GOSSEN METRAWATT

R2700 / R2500

Bus Interfaces

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7/2.12

Page

1 RS 485-Bus

1.1 Interface Configuration

The controller with designation F1 and/or E1 is equipped with serial interfaces with the following configurations:

Parameter	RS 485, (2-wire)	Infrared
Baud rate	9600 or 19,200 baud (adjustable)	19,200 baud
Data format	8 data bits, 1 parity bit, 1 stop bit	8 data bits, 1 parity bit, 1 stop bit
Parity	Even	Even
Protocol	Adjustable	Modbus

1.2 Communication Protocol

- If the Modbus protocol is utilized for communication between the field control level and the device level, the RTU mode and conformity class 0 (read and write words) are used.
- The HB-THERM® protocol has been expanded relative to document O8099-D0105 from HB-THERM®.
- The communication protocol for the RS 485 interface can be configured to DIN 19244E in order to replace an R2600 or an R0217 with an R2700.

1.3 Primary Function

A master-slave interface is used with a permanently assigned master (master computer) and up to 255 slaves (devices). Communication takes place in the half-duplex operating mode, i.e. a device connected to the master computer only becomes active (responds):

- If it receives a valid frame addressed to itself
- If the specified maximum response delay time (t rd) has elapsed, allowing the master computer enough time to become ready to receive

The master computer may not become active again until:

- It receives a valid response frame from the addressed device and the specified waiting period after completion of the response frame (t rw) has elapsed
- The specified maximum response delay time (t rd) has elapsed
- The specified character delay time has elapsed (t cdt = pause between 2 character transmissions). This waiting time also applies for the receipt of invalid and incomplete responses!

1.4 Time Response

Ready to transmit / receive after power-up	t rdy	approx. 5 s
Character delay time (device)	t cdt	< 3.5 t ch (2 ms at 19.2 kbd)
Character delay time (master, Modbus / HB-THERM®)	t cdm	< 3.5 t ch (2 ms at 19.2 kbd) / < 50 ms
Response delay time (device)	t rd	10 ... 100 ms
Query waiting time after response (master)	t rw	> 10 ms

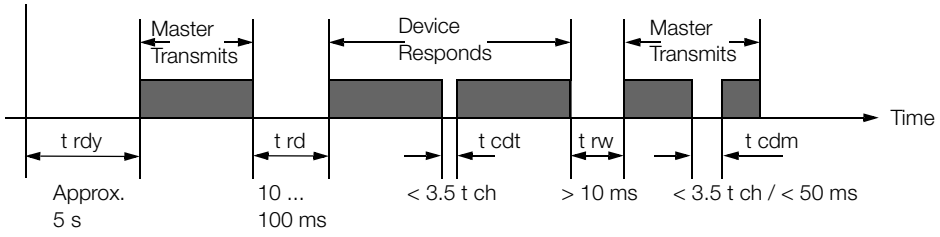
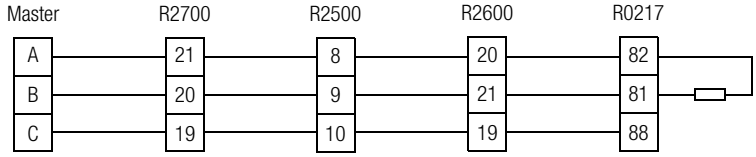


Figure 1:Basic Time Response

Character time = time for transmitting one character	t ch	0.57 ms at 19.2 kbd

1.5 Connecting the Bus Interface

Up to 32 devices (R2700, R2500 and others) can be connected to the bus if the RS 485 interface is used. All terminals, A, B and C, are connected to each other in parallel to this end. Wiring must be executed from device to device – devices may not be star-connected. In the case of long bus lines (longer than 5 meters) the bus should be terminated with characteristic wave impedance at both ends (e.g. 200 Ω between A and B).



If the W&T #86201 interface converter is used at the master, the following connector pin assignments apply to the 9-pin D-sub plug connector: A = 1 + 2, B = 6 + 7, C = 5

2 Modbus Protocol

2.1 Frame Types and Layout

2.1.1 Basic Layout

Number of Characters	Meaning	Comment
1	Slave address (0 to 255)	Device address (not 0) 0 = to all (only where function code = 5, 16)
1	Function code	See section 2.1.3 on page 4
n	Data	See section 2.1.4 on page 5 and section 2.1.6 on page 6.
1	Error check (CRC-16) low byte	See section 2.1.5 on page 5
1	Error check (CRC-16) high byte	
(4)	Waiting time, no characters are transmitted	See section 2.1.2 on page 4

2.1.2 Waiting Time

- Waiting time is equal to the time it would take to transmit 4 characters.
- Waiting time serves to delineate the beginning and the end of the frame, because no explicit length specification is included in the frame.
- A frame is considered finished when waiting time has expired.
- If, for any reason, transmission of a frame is interrupted for a period which exceeds waiting time, the frame is considered finished. The first character after the interruption is interpreted as the first character of a new frame (both parts of the frame are rejected due to error check failures for this reason).

2.1.3 Function Code

The following function codes (FC) are supported:

Function Code	Meaning	Applications
3	Read words	For reading values and parameters
5	Write single bit	Only for resetting the device
7	Read status	Query: “device OK”
16	Write words	For writing parameters

2.1.4 Data

Refer to section 2.1.6 on page 6 and section 2.2 on page 8 for details concerning the data field in the frame.

- Data used with Modbus are always 16 bit words.
  The high byte is transmitted first.
- Numeric values are represented as compliments of 2.
- Quantities with a ± 7 bit format are expanded to ± 15 bit.
- Bit fields in 8 bit format are expanded with a high byte = 0.

2.1.5 Error Check

Correct transmission of the frame is assured by means of the CRC-16 cyclical redundancy check. Both CRC-16 characters are generated as follows based upon all of the characters included in the frame (slave address to last data byte):

1. Presetting of a 16 bit register (CRC-16 register) with FFFFh
2. Exclusive OR linking of the low bytes in the CRC-16 register to the frame's character, results to CRC-16 register
3. Shift the CRC-16 register one bit to the right;
   A 0 is added and the displaced least significant bit (LSB) is saved.
4. Where LSB = 0, continue as of step 5.
   Where LSB = 1, establish exclusive OR linking of the CRC-16 registers to A001h.
5. Repeat steps 3 and 4 until a total of 8 shifts to the right have occurred.
   At this point, one of the frame's characters has been processed.
6. Execute steps 2 through 5 for each of the frame's remaining characters.
7. The content of the CRC-16 register, preceded by the low byte, is added to the frame after all of the frame's characters have been processed.

For example, programming in C would result in the following code:

```
/* ----------------------------------------------------------------
crc_16()                        calculate the crc_16 error check field
Input parameters:    buffer:    string to calculate CRC
                     length:    bytes number of the string
Return value:                   CRC value.
---------------------------------------------------------------- */
unsigned int crc_16 (unsigned char *buffer, unsigned int length) {
   unsigned int i, j, lsb, tmp, crc = 0xFFFF;
   for ( i = 0; i < length; i++ ) {
      tmp = (unsigned char) *buffer++;
      crc ^= tmp;
      for ( j = 0; j < 8; j++ ) {
         lsb = crc & 0x0001;
         crc >>= 1;
         if ( lsb != 0 ) crc ^= 0xA001;
      }
   }
   return (crc);
}
```

2.1.6 Support Frames

Read Words (FC = 3)

Query from Master:

Character No.	Meaning
1	Slave address (not 0)
2	FC = 3
3	Word address (high byte)
4	Word address (low byte)
5	Number of words (high byte)
6	Number of words (low byte)
7	CRC-16 (low byte)
8	CRC-16 (high byte)

Response from Slave:

Character No.	Meaning
1	Slave address
2	FC = 3
3	Number of characters (n)
4	Word data (n/2 words)
...	Respective high byte first
...	...
4 + n	CRC-16 (low byte)
5 + n	CRC-16 (high byte)

If the word address does not exist in the controller, or if the number of words is too great, the controller transmits an “error response” with corresponding error code (see also section 2.1.7 on page 8).

Reset (FC = 5)

Query from Master:

Character No.	Meaning
1	Slave address
2	FC = 5
3	Bit address (high byte) = 0
4	Bit address (low byte) = 0
5	Bit data (high byte) = 0
6	Bit data (low byte) = 0
7	CRC-16 (low byte)
8	CRC-16 (high byte)

Response from Slave:

	Not possible

Transmission of a request to all slaves is possible (slave address = 0).
The “write single bit function” is used exclusively for restarting the device.
If the bit address is not 0, or if it is not deleted, the controller transmits an “error response” with corresponding error code (see also section 2.1.7 on page 8).

Query: “Device OK” (FC = 7)

Query from Master:

Character No.	Meaning
1	Slave address (not 0)
2	FC = 7
3	CRC-16 (low byte)
4	CRC-16 (high byte)

Response from Slave:

Character No.	Meaning
1	Slave address
2	FC = 7
3	Status
4	CRC-16 (low byte)
5	CRC-16 (high byte)

Bit 4 is set in the status if no write tasks are currently possible (FC = 16).
Bit 5 is set if an error has occurred (operator prompt, read error status).
Other bits are set to 0.

Write Words (FC = 16)

Request from Master:

Character No.	Meaning
1	Slave address
2	FC = 16
3	Word address (high byte)
4	Word address (low byte)
5	Number of words (high byte)
6	Number of words (low byte)
7	Number of characters (n)
8	Word data (n/2 words)
...	Respective high byte first
...	...
8 + n	CRC-16 (low byte)
9 + n	CRC-16 (high byte)

Response from Slave:

Character No.	Meaning
1	Slave address (not 0)
2	FC = 16
3	Word address (high byte)
4	Word address (low byte)
5	Number of words (high byte)
6	Number of words (low byte)
7	CRC-16 (low byte)
8	CRC-16 (high byte)

Transmission of a request to all slaves is possible (slave address = 0), in which case no response ensues from the slaves.
If the word address does not exist in the controller, if the number of words is too great or if the contained data is invalid, the controller transmits an “error response” with corresponding error code (see also section 2.1.7 on page 8).

2.1.7 Error Handling

If the slave address does not exist, if a parity error has occurred, if the error check fails (CRC-16 false) or if the function code is not supported, the slave does not send a response.

If the controller is incapable of executing the request although the frame is formally correct, it generates an error response in whose error code (character 3) the reason for non-execution is specified.
The error response is recognized by the fact that the most significant bit is set in the returned function code.

Error Response

Character No.	Meaning
1	Slave address (not 0)
2	FC + 80h
3	Error code
4	CRC-16 (low byte)
5	CRC-16 (high byte)

Error Code

Value	Meaning
2	Impermissible address
3	Impermissible data content
6	Currently no write tasks possible
9	Number of words is too great
10	Writing impermissible

2.2 Reading and Writing Data

2.2.1 Addressing

All controller setting parameters and data are assigned to parameters groups according to functional relationships. Together with cyclical data (measured values) and events data (errors and alarms), the controller can thus be operated entirely via the bus interface.

A complete list of all parameters and data is included in section 5 on page 22.

2.2.2 Format

Data are transferred in the same format in which they appear at the device display.
Temperature quantities are formatted depending upon configuration in tenths of a degree of full degrees, in °C or °F.

2.2.3 Writing Parameters

Example:
Set the setpoint for the device with address 3 to 200° C.

Request from Master (± 7 bit quantities are expanded to ± 15 bit):

Character No.	Value	Meaning
1	03h	Device address
2	10h	Function code = write words
3	00h	Word address (high byte)
4	00h	Word address (low byte)
5	00h	
6	01h	Number of words = 1
7	02h	Number of characters = 2
8	00h	
9	C8h	Setpoint
10	BEh	
12	A6h	CRC-16

Response from Slave (if no error has occurred)

Character No.	Value	Meaning
1	03h	Device address
2	10h	Function code = write words
3	00h	Word address (high byte)
4	00h	Word address (low byte)
5	00h	
6	01h	Number of words = 1
7	00h	
8	2Bh	CRC-16

2.2.4 Reading Parameters

Example:
Read in cyclical data from the device with address 3.

Query from Master

Character No.	Value	Meaning
1	03h	Device address
2	03h	Function code = read words
3	B0h	Word address (high byte)
4	00h	Word address (low byte)
5	00h	
6	05h	Number of words = 5
7	A2h	
8	EBh	CRC-16

Response from Slave (if no error has occurred)

Character No.	Value	Meaning
1	03h	Device address
2	03h	Function code = read words
3	0Ah	Number of characters = 2 times 5
4	00h	
5	B7h	Actual value: 183° C
6	00h	
7	00h	No measured value available
8	00h	
9	64h	Manipulated variable: 100% heat
10	00h	
12	00h	No measured current value available
12	00h	
14	1Ch	Cold junction temperature: 28° C
15	40h	
15	02h	CRC-16

3 HB-THERM® Protocol

3.1 Frame Layout

3.1.1 Basic Layout

Character No.	Content	Comment	Format	Value Range
1	Address	Device address 1 ... 79	30h + address	B1h ... FFh 31h ... 7Fh
2 ... 4	Block length	Binary number of bytes in the entire frame	3-place pseudo ASCII	3 x 30h ... 3Fh
5	Type of message	Target data, actual dataSee section 3.2.1	Binary	41h
		Trigger reset, device is restarted Empty message	Binary	44h
		Clear all errors, stored channel and device errors are deleted Empty messages	Binary	49h
		Read parametersSee section 3.2.3	Binary	51h
		Write parametersSee section 3.2.4	Binary	61h
		Parameters cannot be written, response in case of invalid value or if flash is active Empty message	Binary	69h
		Message not understood, response in case of incorrect block length, message type or checksum Empty message	Binary	7Fh
6 ... n	Message	Setpoint, actual value, manipulated variable Status Parameters index Parameters Or empty	4-place BCD Binary 2-place pseudo ASCII 4-place pseudo ASCII	2Dh, 30h ... 39h 00h ... 7Fh 2 x 30h ... 3Fh 4 x 30h ... 3Fh
n+1, n+2	Checksum	Low byte of the sum of all characters	2-place pseudo ASCII	2 x 30h ... 3Fh

To a great extent the protocol is compatible with the R6000.

3.1.2 Formats

Pseudo ASCII

Block length, checksum and parameters are transmitted on a hexadecimal basis. The hexadecimal numbers are converted to ASCII, and all numbers greater than 9 (A ... F) are represented as 3Ah ... 3Fh. Negative quantities are represented as compliments of 2 (e.g. -100 → 3Fh, 3Fh, 39h, 3Ch).

BCD

Temperature setpoint and actual value are transmitted in message 41h in BCD format.
Negative quantities are preceded by a minus sign. e.g. -100 → 2Dh, 31h, 30h, 30h)

3.2 Message Contents

3.2.1 Setpoint and Actual Value, Status (41h)

Master Transmission (machine → device, block length: 14)

Character No.	Content	Comment	Value
6 ... 9	Setpoint in 0.1° C	-99.9° C ... 999.9° C	2Dh, 39h, 39h, 39h ... 39h, 39h, 39h, 39h
10	Reserve		60h
12	Control command	See section 3.2.2	“B” ... “t” (42h ... 74h)
12	Reserve		20h

Slave Response (device → machine, block length: 19)

Character No.	Content	Comment	Value
6 ... 9	Actual value in 0.1° C	-99.9° C ... 999.9° C	2Dh, 39h, 39h, 39h ... 39h, 39h, 39h, 39h
10 ... 13	Manipulated variable in %	-100 ... 100	2Dh, 31h, 30h, 30h ... 30h, 31h, 30h, 30h
15	Status word	Bit 0 Remote = machine Bit 1 Sensor = internal Bit 2 Received impermissible setpoint Bit 3 Reserve Bit 4 Group alarm (without channel alarms)1 Bits 5, 6 and 7Fixed code	0 1 0 / 1 0 0 / 1 1, 1, 0
15	Alarm 1	Low byte, channel error status (PI = 21h)*	
16	Alarm 2	High byte, channel error status (PI = 21h)*	
17	Response	Control commandSee section 3.2.2*	“B” ... “t” (42h ... 74h)

*Deviates from original protocol, e.g. extended

3.2.2 Control Commands, Responses

The controller’s conditions (response) are unambiguous in the HB-THERM® protocol, and are unambiguously switched by means of the control commands.

The R2500 / R2700 can have several conditions at the same time – in combinations which are practical or necessary (e.g. controller on + start-up + self-tuning).

Six conditions are combined for hot-runner control (controller function bits, PI = 20h):

controller on, manual mode, self-tuning on, start-up activated, reduction (setpoint swapping) and boosting.

Control Command, Response	p	m	r	o	t	b	R	O	T	B
Controller on	—	x	x	x	x	x	x	x	x	x
Manual operation	?	x	—	—	—	—	—	—	—	—
Start-up	?	?	—	—	—	—	x	x	x	x
Self-tuning	—	—	—	x	—	—	—	x	—	—
Reduction (setpoint swapping)	?	?	—	—	x	—	—	—	x	—
Boost	?	?	—	—	—	x	—	—	—	x

x set

— not set

? Any

3.2.3 Reading Parameters (51h)

All parameter of a given type, i.e. from the same parameters index, are transmitted together in the R2500 / R2700. There is no access to individual words.
As opposed to the Modbus protocol, all temperature values are transmitted in tenths of a degree Celsius, regardless of configuration.

Master Transmission (machine → device, block length: 9)

Character No.	Content	Comment	Value
6 ... 7	Parameters Index	See section 5	30h, 30h ... 3Ah, 30h

Slave Response (device → machine, block length: 13 ... 89)

Character No.	Content	Comment	Value
6 ... 7	Parameters Index	See section 5	30h, 30h ... 3Ah, 30h
8 ... 7 + 4 x n	n parameters	n times 4-place pseudo ASCII	n times 30h, 30h, 30h, 30h ... 3Fh, 3Fh, 3Fh, 3Fh

3.2.4 Writing Parameters (61h)

For addressing and contents see section 3.2.3 on page 12

Master Transmission (machine → device, block length: 13 ... 89)

Character No.	Content	Comment	Value
6 ... 7	Parameters Index	See section 5	30h, 30h ... 3Ah, 30h
8 ... 7 + 4 x n	n parameters	n times 4-place pseudo ASCII	n times 30h, 30h, 30h, 30h ... 3Fh, 3Fh, 3Fh, 3Fh

Slave Response (device → machine, block length: 7)

- After the parameters have been accepted, the device responds with 61h and an empty message.
- If a parameter value is impermissible, or if the memory cannot be accessed at the moment, the device responds with 69h and an empty message.

3.3 Examples

3.3.1 Example for Setpoint and Actual Value

Data exchange, 1st channel at device 1

Setpoint data:	Setpoint	95 °C	Actual value data:	Actual value	95 °C
	Command	Control		Manipulated variable	23%
				Error	None
				Response	Control

Machine Transmission:

B1h	Address = B0h + device address
30h, 30h, 3Eh	Block length = 14
41h	Setpoint code, command
30h, 39h, 35h, 30h	Setpoint: 95.0° C
60h	Reserve
72h	control
33h, 30h	Checksum = 330h

Device Response:

31h	Address = 30h + device address
30h, 31h, 33h	Block length = 19
41h	Actual value code, status
30h, 39h, 35h, 30h	Actual value: 95.0 °C
30h, 30h, 32h, 33h	Manipulated variable: 23%
62h	Status
00h, 00h	No channel alarms
72h	control
36h, 3Dh	Checksum = (3)6Dh

3.3.2 Example for Writing Parameters

Upper limit value 1 of the device with address 3 is set to 10 °C.

Machine transmission:

B3h	Address = B0h + device address
30h, 32h, 39h	Block length = 41
61h	Code = write parameters
30h, 31h	Parameters index = 01h
30h, 30h, 36h, 34h	0064h = 100 corresponds to 10.0°
3Dh, 3Ah	Checksum = 2DAh

Device response:

3h	Address = 30h + device address
30h, 30h, 37h	Block length = 7
61h	Code = write parameters, request executed
32h, 3Bh	Checksum = 12Bh

4 Profibus DP Interface

4.1 General

4.1.1 Connection

R2700 Terminal	Designation		9-Pin Subminiature Plug Connector
19	DGND	C	5
20	RxD/TxD-P	B	3
21	RxD/TxD-N	A	8

4.1.2 Interface Configuration

- The R2700 is equipped with an RS 485 serial interface per EN 50170 (Profibus DP) for communication with a master computer, an SPC etc. Baud rates of up to 12 Mbit per second are supported.
- The user address for Profibus operation is selected during configuration. User address changes do not become effective until the device has been switched off and then back on again.
- Address selection via the Profibus “SetSlaveAdress” function is not supported.

4.1.3 Communication Protocol

The data transmission protocol per EN 50170 is used for communication between the field control level and the device level.

4.1.4 DDBF GMC_059D.gsd

The file required for configuring the Profibus DP (DDBF multi-channel Profibus DP) can be downloaded free of charge from the GMC-I Messtechnik GmbH website (http://www.gossenmetrawatt.com). It’s identical to the file for the R6000.

4.1.5 Data Exchange

Data exchange is similar to the process used for the R355, i.e. the HTBs can be used in consideration of Profibus connection for combination with R355 or R6000.

Basic Layout of Output Data in the Data_Exchange Send Frame (Profibus master → R2700)

Addr. Offset	Contents	Configura-tion	Contents
0	FF	8 bit	Function field
1	BL	8 bit	Block number
2, 3	CS	16 bit	Checksum
4 ... 11			Data
12 ,13	SP	± 15 Bit	Setpoint
14, 15		16 bit	Security code: 55AAh
16 ... 27			Unused

Basic Layout of Input Data in the Data_Exchange Response Frame (R2700 → Profibus master)

Addr. Offset	Contents	Configura-tion	Contents
0	FF	8 bit	Function field
1	BL	8 bit	Block number
2, 3	CS	16 bit	Checksum
4 ... 11			Data
12 ,13	PV	± 15 Bit	Actual value (controlled variable)
14, 15	ED	± 15 Bit	Manipulated variable in %
16 ... 27			Unused

4.2 Quick Exchange of Setpoints and Actual Values

The command variable (setpoint) is transmitted to the R2700 in the peripheral output word with address offset 12. The command variable is only accepted by the controller if security code 55AAh is pending in the output word with offset address 14; and the value lies within the setpoint limits.

The controlled variable (actual value) and the manipulated variable are specified as a percentage (%) in the peripheral input words with addresses 12 and 14. Updating takes place every 100 ms commensurate with the sampling cycle.

4.3 Exchange of Measured Values, Parameters and Configurations

In order to exchange large volumes of data in a targeted fashion, the first two addresses (function field and block number) are used to control transmission.

Data are only accepted or delivered if the write or read request (toggle bits) is written.

Data Exchange Profibus Master → R2700

Addr. Offset	Con-tents	Config-uration	Contents
0	FF	8 bit	Function field
1	BL	8 bit	Block number
2, 3	CS	16 bit	Word checksum via addr. offset 0, 4 ... 10
4 ... 11			Data to be written

Data Exchange R2700 → Profibus Master

Addr. Offset	Con-tents	Config-uration	Contents
0	FF	8 bit	Function field
1	BL	8 bit	Block number
2, 3	CS	16 bit	Word checksum via addr. offset 0, 4 ... 10
4 ... 11			Read data

General

- The quantities are selected using block numbers.
  Each block includes 4 quantities (values, parameters or configurations).
  The quantities are in 16 bit format (with some exceptions).
- During the read operation, the R2700 offers the newest data blocks available for reading.
- Recall of data to be written works in the same way as the write operation, and the write request is set in the function field (bit 2 = 1).
- Communication is initiated by writing to the FFh block. Time and a command word are written.
  The controller then transmits the parameter set ID and the device variant (block FFh).
  If the command word is set to 100h, all of the channels' parameters which are permitted to communicate then follow, so that the data blocks receive the controller's settings.

4.3.1 Function Field

The function field controls the read and write operations. The R2700 only responds at the moment the read or write toggle bit is changed. This means that the block number and the data always have to be written first, and finally the function field.

Function Field (addr. offset 0)Profibus Master → R2700

Bit	Function	Value	Meaning
0, 1	FC Function code	0 1 2, 3	No function Data Exchange Reserved
2	Request	0 / 1	1 = read request instead of write request
3	—	0 / 1	Not used
4	Acknowledge	0 / 1	1 = data to be read accepted
5	—	0 / 1	Not used
6	S toggle	0 / 1	When the status changes, new data to be written are pending.
7	L toggle acknowledgment	0 / 1	If the same status is set as in the peripheral input and the acknowledge bit, the read data have been accepted. At the same time, this is a request for the R2700 to generate new data to be read.

Function Field (addr. offset 0)R2700 → Profibus Master

Bit	Function	Value	Meaning
0, 1	FC Function code	0 1 2, 3	No function Data Exchange Reserved
2	Request	0 / 1	Same value as Profibus Master -> R2700
3	—	0 / 1	Not used
4	Acknowledge	0 / 1	1 = data to be written accepted 0 = data to be written not accepted, no S toggle acknowledgement
5	—	0 / 1	Not used
6	S toggle acknowledgement	0 / 1	If status is the same as in the peripheral output, the data have been accepted by the R2700.
7	S toggle	0 / 1	When the status changes, new data to be read are pending at the R2700.

4.3.2 Block number

- The content of the blocks to be written is predefined (see also section 4.3.5).
- The setting limits for the parameters are monitored during writing. If a parameter is not accepted, the “impermissible parameter” error bit is set. This bit must be acknowledged in the error status.

4.3.3 Checksum

In order to assure correct transmission, the word checksum (EXOR operation) of peripheral words 0, 4, 6, 8 and 10 is inserted into the peripheral word with offset 2. If the checksum is incorrect, the acknowledge bit is cleared by the respectively receiving page without changing the toggle bit.

4.3.4 Data Block Format

Each of the quantities to be transmitted is transmitted in one word (16 bit). The order depends on the respective parameters index (PI).

Config-uration	Interpretation	Value Range	MSB
8 bit	Bit field, positive number	0 ... 255	0
± 7 bits	Number	–128 ... 127	Expanded with plus or minus sign
16 bit	Bit field	(0 ... 65535)	—
± 15 bits	Number	–32768 ... 32767	—
BCD	2 BCD numbers	2 times 0 ... 99	—

4.3.5 Predefined Blocks

The word addresses of the corresponding data blocks for the S7 project are specified in the address columns.

Channel Blocks

- Blocks 10 and 11 are only read. Block 10 is updated at each channel every 100 ms.
  Block 11 is only updated when its content changes, and at the beginning of communication.
- Block 14 is transmitted independently after self-tuning has been completed. The handling blocks should take this into consideration, so that ascertained values are not overwritten.
- The same applies to block 17, which contains the nominal heating current value after triggering automatic ascertainment of the nominal heating current value.

Block	Address	PI	Value
			Read only
10	10	B1	Momentary actual value
	12	B0	Momentary manipulating factor
	14	21	Error status (actual)
	16	24	Controller status
11	18	20	Controller function (actual)
	20	B8	Momentary setpoint
	22	6C	Actual heating current value
	24	—	—
			Write
12	26	20	Controller function (setpoint)
	28	00	Setpoint
	30	21	Error status (acknowledgement)
	32	03	Setpoint 2
13	34	28	Manual manipulating factor
	36	—	—
	38	07	Maximum setpoint
	40	06	Minimum setpoint
14	42	10	Proportional zone heating (Xpl)
	44	11	Proportional zone cooling (Xpll)
	46	14	System delay (Tu)
	48	15	Cycle time
15	50	01	First upper limit value
	52	02	First lower limit value
	54	04	Second upper limit value
	56	05	Second lower limit value
16	58	0E	Setpoint ramp, up
	60	0F	Setpoint ramp, down
	62	12	Dead band H/C
	64	1F	Switching hysteresis
17	66	1D	Maximum manipulating factor
	68	1C	Minimum manipulating factor
	70	18	Motor stroke time
	72	60	Nominal heating current
18	74	16	Actuator manipulating factor
	76	17	Actuation manipulating factor
	78	19	Influencing quantity manipulating factor
	80	1E	Sensor error manipulating factor
19	82	08	Setpoint boosting
	84	09	Boosting duration
	86	0A	Actuation setpoint
	88	0B	Dwell time during actuation
1A	90	33	Sensor type
	92	0C	Actual value correction
	94	0D	Actual value factor
	96	25	Oscillation disabling
1B	98	22	Controller config.
	100	—	—
	102	—	—
	104	36	Limit value configuration

Device Blocks

- Time is set with the FFh block.
- Read blocks 90 and 91 are only updated when their content changes, or at the beginning of communication.

Block	Address	PI	Value	Meaning
			Read only	
90	10	21	Device error status (actual)	
	12	—	—	
	14	—	—	
	16	71	Program status	
91	18	B0	Measured quantity, input 1	
	20	B0	Measured quantity, input 2	
	22	24	Output status	
	24	B0	Reference junction temperature	
			Write	
92	26	21	Device error status (acknowledgement)	
	28	32	Device Control	
	30	70	Program configuration	
	32	71	Program status	
93	34	3F	Parameter set ID in BCDs, min	
	36	3F	h, d	
	38	3F	mon, y	
	40	31/35	Device feature / firmware version	
94	42	30	Device ID	
	44	35	Firmware version	
	46	92	Logger sampling cycle	
	48	93	Logger controller	
95	50	64	Primary current transformer	
	52	68	Current monitoring threshold	
	54	0C	Measuring range lower limit	
	56	0D	Measuring range upper limit	
96	58	37	Binary input 1	
	60	37	2	
	62	37	Switching output1	
	64	37	2	
97	66	37	3	
	68	37	4	
	70	37	Continuous output	
	72	—	—	
98	74	10	Proportional zone heating (Xpl)	
	76	—	—	
	78	14	System delay (Tu)	
	80	15	—	
99	82	—	Channel error mask A1	
	84	—	Device error mask A1	
	86	—	Channel error mask A2	
	88	—	Device error mask A2	

Block	Address	PI	Value	Meaning
			Write and read	
9A	90	—	Address	
	92	—	Control commands	
	94	—	Reserved	
	96	2E / —	Device error / —	From 4th entry
			Read only	
9B	98	2F/98	Number of entries	
	100	2E / —	Time stamp, s/min	Time stamp for the first entry, calculated from the point in time of the last entry (PI = 99h) for logger data.
	102	2E / —	Time stamp, h/d	
	104	2E / —	Time stamp, mon/y	
9C	106	2E/96	Channel error / logger data	4 entries are always transmitted (see also section 5, PI = 2Eh or PI = 96h).
	108	2E/96	Device error / logger data	
	110	2E/96	Time stamp / logger data	
	112	2E/96	Time stamp / logger data	
9D	114	2E/96	Time stamp / logger data	
	116	2E/96	Channel error / logger data	
	118	2E/96	Device error / logger data	
	120	2E/96	Time stamp / logger data	
9E	122	2E/96	Time stamp / logger data	
	124	2E/96	Time stamp / logger data	
	126	2E/96	Channel error / logger data	
	128	2E/96	Device error / logger data	
9F	130	2E/96	Time stamp / logger data	
	132	2E/96	Time stamp / logger data	
	134	2E/96	Time stamp / logger data	
	136	2E/96	Channel error / logger data	

Blocks 9Ah through 9Fh are used to transmit large volumes of data – currently for reading out the alarm history (up to 1 kB) and the data logger (up to 30 kB).
Data to be read out are selected with the first word of block 9Ah.

3600 ...	1 –1	Logger entry to be read Following 4 logger entries
4196 ...	4097 4095	Alarm history to be read (100 ... 1 +4096) Following 4 entries(–1 +4096)

The read operation is controlled with bits 0 through 3 of the second word of block 9Ah.

Bit	Function	Profibus Master → R2700	R2700 → Profibus Master
0	Read request	1 = read request	0 = read request processed
1	Read acknowledgment	0 = acknowledgment of read request	1 = requested data transmitted
2	No entry	0 = acknowledgment of read request	1 = no data to transmit
3	Incorrect address	0 = acknowledgment of read request	1 = incorrect address

Program Blocks

- Configuration, control and status query is carried out by means of device blocks.
- The data content of blocks 32 through 39 is the content of word addresses 7300h through 731Dh (see also section 5).

Block	Address	PI	Value
			Read only
30	10	—	—
	12	—	—
	14	—	—
	16	—	—
31	18	—	—
	20	—	—
	22	—	—
	24	—	—
			Write
32	26	73	Duration 1st segment
	28	73	Duration 2nd segment
	30	73	Duration 3nd segment
	32	73	Duration 4th segment
33	34	73	Duration 5th segment
	36	73	Duration 6th segment
	38	73	Duration 7th segment
	40	73	Duration 8th segment
34	42	73	Duration 9th segment
	44	73	Duration 10th segment
	46	73	Duration 11th segment
	48	73	Duration 12th segment
35	50	73	Target setpoint 1st segment
	52	73	Target setpoint 2nd segment
	54	73	Target setpoint 3rd segment
	56	73	Target setpoint 4th segment
36	58	73	Target setpoint 5th segment
	60	73	Target setpoint 6th segment
	62	73	Target setpoint 7th segment
	64	73	Target setpoint 8th segment
37	66	73	Target setpoint 9th segment
	68	73	Target setpoint 10th segment
	70	73	Target setpoint 11th segment
	72	73	Target setpoint 12th segment
38	74	73	Control tracks, 1st and 2nd segments
	76	73	Control tracks, 3rd and 4th segments
	78	73	Control tracks, 5th and 6th segments
	80	73	Control tracks, 7th and 8th segments
39	82	73	Control tracks, 9th and 10th segments
	84	73	Control tracks, 11th and 12th segments
	86	—	—
	88	—	—

Start Block

- Block FFh is written in order to initiate communication.
  "Current time" (PI = 90h) can also be set.
- The read block returns the parameter set ID and the device feature, so that exchange of a controller module is detected.
- If the command code is set to 0100h, all enabled parameter blocks are read so that the data blocks can receive the controller's settings.

Block	Word	PI	Value
			Read only
FF	0	3F	Parameter set ID in BCDs, min
	1	3F	h, d
	2	3F	mon, y
	3	31 / 35	Device feature / firmware version
			Write only
FF	0	90	Current time in BCDs, min
	1	90	h, d
	2	90	mon, y
	3	--	Command code:000h -> only read blocks are transmitted 100h -> all write blocks are transmitted

4.3.6 Transmission of Parameter Sets

- A complete parameter set comprises 312 bytes.
  The first 250 bytes contain the entire configuration and parameter settings of the controller
  The following 60 bytes contain the latest programme.
  The last 2 bytes contain the CRC16 backup.
- Writing in the controller can be done in any order whatever
  The parameter set is activated and included in the internal memory when the last byte has been written and the CRC16 check has been completed successfully
  The parameters contained are not checked for their setting limits. The CRC16 check serves as a safeguard as it ensures that the parameter set is derived from a controller or a configuration tool.
- Read-out of the parameter set is initiated by writing on block FDh.
  In order to obtain the momentary settings, reading has to be started from address 0.
  The controller subsequently supplies 52 blocks (318 bytes) of the active parameter set.

Block	Word	fix	PI	Value
				Write only
FD	0	X	—	Initial data address (normal = 0)
	1	X	—	not in use
	2	X	—	not in use
	3	X	—	not in use
				Read and write
FE	0	X	—	Data address
	1	X	—	Parameter set content
	2	X	—	Parameter set content
	3	X	—	Parameter set content

5 R2500 / R2700 Data and Parameters with the Associated Word Addresses

Parameters Index	Word Address	Value	Display	Format	U/M	Setting Range	Standard	Comment
		Temperature Parameters						
00h	0000h	Setpoint		± 15 bits	Dim	SP L ... SP H	0° C	
01h	0100h	Upper limit value, alarm 1	AL1H	± 15 bits	Dim	0° C = oFF 0 ... MBU / 2 X1 ... X2	oFF	 Relative limit value Absolute limit value
02h	0200h	Lower limit value, alarm 1	AL1L	± 15 bits	Dim	Same as AL1H	oFF	
03h	0300h	Setpoint 2	SP 2	± 15 bits	Dim	SP L ... SP H	0° C	
04h	0400h	Upper limit value, alarm 2	AL2H	± 15 bits	Dim	Same as AL1H	oFF	
05h	0500h	Lower limit value, alarm 2	AL2L	± 15 bits	Dim	Same as AL1H	oFF	
06h	0600h	Minimum setpoint	SP L	± 15 bits	Dim	X1 ... SP H	0° C	
07h	0700h	Maximum setpoint	SP H	± 15 bits	Dim	SP L ... X2	600° C	
08h	0800h	Setpoint boosting	SPbo	± 15 bits	Dim	0 ... MBU / 2	0	
09h	0900h	Boosting duration	t bo	± 15 bits	s	0 ... 60 s	0	
0Ah	0A00h	Actuation setpoint	SPSU	± 15 bits	Dim	SP L ... SP H	0° C	
0Bh	0B00h	Start-up dwell time	t SU	± 15 bits	s	0 ... 300 s	0	
0Ch	0C00h	Actual value correction	CAL	± 15 bits	Dim	–MBU / 2 ... MBU / 2	0	
	0C01h	Measuring range lower limit	rn L	± 15 bits	Dim	–1999 ... X2	0	
0Dh	0D00h	Actual value factor	GAin	± 15 bits	0.1%	0 ... 5000	1000	
	0D01h	Measuring range upper limit	rn H	± 15 bits	Dim	X1 ... 9999	1000	
0Eh	0E00h	Setpoint ramp, up	SPuP	± 15 bits	Dim/min	0 = oFF 0 ... MBU / 2 per min.	oFF	
0Fh	0F00h	Setpoint ramp, down	SPdn	± 15 bits	Dim/min	0 = oFF 0 ... MBU / 2 per min.	oFF	
		Control Parameters						
10h	1000h	Proportional band heating	Pb I	± 15 bits	Dim	0 ... MBU / 2	50 K	
	1001h	Proportional band heating at the switching controller	Pb 2	± 15 bits	Dim	0 ... MBU / 2	50 K	R2700 only
11h	1100h	Proportional band cooling	Pb II	± 15 bits	Dim	0 ... MBU / 2	50 K	
	1101h	Proportional band cooling 2		± 15 bits	Dim	0 ... MBU / 2	50 K	Unused
12h	1200h	Dead band H/C	dbnd	± 15 bits	Dim	0 ... MBU / 2	0	
14h	1400h	System delay	tu	± 15 bits	0.1 s	0 ... 900 s	500	
	1401h	System delay at the switching controller	tu 2	± 15 bits	0.1 s	0 ... 900 s	500	R2700 only
15h	1500h	Actuation cycle time	tc	± 15 bits	0.1 s	0.1 ... 300 s	10	
	1501h	Actuation cycle time 2		± 15 bits	0.1 s	0.1 ... 300 s	10	Unused
16h	1600h	Manipulated variable during actuation mode	Y St	± 15 bits	%	Y L ... Y H	0	
17h	1700h	Start-up manipulated variable	Y SU	± 15 bits	%	Y L ... Y H	10	
18h	1800h	Motor run-time	t Y	± 15 bits	s	1 ... 600 s	60	
19h	1900h	Influencing quantity manipulated variable	Y FF	± 15 bits	%	Y L ... Y H	0	
1Ch	1C00h	Minimum manipulated variable	Y L	± 15 bits	%	–100 ... 100%	–100	
1Dh	1D00h	Maximum manipulated variable	Y H	± 15 bits	%	–100 ... 100%	100	
1Eh	1E00h	Sensor error, manipulated variable	Y SE	± 15 bits	%	Y L ... Y H	0	
1Fh	1F00h	Switching hysteresis for alarms and limit transducer	HYSt	± 15 bits	Dim	0 ... MBU / 2	4 K	
		Control Commands						
20h	2000h	Controller function		Bit field	—	See table	0	
21h	2100h	Channel error status		Bit field	—	See table	—	Writing deletes the error status
	2101h	Device error status		Bit field	—	See table	—	Writing deletes the error status
22h	2200h	Controller configuration		Bit field	—	See table	4004h	
24h	2400h	Controller status		Bit field	—	See table	—	Read only
	2401h	Output status		Bit field	—-	See table	—	Read only
25h	2500h	Oscillation inhibiting periods	tSUP	± 15 bits	0.1 s	2 = oFF 3 ... 250	oFF	
28h	2800h	Manual manipulated variable	Y xx	± 15 bits	%	Y L ... Y H	0	Write in manual mode only
29h	2900h ... 2903h	Channel error mask A1 Device error mask A1 Channel error mask A2 Device error mask A2		Bit field	—	See table	0 = def 0 0 0	
2Dh	2D00h	Number of entries to be read from the alarm history		± 15 bits	—	1 ... number of entries	—	Via interface only
2Eh	2E00h ... 2E28h	Entries in the alarm history with time stamp		41 words	...	See table	—	Read only Via interface only

Parameters Index	Word Address	Value	Display	Format	U/M	Setting Range	Standard	Comment
2Fh	2F00h	Number of entries in the alarm history		± 15 bits	—	0 ... 100	—	Read only Via interface only
		Device Specifications						
30h	3000h	Device ID		± 15 bits	—	0025h = R2500 0027h = R2700	—	Read only
31h	3100h	Device features		Bit field	—	See table	—	Read only
32h	3200h	Device control	PSEt	± 15 bits	—	See table	0	
33h	3300h	Sensor type, dimension	SEnS	Bit field	—	See table	0	
35h	3500h	Firmware version		± 15 bits	—	0038h =V3.8	—	Read only
36h	3600h	Alarm configuration	AL X	Bit field	—	See table	0	
37h	3700h	Configuration, binary input 1	In 1	± 15 bits	—	See table	1	
	3701h	Configuration, binary input 2	In 2	± 15 bits	—	See table	0	R2700 only
	3702h	Configuration, switching output 1	Out1	± 15 bits	—	See table	1	
	3703h	Configuration, switching output 2	Out2	± 15 bits	—	See table	0	
	3704h	Configuration, switching outputs	Out	± 15 bits	—	0 = normal 1 = switching outputs and alarm outputs are reversed	0	R2500 or if Out3 and Out4 are not available
	3704h	Configuration, switching output 3	Out3	± 15 bits	—	See table	0	R2700 only
	3705h	Configuration, switching output 4	Out4	± 15 bits	—	See table	0	R2700 only
	3706h	Configuration, continuous output	Cont	± 15 bits	—	See table	0	
		Heating Current Monitoring						
60h	6000h	Heating current setpoint	AMPS	± 15 bits	0.1 A	–1 = Auto 0 = oFF 1 ... A H	oFF	
64h	6400h	Current monitoring threshold	A H	± 15 bits	0.1 A	10 ... 2000	500	
68h	6800h	Monitoring threshold	HC%	±15 Bit	%	def, 1 ... 100	def	
		Program Controller						
70h	7000h	Configuration		Bit field	—	See table	1	
71h	7100h	Status		Bit field	—	See table	0	Only bits 0 and 1 are writeable
73h	7300h ... 731Dh	Program		30 words	...	See table	—	
		Time / Logger						Via interface only
90h	9000h 9001h 9002h	Current time		2 x 8 bits 2 x 8 bits 2 x 8 bits	Time Date	Low byte = second High byte = minute Low byte = hour High byte = day Low byte = month High byte = year – 2000	—	No real-time clock
92h	9200h	Logger sampling cycle		± 15 bits	0.1 s	0, 1 ... 300 s	10	
93h	9300h	Logger controller		Bit field	—	See table	0	
94h	9400h	Number of logger entries to be read		± 15 bits	—	1 ... number of entries	—	
96h	9600h ... 961Fh	Logger entries		32 words	...	See table		Read only
98h	9800h	Number of logger entries		± 15 bits	—	0 ... 3600	—	Read only
99h	9900h 9901h 9902h	Time of last logger entry		6 x 8 bits	Time, date	See WA 9000 ... 9002	—	Read only
		Bus Interface						
A0h	A000h	Configuration	Prot	Bit field	—	See table	0	Only via IR interface
A1h	A100h	Device address	Addr	± 15 bits	—	0 ... 255	250	Only via IR interface
		Cyclical Data, Current Quantities						
B0h	B000h	Measured quantity, input 1		± 15 bits	Dim	X1 ... X2	—-	Read only
	B001h	Measured quantity, input 2		± 15 bits	Dim	X1 ... X2	—	Read only
	B002h	Manipulated variable		± 15 bits	%	Y L ... Y H	—	Read only
	B003h	Displayed heating current		± 15 bits	0.1 A	0 ... A H	—	Read only
	B004h	Cold junction temperature		± 15 bits	Dim	–20 ... 100 °C	—	Read only
B1h	B100h	Momentary controlled variable		± 15 Bit	Dim	±(X2–X1)	—	Read only
B4h	B400h	Measured heating current		± 15 bits	0.1 A	0 ... A H	—	Read only
B8h	B800h	Momentary setpoint		± 15 bits	Dim	SP L ... SP H	—	Read only

Unit of Measure for Temperature Parameter (dim)

Feature	Unit of Measure	Comment
B1, B3, B4	1 °C, 1 °F, 0.1 °C or 0.1 °F, depending upon configuration	Numeric values as in the display, without decimal point
B2	Scaled with rn L and rn H	Numeric values as in the display, without decimal point

Controller Function (WA = 2000)

Bit	Meaning	Display	Comment
0	Setpoint 2 active	W2 LED	1)
1	Enable start-up circuit	StUP	
2	Feed-forward control		1)
3	Temporary setpoint increase (boosting)		1)
4	Switch controller active	W2 LED blinks.	R2700 only, 1)
5	Clear stored limit value errors		Only via interface, 1)
6	Controller on		
7	Start self-tuning	tunX	
8	Manual operation	Hand LED	
9	Logger recording active	LOGG	1)
10	Alarm history active	HISt	
11, 12	Parameter set loaded	W2-LED	1)
13	Backup function	Hand LED	1)
14 ... 15	—		Unused

1) Is not stored permanently

Modbus Channel Error Status (WA = 2100), Channel error mask (WA=2900, 2902)

Bit assignments compatible with R2600

Bit	Meaning	Display	Relay (default)	Comment
0	Broken sensor, 2nd input	SE H	A1	
1	Reversed polarity, 2nd input	SE L	A1	
2	Analog error	AE	A1	
3	Broken sensor	SE H	A1	
4	Reversed polarity	SE L	A1	
5	1st Lower limit value fallen short of	Blinks	A1	
6	2nd lower limit value fallen short of	Blinks	A2	
7	1st upper limit value exceeded	Blinks	A1	
8	2nd upper limit value exceeded	Blinks	A2	
9	Parameter impermissible for entry via interface		—	
10	—		—	Unused
12	Heating circuit error	LE	A1	
12	Self-tuning start-up error	no t	—	
14	Self-tuning error or abort	tE X	A1	
14, 15	—		—	Unused

Modbus Device Error Status (WA = 2101), Device error mask (WA=2901, 2903)

Bit assignments compatible with R2600

Bit	Meaning	Display	Relay (default)	Comment
0	—		—	Unused
1	Heating current overrange	CE	A1	
2	Cold junction error	CJE	A1	
3	—		—	Unused
4	Heating current not off	Blinks	A1	
5	Heating current too low	Blinks	A1	
6	Heating current too high	Blinks	A1	
7	—		—	Unused
8	Memory error	FE	A1	
9	Parameter error	PE	A1	
10 ... 15	—		—	Unused

HB-THERM® Channel Error Status (PI = 21)

Bit assignments compatible with R6000

Bit	Meaning	Display	Comment
0	Broken sensor	SE H	
1	Reversed polarity	SE L	
2	2nd upper limit value exceeded		
3	1st upper limit value exceeded	blinks	
4	1st lower limit value fallen short of	blinks	
5	2nd lower limit value fallen short of		
6	Parameter impermissible for entry via interface		
7	Heating current not off	blinks	
8	Heating current too low	blinks	
9	Heating circuit error	LE	
10	Self-tuning start-up error	no t	
12	Self-tuning error or abort	tE X	
12	Heating current too high	blinks	
14	Cold junction error	CJE	
14, 15	—		Unused

HB-THERM® Device Error Status (PI = 21)

Bit assignments compatible with R6000

Bit	Meaning	Display	Comment
0	Analog error	AE	
1	Heating current overrange	CE	
2 ... 5	—		Unused
6	Cold junction error	CJE	
7	Memory error	FE	
8, 9	—		Unused
10	Parameter error	PE	
11 ... 12	—		Unused
13	CRC-Error	—	
15	Broken sensor, 2nd input	SE H	
15	Reversed polarity, 2nd input	SE L	

Controller Configuration (WA = 2200)

Bit	Value	Meaning	Display	Comment
0 ... 2		Controller Type	COut	
	0	Off	—	
	1	Measurements	MEAS	
	2	Actuator	POW	
	3	Limit transducer	OnOF	
	4, 5	PDPI controller	PdPI	
	6	Proportional actuator	ProP	
	7	—	—	
3 ... 5		Controller Sort	C In	only with code B3
	0	Fixed setpoint controller	nor	
	1	Differential controller	diFF	
	2	Slave controller	SLA	
	3	Switch controller	SWit	
	4	Ratio controller	rAti	
	5 ... 7	—		
6		Heating circuit monitoring	LbA	
7		Limiter	LiM	
8		Adaptive measured value correction	AMC	
9		Actuator output for contactor	RELA	
10		PI controller	PI	
12		No cooling with setpoint 2	noII	
12	0 / 1	Manual key function: 0/1 = oFF / HAnd	HKEY	
14		Start self-tuning with keys disabled	tunE	
15		0/1 = – / extra derivative action for cooling	tu/2	Unused
15		Binary input function: 0/1= static/dynamic	In	

Controller Status (WA = 2400)

Bit	Value	Meaning	Display	Comment
0 ... 3	 0 1 2 ... 14 15	Self-tuning phase None Start Self-tuning on Save results, exit	 tune1 ... tune9	
4		SP ramp, up	r	
5		SP ramp, down	r	
6		Start-up (below start-up setpoint)		
7		Start-up (remain at start-up setpoint)		
8, 9		—		Unused
10		Binary input 1 active		
12		Binary input 2 active		
12 ... 15		—		Unused

Output Status (WA = 2401)

Bit	Meaning	Comment
0	I LED	
1	II LED	
2	A1 LED	
3	A2 LED	
4	Out1	
5	Out2	
6	A1 relay	
7	A2 relay	
8	Out3	
9	Out4	
10	W2 LED	
12	Hand LED	
12 ... 15	—	Unused

Alarm History Entries (WA = 2E00 ... 2E28)

Word Address	Value		Format	U/M	Setting Range	Comment
2E00h	Entry 1	Time stamp	2 x 8 bits	Time	Low byte = second High byte = minute	
2E01h		Time stamp	2 x 8 bits		Low byte = hour High byte = day	
2E02h		Time stamp	2 x 8 bits	Date	Low byte = month High byte = year – 2000	
2E03h		Channel error status	Bit field	—	See WA = 2100	
2E04h		Device error status	Bit field	—	See WA = 2101	
2E05h ... 2E09h	Entry 2	...				A new entry is written when at least one bit has been changed in the error statuses.
...						
2E23h ... 2E27h	Entry 8	...				
2E28h	Number of valid entries		± 15 bits	—	1 ... 8	Eight entries are always transmitted, even if only one is new.

Device Features (WA = 3100)

Bit	Meaning	Feature	Comment
0	OEM version		
1 ... 6	—		Unused
7	with Profibus DP	F2	
8	with 2 standard signal inputs	B5	
9	With RS 485 interface	E1 / F1	
10	With continuous output	A4 ... A6	
12	R2700		
12	With relay Out4	A3, A6	
14	With relays Out1 / Out3	Not A1, A4	
15	With second measurement input	B3, B4	
15	With standard signal input	B2, B4	

Device Control (WA = 3200)

Value	Meaning	Display	Comment
000Dh	Save current parameter set as set 1	Put1	
000Eh	Load parameter set 1	GEt1	
000Fh	Load default settings	dEF	
001Dh	Save current parameter set as set 2	Put2	
001Eh	Load parameter set 2	Get2	
002Dh	Save current parameter set as set 3	Put3	
002Eh	Load parameter set 3	Get3	
003Dh	Save current parameter set as set 4	Put4	
003Eh	Load parameter set 4	Get4	

Sensor Type, Dimension (WA = 3300)

Bit	Value	Meaning	Display	Comment
0 ... 4		Sensor type		
	0	Type J 0 to 900 °C	tYP.J	
	1	Type L 0 to 900 °C	tYP.L	
	2	Type K 0 to 1300 °C	tYP.K	
	3	Type B 0 to 1800 °C	tYP.b	
	4	Type S 0 to 1750 °C	tYP.S	
	5	Type R 0 to 1750 °C	tYP.r	
	6	Type N 0 to 1300 °C	tYP.n	
	7	Type E 0 to 700 °C	tYP.E	
	8	Type T 0 to 400 °C	tYP.t	
	9	Type U 0 to 600 °C	tYP.U	
	10	Type C 0 to 2300 °C	tYP.C	
	12	—	tYP.-	
	12	Pt100 -200 to 600 °C	Pt 1	
	14	Ni100 -50 to 250 °C	ni 1	
	15	Ni120 -50 to 250 °C	ni12	
	15	—	rES	
	16	Resistance 0 to 340 Ω	OHM	
	17	Linear 0 to 50 mV	Lin	
5	0 / 1	Dead zero / live zero		For standard signal input
6, 7		Unit of Measure		Unit of measure for display and interface, not with feature B2
	0	1 °C	1 °C	
	1	1 °F	1 °F	
	2	0.1 °C	0.1 °C	
	3	0.1 °F	0.1 °F	
8, 9	0 ... 3	Places to the right of the decimal point	0 to 0.003	For display only With feature B2 only
10	0/1	— / ph control	PH	With feature F2 only
10 ... 15		—		Unused

Alarm Configuration (WA = 3600)

Bit	Meaning		Display	Comment
0	**AL 1**	Absolute limit values	rEL / AbS	
1		Start-up suppression	nSUP / SUP	
2		Closed-circuit current	noc / ncc	
3		Storage	nSto / Stor	
4 ... 7	—			Unused
8	**AL 2**	Absolute limit values	rEL / AbS	
9		Start-up suppression	nSUP / SUP	
10		Closed-circuit current	noc / ncc	
12		Storage	nSto / Stor	
12 ... 14	—			Unused
15	Heizstromerfassung		4121 / AC	

Configuration for Binary Inputs 1 and 2 (WA = 3700, 3701)

Value	Meaning	Display	Comment
–2	Program sequence pause	PhLt	With configured program controller only
1B	Start / stop program sequence	Prun	With configured program controller only
0	No function	oFF	
1	Setpoint 2	SP 2	
2	Controller on	LooP	
3	Manual operation	HAnd	
4	Start self-tuning	tunE	
5	Clear stored limit value errors	Quit	
6	Feed forward	FEFO	
7	Enable start-up circuit	StUP	
8	Start boosting	booS	
9	Enable data logging	LOGG	
10	darken Display	dArk	with In1 only
10	Switch controller	SWit	with code B3 and In2 only
11	Change of parameter sets	SEt2/SEt3	with In1 / In2
12	Backup Functions	bACK	

Configuration for Switching Outputs 1 through 4 (WA = 3702 ... 3705)

Value	Meaning	Display	Comment
–6	Control track 4	tr 4	With configured program controller only, R2700
–5	Control track 3	tr 3	With configured program controller only, R2700
–4	Control track 2	tr 2	With configured program controller only
–3	Control track 1	tr 1	With configured program controller only
–2	Program sequence pause	PhLt	With configured program controller only
–1	Program running	Prun	With configured program controller only
0	No function	oFF	
1	Heat, more heat with step-action controller	HEAt	
2	Cooling, more cooling with step-action controller	CooL	
3	Cool with water	H2O	
4	Less heat with step-action controller	HcLo	
5	Less cooling with step-action controller	CcLo	
6	Hot-runner heat	Hotr	With transistor outputs only
7	Induction heating	Indu	With transistor outputs only
8	1st lower limit value	AL1L	

Continuous Output Configuration (WA = 3706)

Bit	Value	Meaning	Display	Comment
0 ... 2	0 1 2 3 4 5 6 7	No function Heating Cooling Controlled variable Momentary setpoint Measured quantity 1 Measured quantity 2 —	oFF HEAt CooL Proc SP MEA1 MEA2	
3, 4	0 / 1 2 / 3	Dead zero / live zero (normal) Dead zero / live zero (inverted)	0 - 20 / 4 - 20 20 - 0 / 20 - 4	
5 ... 15		—		Unused

Program Controller Configuration (WA = 7000)

Bit	Value	Meaning	Display	Comment
0	0 / 1	Enable / disable display and control	ProG	
1	0 / 1	Automatic stop / run after reset	Auto	
2	0 / 1	Segment time = seconds / minutes	tIME	
3	0 / 1	— / wait until setpoint is reached	WAit	
4 ... 6	0 ... 7	Program to be executed	ProG	
7, 8	0 / 1	—	—	Reserved
9	0 / 1	Segments = ramps / increments	SEGS	
10 ... 15		—		Unused

Program Controller Status (WA = 7100)

Bit	Value	Meaning	Display	Comment
0	0 / 1	Stop / run program	StoP / run	
1	0 / 1	Run / pause program	run.X / hLt.X	
2	0 / 1	Program running / waiting until setpoint is reached	run.X / Wt.X	Read only
3	0 / 1	—		Unused
4 ... 7	0 1 ... 12	Stopped Active segment	StoP run.X / hLt.X	Read only
8 ... 15		—		Unused

Program Entries (WA = 7300 ... 731D)

Word Address	Value	Format	Unit of Measure	Setting Range	Comment
7300h	Duration of 1st segment	± 15 bits	s / Min	0 ... 5999	
7301h	Duration of 2nd segment	± 15 bits	s / Min	–1 = end of program 0 ... 5999	
...					
730Bh	Duration of 12th segment	± 15 bits	s / Min	–1 = end of program 0 ... 5999	
730Ch	Target setpoint, 1st segment	± 15 bits	Dim	SP L ... SP H	
...					
7317h	Target setpoint, 12th segment	± 15 bits	Dim	SP L ... SP H	
7318h	Control tracks, 1st and 2nd segment	2 x 8 bits	—	Low byte = 1st segment High byte = 2nd segment	
...					
731Dh	Control tracks, 11th and 12th segments	2 x 8 bits	—	Low byte = 11th segment High byte = 12th segment	Bit 0 = track 1 Bit 3 = track 4

Logger Control = 9300

Value	Meaning	Display	Comment
0 / 1	Data logging stopped / running	LOGG	See controller function, bit 8
0080h	Clear logger		Value will not be saved

Logger Entries (WA = 9600 ... 961F)

The logger entries are always saved in packets of eight samplings. Only complete packets can be read out, i.e. up to seven of the most recent entries cannot be read out.

Word Address	Value		Format	U/M	Setting Range	Comment
9600h	Entry 1	Measured value 1	± 15 bits	Dim		
9601h		Measured value 2	± 15 bits	Dim		
9602h		Manipulated variable	± 15 bits	%		
9603h		—	± 15 bits	—	0	Unused
...						
961Ch	Entry 8	Measured value 1	± 15 bits	Dim		
961Dh		Measured value 2	± 15 bits	Dim		
961Eh		Manipulated variable	± 15 bits	%		
961Fh		—	± 15 bits	—	0	Unused

Bus Interface Protocol (WA = A000)

Bit	Value	Meaning	Display	Comment
0, 1	0 1 2 3	DIN19244E protocol Modbus protocol DIN19244E protocol HB-THERM® protocol	r260 Mod r217 hbth	Same as R2600 Same as R0217
2	0 / 1	Baud rates: 9600 / 19,200	9.6 / 19.2	Not with DIN protocol
3 ... 15		—		Unused

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