB	High Byte of zone 1 temperature setpoint (1°C to 499°C)..
7	zone1setpoint LB	Low Byte of zone 1 temperature setpoint.
8	zone1CtrlFlags1	Byte 1 of zone 1 control flags. unused.

index	value	description
9	zone1CtrlFlags2	Byte 2 of zone 1 control flags. b7 – Zone enable (active high). b6 down to b0 – unused
...	zoneXsetpoint HB	
...	zoneXsetpoint LB	
...	zoneXCtrlFlags1	
...	zoneXCtrlFlags2	
26	zone6setpoint HB	
27	zone6setpoint LB	
28	zone6CtrlFlags1	
29	zone6CtrlFlags2	

2.2.1 Parameter Mailbox

The first six bytes of Dout data is structured as a data mailbox used to read and write RT416 parameters.

To begin a parameter access, the master loads the desired parameter ID code (see section 4) into the Dout Parameter ID code byte.

For a **read** of the parameter, the master **sets bit 6** in the Parameter Mailbox Handshake and Control bits byte.

For a **write** of the parameter, the master loads the parameter value to be written into the parameter data bytes beginning with the least significant byte of the value. Then the master **clears bit 6** in the Parameter Mailbox Handshake and Control bits byte.

To **trigger** the parameter read or write access, the master **toggles bit 7** in the Parameter Mailbox Handshake and Control bits byte.

Then the master must monitor bit 7 of the Din Parameter Mailbox Handshake and Status bits byte. When the Din toggle bit changes to become the same as the Dout toggle bit, the parameter data is valid in the Din parameter data bytes. For both parameter reads and writes, the accessed Parameter ID code is echoed back in the Din Parameter ID code byte and the Din parameter data bytes contain the present parameter value.

Bits 2 down to 0 of the Din Parameter Mailbox Handshake and Status bits indicate any error code resulting from the access. An error code of 0 indicates a successful access.

2.3 Data Exchange Message from Slave to Master (Din):

Data Exchange Din data is composed of a system part, and a zone part. The system part contains values that apply to the entire node. The zone part contains values that apply to individual zones. The system data precedes the zone data. As in other messages, temperature values have units of 1/32 degree C. The Data Exchange Message data from Slave to Master (Din) has the following format:

Table 3, Data Exchange Din Message

index	value	description
0	Parameter Mailbox Handshake and Status bits	Parameter mailbox handshake and status bits. b7 – toggling handshake bit b6 – parameter R/W bit, 1 is read b5 down to b3 unused b2 down to b0 – parameter access error code (see table below).

index	value	description
1	Parameter ID code	Parameter ID code (see parameter code table at the end of this document).
2	Parameter data LB	Lowest Byte of parameter data.
3	Parameter data HB	High Byte of parameter data.
4	Parameter data HLB	High Low Byte of 32 bit parameter data.
5	Parameter data HHB	High High Byte of 32 bit parameter data.
6	SysStatusFlags1	Byte 1 of system status flags. b7 down to b6 – unused b5 – Profibus comm. error. Indicates recovery from a loss of Profibus communications. b4 – Rotor data comm. error. Indicates rotor communications have been lost. b3 – Vrs range error. Indicates stator voltage is out of the normal 13V to 16V operating range. b2 – Irs range error. Indicates stator current is out of the normal 30mA to 100mA operating range. b1 – Vpwr range error. Indicates that the regulated controller interface +15V supply is out of the normal 13.5V to 16.5V operating range. b0 – Vpwr below regulation threshold. Indicates that the regulated controller interface +15V supply is below +5.5V.
7	SysStatusFlags2	Byte 2 of system status flags. b7 – Mode switch flag, set when in test mode. b6 down to b0 - unused
8	Firmware version minor	Minor firmware version byte.
9	Firmware version major	Major firmware version byte.
10	DebugData0 LB	Low Byte of data from debugPntr0.
11	DebugData0 HB	High Byte of data from debugPntr0.
...	DebugDataX LB	Low Byte of data from debugPntrX.
...	DebugDataX HB	High Byte of data from debugPntrX.
24	DebugData7 LB	Low Byte of data from debugPntr7.
25	DebugData7 HB	High Byte of data from debugPntr7.
26	zone1temp HB	High Byte of zone 1 compensated measured surface temperature (-10°C to 509°C).
27	zone1temp LB	Low Byte of zone 1 compensated measured surface temperature.
28	zone1setpoint HB	High Byte of zone 1 temperature setpoint.
29	zone1setpoint LB	Low Byte of zone 1 temperature setpoint.
30	zone1CtrlFlags1	Byte 1 of zone 1 control flags. unused.
31	zone1CtrlFlags2	Byte 2 of zone 1 control flags. b7 – Zone enable (active high). b6 down to b0 – unused

index	value	description
32	zone1PWM duty	PWM duty cycle value needed for zone 1 control (0 to 255). A value of 0 is OFF. A value of 255 is 100% duty cycle.
33	zone1statusFlags	Status flags for zone 1. b7 down to b6 – unused. b5 – zone temperature is above control window defined by zone's Window parameter. b4 – zone temperature is below control window defined by zone's Window parameter. b3 – zone temperature control timeout. Zone temperature has been outside of control window for longer than the Zone Timeout parameter time. b2 – zone temperature is above high alarm threshold defined by zone's HiTemp parameter. b1 – RTD rate change error, RTD connection could be bad. Slope of RTD temp curve is noisy. b0 – RTD value is a special code, not a temperature value.
...	zoneXtemp HB	zone X Din data, same as above.
...	zoneXtemp LB	
...	zoneXsetpoint HB	
...	zoneXsetpoint LB	
...	zoneXCtrlFlags1	
...	zoneXCtrlFlags2	
...	zoneXPWM duty	
...	zoneXstatusFlags	
66	zone6temp HB	zone 6 Din data.
67	zone6temp LB	
68	zone6setpoint HB	
69	zone6setpoint LB	
70	zone6CtrlFlags1	
71	zone6CtrlFlags2	
72	zone6PWM duty	
73	zone6statusFlags	

3 Special Temperature Codes

Reported measured temperature values of 500°C and above are actually special temperature fault codes. The following table lists and explains each fault code.

Table 4, RTD Value Special Temperature Codes

Temperature Value (°C)	Special Temperature Code	Description
-10	0xFEC0	RTD under range condition (possible short).
510	0x3FC0	RTD over range condition (possible open).
520	0x4100	RTD unstable, possible loose RTD connection, bad RTD or bad RTD wiring.
600	0x4B00	Rref error, one of the reference resistors on the Rotor has measured out of spec. Possible bad Rotor circuit.
610	0x4C40	An undefined error code was received from the Rotor.
700	0x5780	No error free data has been rxd in about 2.5 seconds.
701	0x57A0	Rotor FSK cycle times are out of range.
702	0x57C0	Rotor data byte framing error. Start bit or stop bit was not received as expected. Possible noise in the rotor communications or the rotor data signal is weak.
703	0x57E0	The RTD channel data received was not the one expected. A channel may have been missed due to noise or weak rotor communications.
704	0x5800	The RTD sample checksums do not match. Possible noise in the rotor communications or the rotor data signal is weak.
705	0x5820	Received a start bit while waiting for block stop bits. Possible noise in the rotor communications or the rotor data signal is weak.

4 Parameters

Parameters are values used to define the characteristics of the system. The parameters are divided into two groups; system and zone. System parameters apply to the node as a whole. Zone parameters are settings that apply to individual zones within the node.

4.1 Parameter Codes

System parameter ID codes have values less than 0x20. Zone parameters have parameter ID codes greater than or equal to 0x20. Zone parameter ID codes are generally a base ID value plus the zero based zone number. The RT416-PB controls up to six zones. With regards to parameter ID codes, the six zones are numbered 0 through 5.

Table 5, System Parameter code table

parameter ID code	parameter name	length (bytes)	default value	description
0x00	debugPntr0	2	0x0b00	Pointer to any 16 bit RAM variable. Used for debugging. Range 0x800 to 0xBFE, even addresses only
...	debugPntrX	2	0x0b0X	

parameter ID code	parameter name	length (bytes)	default value	description
0x07	debugPntr7	2	0x0b0e	
0x08	SysCtrlFlags	2	0x0000	System control flags. b15 – Reset node (active high). b14 – Reset parameters to default values (active high). b13 down to b0 – unused.
0x09	High Temp Alarm Threshold	2	0x1F40 (250°C)	High Temperature alarm threshold for all zones. (-10°C to 509°C)
0x0A	Window Temp Threshold	2	0x0060 (±3°C)	Temperature setpoint control window value for all zones (± deviation allowed from setpoint, 1/32°C to 10°C).
0x0B	Ctrl window timeout	2	0x012C (300 sec)	Time value in seconds enabled zones can be outside their temperature windows before a zone timeout error is declared (0 to 1800 seconds).

Table 6, Zone Parameter code table

parameter ID code	parameter name	length (bytes)	default value	description
0xA0	zone1 TempCF	2	0x0000	zone 0 surface temperature correction factor (signed temperature offset to add to measure temp, -10°C to 10°C).
0xB0	zone1 Pgain	2	0x0010	zone 1 Proportional gain value (1 to 256).
0xC0	zone1 Igain	2	0x0002	zone 1 Integral gain value (0 to 256).
0xD0	zone1 Dgain	2	0x0080	zone 1 Derivative gain value (0 to 256).
...0xAZ	zoneZ TempCF	2	0x0000	zone Z parameters, same as above.
...0xBZ	zoneZ Pgain	2	0x0010	
...0xCZ	zoneZ Igain	2	0x0002	
...0xDZ	zoneZ Dgain	2	0x0080	
0xA5	zone6 TempCF	2	0x0000	zone 6 parameters.
0xB5	zone6 Pgain	2	0x0010	
0xC5	zone6 Igain	2	0x0002	
0xD5	zone6 Dgain	2	0x0080	

4.2 Parameter Access Error Codes

When using the Parameter Mailbox as described in paragraph 2.2.1 the parameter access error codes listed in the following table apply.

Table 7, Parameter Access Error Codes

parameter access error code	description of parameter mailbox transfer error

0x0	No error.
0x1	Invalid parameter ID received.
0x2	Parameter write value is out of range.

5 PROFIBUS GSD File

The RT416-PB PROFIBUS GSD file is named BEI_0E45.GSD and can be obtained upon request from Binsfeld Engineer.