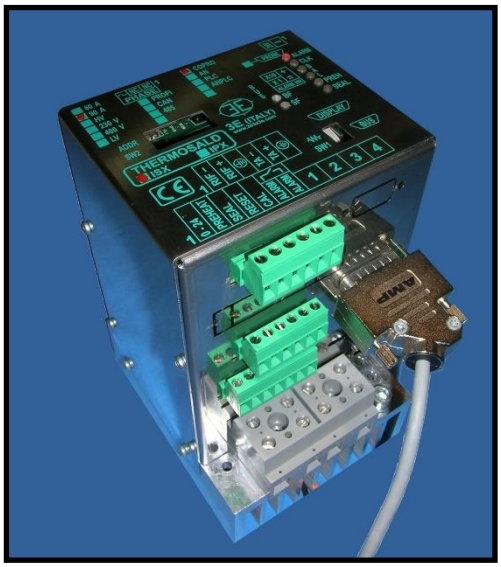
THERMOREGULATOR for PULSE WELDING

THERMOSALD ISX



RS485 MODBUS RTU HALF DUPLEX
PROFIBUS DPV0
PROFINET IO RT
ETHERNET/IP
POWERLINK

Thermosald ISX
BUS Installation and user's manual
(ENGLISH)

3E S.r.l. - **Via del Maccabreccia 46 - 40012 CALDERARA DI RENO (BOLOGNA)**
Tel. ++39 051 6466225 – 051 6466228 **E-Mail:** mail@3e3e3e.com
Fax ++39 051 6426252 **Web:** www.3e3e3e.com

1 GENERAL INFORMATION

1.1 Revisions of this manual:

Rev.	*Date*	*Description*
1	10/10/2017	Initial revision
2	22/01/2018	Added RS485 schematich connection
3	14/06/2018	Updated RS485 resistances value table

1.2 Information on this document

This document describes the functions of the communication interfaces developed on the thermoregulator:

- RS485 MODBUS RTU HALF DUPLEX
- PROFIBUS DPV0 with cyclical exchange up to 12Mbps
- PROFINET IO RT with cyclical exchange
- ETHERNET/IP
- POWERLINK

In particular:

- At chapter2, the description of the communication parameters of the individual interfaces.
- At chapter 3, the description of the connections and the hardware configuration via dip switches.
- At chapter 4, the description of the diagnostics via Led of the thermoregulator.
- At chapter 5, the description of the telegrams, the exchange areas, as well as the communication protocol.
- At chapter 6, the description of communication startup.
- At chapter 8, the description of the functions available on the device web page, when available.
- At chapter 9, the complete list of the thermoregulator variables.

To continue reading this document, you need to know the basic functions of the communication of the previously listed buses.
The thermoregulator operates as communication slave.

1.3 Reference documents

- THERMOSALD ISX Installation and user's manual, code 3ES100_MDU_V4 and following versions (available on the web site: www.3e3e3e.com).

2 INTRODUCTION

2.1 RS485 MODBUS RTU HALF DUPLEX

The implementation supports the Modbus RTU SLAVE (Remote Terminal Unit). For detailed information on the standard, please refer to the manual "Modicon Modbus Protocol Reference Guide", PI-MBUS-300, Rev. J for RS485 MODBUS RTU HALF DUPLEX.

2.1.1 Communication parameters

Parameter	Range	Default
DEVICE ADDRESS	1-127	1
IDLE CHAR BEFORE TX	0-100 [ms.]	10 [ms]

2.1.2 Idle char before TX

Transmission start and end times during which characters are not transferred. The time between the last character transmitted by the master and the first character responded by the slave must be 2 x "idle char". E.g.: 2 x 10 ms = 20ms.
The IDLE CHAR BEFORE TX parameter may be changed via software through the protocol illustrated at paragraph 5.1 - Telegrams RS485 V5 MODBUS RTU HALF DUPLEX.

2.1.3 Device Address

To change the DEVICE ADDRESS please refer to paragraph 3.1.2 - Setting the .

2.1.4 Parameters of the serial interface

Parameter	Range	Default
TRANSMISSION RATE	9600-19200-28800-38400-48000-57600	9600
DATA BIT (LSB first)	8	8
PARITY	None	none
START BIT	1	1
STOP BIT	1.2	2

2.1.5 Transmission Rate

The TRANSMISSION RATE parameter may be changed via software through the protocol illustrated at paragraph 5.1 - Telegrams RS485 V5 MODBUS RTU HALF DUPLEX.

2.1.6 STOP BIT

To change the STOP BIT please refer to paragraph 3.1.3 - Setting the STOP BIT.

2.2 PROFIBUS

2.2.1 Communication parameters

Parameter	Range	Default
DEVICE ADDRESS	1-128	1

To change the DEVICE ADDRESS, please refer to paragraph 3.2.2 - Setting the DEVICE ADDRESS.

2.3 PROFINET

2.3.1 Communication parameters

Parameter	Default
IP ADDRESS	192.168.0.55

To change the DEVICE ADDRESS, please refer to paragraph 6.3.1 - Changing the IP address software.

2.4 ETHERNET/IP

2.4.1 Communication parameters

Parameter	Default
IP ADDRESS	192.168.0.55

To change the IP ADDRESS please refer to paragraphs 6.4.3 - Changing the IP address software and 6.4.3 - Changing the IP address software.

2.5 POWERLINK

2.5.1 Communication parameters

Parameter	Range	Default
DEVICE ADDRESS	1-239	1

To change the DEVICE ADDRESS please refer to paragraph 3.5.2 - Setting the DEVICE ADDRESS.

3 CONNECTIONS AND DIP SWITCHES

3.1 RS485 MODBUS RTU HALF DUPLEX

3.1.1 Hardware connection

The THERMOSALD ISX thermoregulator can communicate with a PC or PLC supervisor through connector CN10 (see 3.7 - CN10 Connector).
CN10 is a 9-pin female connector (CN10/3 = channel A+; CN10/8 = channel B-).
Note: when the RS85 bus does not transmit, the following condition must be met:

A+ - B- > 200mV

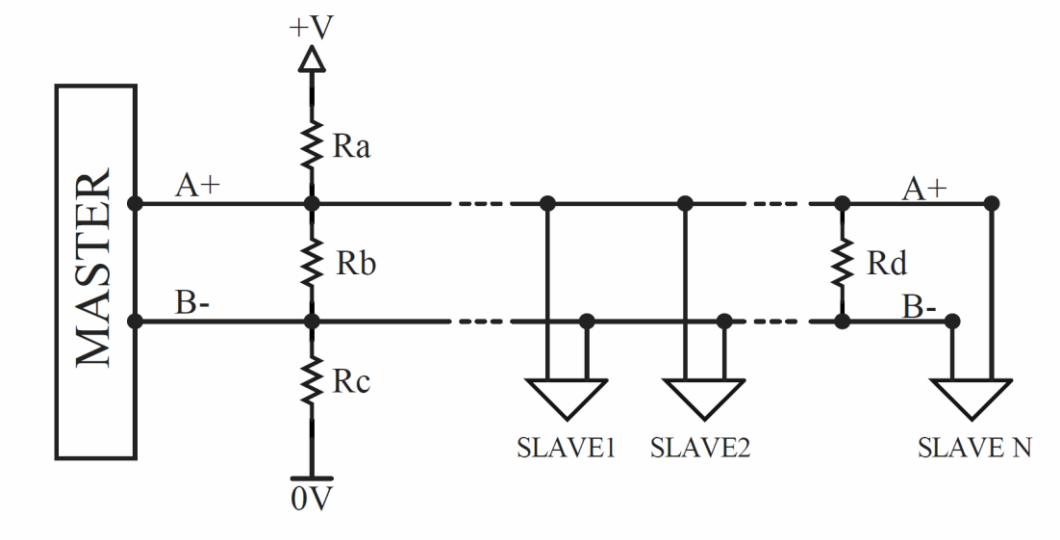
3.1.1.1 NOTE FOR CONNECTION WITH SIEMENS

A+ must be connected to Siemens channel B+; B- must be connected to Siemens channel A- (+ with +; - with -)

3.1.1.2 Pull-up, Pull-down resistors and termination of the A + and B- lines

For the correct bus operation, the pull-up and pull-down resistors that are usually pre-installed in the line master must be inserted on lines A + and B-.

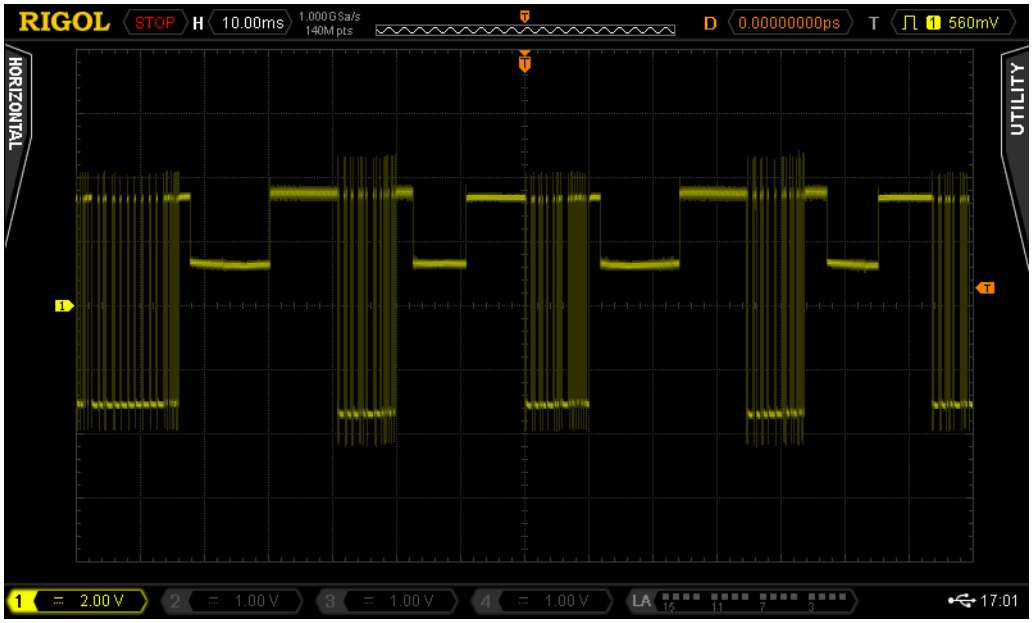
Example of connection:



RA=RC Pull-up/Pull-down (Ω)	RB A+ - B- (Ω)	RD Termination (Ω)	V A+ - B- (mV)	NOTE
1000	220	-	495	-
1000	120	-	283	-
1000	220	220	260	Insert termination only if needed
500	120	-	535	-
500	120	120	283	Insert termination only if needed

* If the power supply is not present or if necessary, an external power supply with 0V floating or connected to the 0V of the master can be inserted.

Characteristic waveform:



3.1.2 Setting the DEVICE ADDRESS

The RS485 address should be set using the SW2[1..7] dip-switches on the device; the address is set in binary format. If the dip switches status is changed, you need to switch off the thermoregulator and switch it on again.

EXAMPLES:
SW2[1]=ON, SW2[2..7]=OFF -> DEVICE ADDRESS=1 (2E0)
SW2[1]=OFF, SW2[2]=ON, SW2[3..7]=OFF -> DEVICE ADDRESS=2 (2E1)
SW2[1]=ON, SW2[2]=ON, SW2[3..7]=OFF -> DEVICE ADDRESS=3 (2E0+2E1)

3.1.3 Setting the STOP BIT

The stop bit should be set using the dip-switch SW2[8] on the device. If the dip switches status is changed, you need to switch off the thermoregulator and switch it on again.

EXAMPLE:
SW2[8]=ON -> 2 STOP BIT
SW2[8]=OFF -> 1 STOP BIT

3.2 PROFIBUS

3.2.1 Hardware connection

The thermoregulator can communicate with a PC or PLC supervisor through connector CN10 (see 3.7 - CN10 Connector).

3.2.2 Setting the DEVICE ADDRESS

The PROFIBUS address should be set using the SW2 dip-switches on the device; the address is set in binary format. If the dip switches status is changed, you need to switch off the thermoregulator and switch it on again.

EXAMPLES:
SW2[1]=ON, SW2[2..8]=OFF -> DEVICE ADDRESS=1 (2E0)
SW2[1]=OFF, SW2[2]=ON, SW2[3..8]=OFF -> DEVICE ADDRESS=2 (2E1)
SW2[1]=ON, SW2[2]=ON ,SW2[3..8]=OFF -> DEVICE ADDRESS=3 (2E0+2E1)

3.3 PROFINET

3.3.1 Hardware connection

The thermoregulator is equipped with an Ethernet switch, which consists of two RJ45 connectors (see 3.6 - Switch Ethernet HMS-ANYBUS CompactCom).

3.3.2 Setting the IP ADDRESS

The IP address and the netmask must be set from the software.

3.4 ETHERNET/IP

3.4.1 Hardware connection

The thermoregulator is equipped with an Ethernet switch which consists of two RJ45 connectors (see 3.6 - Switch Ethernet HMS-ANYBUS CompactCom).

3.4.2 Setting the IP ADDRESS

If switch SW2 is set to 0, all switches are set to off, the IP address and the netmask can be set from the software.
If SW2 value ranges from 1 to 254, the less significant byte of the IP address is set to the SW2 switch value. The 255 address is not valid as it is a broadcast address. If the dip switches status is changed, you need to switch off the thermoregulator and switch it on again.

EXAMPLES:
SW2[1]=ON, SW2[2..8]=OFF -> IP ADDRESS =xxx.xxx.xxx.xx1 (2E0)
SW2[1]=OFF, SW2[2]=ON, SW2[3..8]=OFF -> IP ADDRESS =xxx.xxx.xxx.xx2 (2E1)
SW2[1]=ON, SW2[2]=ON ,SW2[3..8]=OFF -> IP ADDRESS =xxx.xxx.xxx.xx3 (2E0+2E1)

3.5 POWERLINK

3.5.1 Hardware connection

The thermoregulator is equipped with an Ethernet switch which consists of two RJ45 connectors (see 3.6 - Switch Ethernet HMS-ANYBUS CompactCom).

3.5.2 Setting the DEVICE ADDRESS

The POWERLINK address should be set using the SW2 dip-switches on the device; the address is set in binary format. If the dip switches status is changed, you need to switch off the thermoregulator and switch it on again.

EXAMPLES:
SW2[1]=ON, SW2[2..8]=OFF -> DEVICE ADDRESS=1 (2E0)
SW2[1]=OFF, SW2[2]=ON, SW2[3..8]=OFF -> DEVICE ADDRESS=2 (2E1)
SW2[1]=ON, SW2[2]=ON ,SW2[3..8]=OFF -> DEVICE ADDRESS=3 (2E0+2E1)

3.6 Switch Ethernet HMS-ANYBUS CompactCom

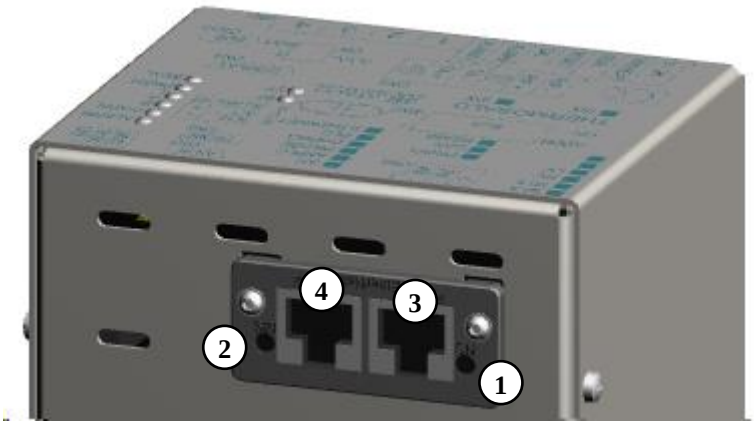


Figure 1 – Switch Ethernet HMS-ANYBUS CompactCom

3.7 CN10 Connector

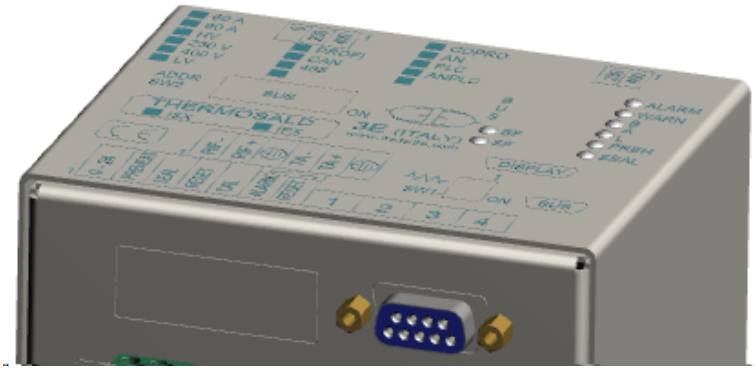


Figure 2 - CN10 Connector

4 LED SIGNALING INTERFACE

4.1 RS485 MODBUS RTU HALF DUPLEX

LED BF	Meaning
ON	CABLE not connected: see 3.1.1 - Hardware connection .
Flashing	Cable connected, address not received within 3 sec. Check that the master is using the address set on the module.
OFF	Communication available, no errors.

4.2 PROFIBUS

LED BF	LED SF	Meaning
ON	x	Cable not connected: see 3.2.1 - Hardware connection .
Flashing	OFF	Cable connected, no data exchange. Check that the master is using the address set on the module.
Flashing	ON	Communication available, application error.
OFF	OFF	Communication available, no errors.

4.3 PROFINET

The following table describes the operation of the LED panel interface on the Ethernet switch (see 3.6 - Switch Ethernet HMS-ANYBUS CompactCom).

LED NS (#1) (Network Status)	LED MS (#2) (Module Status)	Meaning
ON (green)	x	Connection with master established, master in run status.
Flashing (green)	x	Connection with master established, master in stop status.
OFF	x	No connection with master. Check that the Ethernet cable is connected and that the master is using the IP address and the device name set on the module.
x	1 Flashing (green)	Presence of one or more diagnostic events.
x	ON (green)	Normal operation.
x	Flashing (1s, green)	Flash DCP. Used by the tools to identify the node on the network.

x	ON (Red)	Module in error. Contact the technical support.
x	1 Flashing (Red)	The expected identification does not correspond to the actual one.
x	2 Flashings (Red)	IP address not set. Assign the IP address.
x	3 Flashings (Red)	Device name not set. Assign the device name.
x	4 Flashings (Red)	Module in error. Contact the technical support.

The operation of the Link/Activity port 1 (#3) and Link/Activity port 2 (#4) LEDs on the RJ45 connectors is summarized in the following table.

Link/Activity LED	**Meaning**
OFF	No connection.
ON (green)	Ethernet connection present, no activity.
Flashing (green)	Ethernet connection present, activity available.

4.4 ETHERNET/IP

The following table describes the operation of the LED panel interface on the Ethernet switch (see 3.6 - Switch Ethernet HMS-ANYBUS CompactCom).

LED NS (#1) **(Network Status)**	**LED MS (#2)** **(Module Status)**	**Meaning**
ON (Green)	x	Online Module. One or more connections established.
Flashing (Green)	x	Online Module. No connection Check that the master is using the IP address set on the module.
OFF	x	The module has not configured the IP address. Check that the Ethernet cable is connected.
ON (Red)	x	IP address doubled. Fix all IP address conflicts.
Flashing (Red)	x	The module configured the IP address but timeout of one or more connections. Check that the Ethernet cable is connected.
x	ON (Green)	Normal operation. The module is controlled correctly, master in run status.
x	Flashing (Green)	No master configuration or master in stop status. Check master status.
x	ON (Red)	Module in error. Contact the technical support.

x	Flashing (Red)	Module in error. Contact the technical support.

The operation of the Link/Activity port 1 (#3) and Link/Activity port 2 (#4) LEDs on the RJ45 connectors is summarized in the following table.

Link/Activity LED	Meaning
OFF	No connection.
ON (green)	Ethernet connection available (100 Mbit/s), no activity.
Flashing (green)	Ethernet connection available (100 Mbit/s), activity.
ON (yellow)	Ethernet connection available (10 Mbit/s), no activity.
Flashing (yellow)	Ethernet connection available (10 Mbit/s), activity.

4.5 POWERLINK

The following table describes the operation of the LED panel interface on the Ethernet switch (see 3.6 - Switch Ethernet HMS-ANYBUS CompactCom).

LED STS (#1)	LED ERR (#2)	Meaning
Flashing (50ms, green)	x	Ethernet level connected. Powerlink traffic not detected.
1 Flashing (green)	x	Only asynchronous data.
2 Flashings (green)	x	Synchronous and asynchronous data. PDO data not present. In this status, the processing data transmitted are declared not valid and the processing data received must be ignored.
3 Flashings (green)	x	Ready of standard operation. Synchronous and asynchronous data. PDO data not present. In this status, the processing data transmitted are declared not valid and the processing data received must be ignored.
ON (green)	x	Normal operation. Synchronous and asynchronous data. PDO data transmitted and received.
Flashing (200ms, green)	x	Module in stop status, for example due to controlled switching off. PDO data not present. In this status, the processing data transmitted are declared not valid and the processing data received must be ignored.
x	ON (Red)	Module in error. Contact the technical support.

The operation of the Link/Activity port 1 (#3) and Link/Activity port 2 (#4) LEDs on the RJ45 connectors is summarized in the following table.

Link/Activity LED	**Meaning**
OFF	No connection.
ON (green)	Ethernet connection present, no activity.
Flashing (green)	Ethernet connection present, activity available.

5 THERMOSALD PLC – MASTER PLC – SLAVE THERMOSALD COMMUNICATION SOFTWARE INTERFACE

5.1 Telegrams RS485 V5 MODBUS RTU HALF DUPLEX

Every byte contained in the telegrams is binary-coded. For detailed information on the use of the telegrams, please refer to chapter 7 - Communication protocols.

5.1.1 Command code 03: read 1 or n registers

This command allows the supervisor to read 1 or n registers

Query (**MASTER PLC ➔ SLAVE THERMOSALD**):

SlAdd	03	AddHi	AddLo	NPoHi	NPoLo	BCC	BCC

Response (**SLAVE THERMOSALD ➔ MASTER PLC**):

SlAdd	03	ByteC	DataHi	DataLo	…	DataHi	DataLo	…	BCC	BCC

5.1.2 Code command 06: write 1 register

This command allows the supervisor to write 1 register

Query (**MASTER PLC ➔ SLAVE THERMOSALD**):

SlAdd	06	AddHi	AddLo	DataHi	DataLo	BCC	BCC

Response (**SLAVE THERMOSALD ➔ MASTER PLC**):

SlAdd	06	AddHi	AddLo	DataHi	DataLo	BCC	BCC

AddHi: Address (Byte High).
AddLo: Address (Byte Low).
NPoHi: not used
NPoLo: number of bytes requested from Address (Byte Low, max. value:40).
DataHi: Data (Byte High).
DataLo: Data (Byte Low)
ByteC: number of bytes of data received (max. value:40).
BCC: Cyclical Redundancy Check (CRC)

For the list of possible values of the address fields, see chapter 9.
The Data field allows you to retrieve the current value of the variables read with the command 03 or to set the future value of the variables written with the command 06 and receiving the echo from the thermoregulator. For the details of the variables, refer to chapter 9.

5.2 PROFIBUS Data exchange areas V5

For detailed information on the use of the exchange areas, please refer to chapter 7 - Communication protocols.

5.2.1 MASTER PLC ➔ SLAVE THERMOSALD

OUTPUT	Byte/Word	Description	Notes
00	B	Code	03: Read 06: Write
01	W	ID (Byte High)	See chapter 9 for the list of possible values.
		ID (Byte Low)	
02	W	Value (Byte High)	The write command 06 sends the thermoregulator the new value of the variable specified by ID.
		Value (Byte Low)	
03	W	Commands word (Byte High)	See 7.3.2 - Commands word
		Commands word (BYTE Low)	

5.2.2 SLAVE THERMOSALD ➔ MASTER PLC

INPUT	Byte/Word	Description	Notes
00	B	Echo Code	Echo of the Code sent. Allows you to control if the thermoregulator correctly receives the write or read command.
01	W	Eco ID (Byte High)	Echo of the ID sent. Allows you to control if the thermoregulator correctly receives the ID.
		Eco ID (Byte Low)	
02	W	Echo Value (Byte High)	Echo of the sent Value. In read mode, it returns the current value of the variable. In write mode, allows you to control if the thermoregulator correctly receives the new variable value.
		Echo Value (Byte Low)	
03	W	Current temperature (°C) (Byte High, ID 768)	This part of the exchange area contains the direct access to the values of some variables of common use. See chapter 9.1 for the details of the variables.
		Current temperature (°C) (Byte Low, ID 768)	
04	W	Alarm/warning number (Byte High, ID 769)	
		Alarm/warning number (Byte Low, ID 769)	
05	B	Thermoregulator status (ID 774)	

06	B	Reserved.	
07	B	Reserved.	

5.3 PROFINET V5 data exchange areas

For detailed information on the use of the exchange areas, please refer to chapter 7 - Communication protocols.

5.3.1 MASTER PLC ➔ SLAVE THERMOSALD

OUTPUT	Byte/Word	Description	Notes
00	B	Code	03: Read 06: Write
01	W	ID (Byte High)	For the list of the possible values see chapter 9.
		ID (Byte Low)	
02	W	Value (Byte High)	The write command 06 sends the thermoregulator the new value of the variable specified by ID.
		Value (Byte Low)	
03	W	Commands word (Byte High)	See 7.3.2 - Commands word
		Commands word (BYTE Low)	

5.3.2 SLAVE THERMOSALD ➔ MASTER PLC

INPUT	Byte/Word	Description	Notes
00	B	Echo Code	Echo of the Code sent. Allows you to control if the thermoregulator correctly receives the write or read command .
01	W	Eco ID (Byte High)	Echo of the ID sent. Allows you to control if the thermoregulator correctly receives the ID.
		Eco ID (Byte Low)	
02	W	Echo Value (Byte High)	Echo of the sent Value. In read mode, it returns the current value of the variable. In write mode, allows you to control if the thermoregulator correctly receives the variable new value.
		Echo Value (Byte Low)	
03	W	Current temperature (°C) (Byte High, ID 768)	This part of the exchange area contains the direct access to the values of some variables of common use.
		Current temperature (°C) (Byte Low, ID 768)	
04	W	Alarm/warning number	

		(Byte High, ID 769)	See chapter 9.1 for the details of the variables.
		Alarm/warning number (Byte Low, ID 769)	
05	B	Thermoregulator status (ID 774)	
06	W	I effective full wave (A) (BYTE High, ID 770)	
		I effective full wave (A) (Byte Low, ID 770)	
07	W	R (ohm x100) (Byte High, ID 771)	
		R (ohm x100) (Byte Low, ID 771)	
08	W	V effective full wave (V) (Byte High, ID 772)	
		V effective full wave (V) (Byte Low, ID 772)	
09	W	P effective full wave (VA) (Byte High, ID 773)	
		P effective full wave (VA) (Byte Low, ID 773)	
10	W	Steady working conditions % (Byte High, ID 778)	
		Steady working conditions % (Byte Low, ID 778)	
11	W	I0 effective full wave first calibration (A) (Byte High, ID 527)	
		I0 effective full wave first calibration (A) (Byte Low, ID 527)	
12	W	R0 first calibration (ohm x100) (Byte High, ID 528)	
		R0 first calibration (ohm x100) (Byte Low, ID 528)	
13	W	V0 effective full wave first calibration (V) (Byte High, ID 529)	
		V0 effective full wave first calibration (V) (Byte Low, ID 529)	
14	W	P0 effective full wave first calibration (A) (Byte High, ID 530)	

		P0 effective full wave first calibration (A) (Byte Low, ID 530)	
15	W	Calibration temperature (°C) (Byte High, ID 258)	
		Calibration temperature (°C) (Byte Low, ID 258)	
16	W	Max. weld temperature (°C) (Byte High, ID 262)	
		Max. weld temperature (°C) (Byte Low, ID 262)	
17	W	Set Preheat temperature (°C) (Byte High, ID 269)	
		Set Preheat temperature (°C) (Byte Low, ID 269)	
18	W	Set weld temperature (°C) (Byte High, ID 270)	
		Set weld temperature (°C) (Byte Low, ID 270)	

5.4 ETHERNET/IP V5, POWERLINK V5 data exchange areas

For detailed information on the use of the exchange areas, please refer to chapter 7 - Communication protocols.

5.4.1 MASTER PLC ➔ SLAVE THERMOSALD

OUTPUT	Byte/Word	Description	Notes
00	W	Code	03: Read 06: Write
01	W	ID	For the list of the possible values see chapter 9
02	W	Value	The write command 06 sends the thermoregulator the new value of the variable specified by ID.
03	W	Commands word	See 7.3.2 - Commands word

5.4.2 SLAVE THERMOSALD ➔ MASTER PLC

INPUT	Byte/Word	Description	Notes
00	W	Echo Code	Echo of the Code sent. Allows you to control if the thermoregulator correctly receives the write or read command .
01	W	Echo ID	Echo of the ID sent. Allows you to control if the thermoregulator correctly receives the ID.
02	W	Echo Value	Echo of the transmitted Value. In read mode, it returns the current value of the variable. In write mode, allows you to control if the thermoregulator correctly receives the variable new value.
03	W	Current temperature (°C) (ID 768)	This part of the exchange area contains the direct access to the values of some variables of common use. See chapter 9.1 for the details of the variables.
04	W	Alarm/warning number (ID 769)	
05	W	Thermoregulator status (ID 774)	
06	W	I effective full wave (A) (ID 770)	
07	W	R (ohm x100)	

		(ID 771)	
08	W	V effective full wave (V) (ID 772)	
09	W	P effective full wave (VA) (ID 773)	
10	W	Steady working conditions % (ID 778)	
11	W	I0 effective full wave first calibration (A) (ID 527)	
12	W	R0 first calibration (ohm x100) (ID 528)	
13	W	V0 effective full wave first calibration (V) (ID 529)	
14	W	P0 effective full wave first calibration (A) (ID 530)	
15	W	Calibration temperature (°C) (ID 258)	
16	W	Max. weld temperature (°C) (ID 262)	
17	W	Set Preheat temperature (°C) (ID 269)	
18	W	Set weld temperature (°C) (ID 270)	

6 STARTUP

6.1 RS485

The exchange of data is immediate, according to the RS485 MODBUS RTU standard; simply connect the communication cable to a SUPERVISOR equipped with a standard RS485 MODBUS RTU interface, set the communication parameters and the data exchange is immediately operational.

To connect to the thermoregulator, please follow these steps:

1. Connect cable RS485 (see chapter 3 - CONNECTIONS AND DIP SWITCHES)
2. Set the thermoregulator address: the supervisor can address 1 unit at a time with the specific address or write on all of them, together with address 0=broadcasting (see chapter 3 - CONNECTIONS AND DIP SWITCHES).
3. Set stop bit (see chapter 3 - CONNECTIONS AND DIP SWITCHES)
4. Switch on the thermoregulator.
5. Set the thermoregulator default parameters on the supervisor:
   Baudrate: 9600 bauds
   Parity: none
   Data bit: 8
   Stop Bit: previously set value.
   Idle char: 10 ms x 2 = 20 ms

The transmission parameters of the thermoregulator can be changed by the supervisor: for the values that can be specified see paragraph 9.1 - VARIABLES.

6.2 PROFIBUS

To connect to the thermoregulator, please follow these steps:

1. Connect the Profibus cable (see chapter 3 - CONNECTIONS AND DIP SWITCHES)
2. Set the thermoregulator address (see chapter 3 - CONNECTIONS AND DIP SWITCHES)
3. Switch on the thermoregulator.
4. Download the proper GSD archive, for example "*Thermosald ISX BUS Profibus GSD V5.zip*", from the web site www.3e3e3e.com.
5. Extract the archive and install the files GSD 3E__0C4E.gsd and 3E__0C4E.bmp in the configuration tool of the PROFIBUS used. Select the ThermoSald module.

6.3 PROFINET

To connect to the thermoregulator, please follow these steps:

- Connect the Ethernet cable to one of the two Ethernet connectors on the thermoregulator.
- Download the proper GSD archive, for example "*Thermosald ISX BUS Profinet GSDML V5.zip*", from the web site www.3e3e3e.com.

- Extract the archive and install the GSDML file in the configuration tool of the PROFINET used.

6.3.1 Changing the IP address software

The factory's IP address of the Thermosald ISX is 192.168.0.55. The IP address, the netmask, and the PROFINET name can be set via software from the master.
Alternatively, the easiest way to configure the parameters is through the device web page (see 8.1 - Changing the IP address).
There are some dedicated applications, such as HMS Anybus "IP Config" and Siemens "PRIMARY SETUP TOOL (PST)". For downloading these tools, please refer to the HMS Anybus (www.anybus.com) and Siemens (www.siemens.com) web sites.

6.4 ETHERNET/IP

To connect to the thermoregulator, please follow these steps:

1. Connect the Ethernet cable to one of the two Ethernet connectors on the thermoregulator (see chapter 3 - CONNECTIONS AND DIP SWITCHES)
2. Set the thermoregulator address (see chapter 3 - CONNECTIONS AND DIP SWITCHES).
3. Switch on the thermoregulator.
4. Download the proper EDS archive, for example "*Thermosald ISX BUS Ethernet/IP EDS V5.zip*", from the web site www.3e3e3e.com.
5. Extract the archive and install the EDS file in the configuration tool of the ETHERNET/IP used.
6. Assign a 8-byte size (4 words) to the (MASTER PLC -> Slave Thermosald) output.
7. Assign a 38-byte size (19 words) to the (Slave Thermosald -> Master) input.
8. Assign the PLC IN/OUT address location TAG.

6.4.1 Tools incompatible with the EDS interchange format

If the tool does not support the EDS interchange format, proceed as follows:

- Nr. of instances: 2.
- Input instance (Slave Thermosald -> Master PLC): ID:100, Size:38 bytes, Ownership:Exclusive, Priority:Scheduled, Connection:Point to Point, Use Run Idle:False.
- Output instance (Master PLC -> Slave Thermosald): ID:150, Size:8 bytes, Ownership:Exclusive, Priority:Scheduled, Connection:Point to Point, Use Run Idle:True.

6.4.2 Installations

Thermosald has already been successfully integrated on different systems, such as Omron, Yaskawa, Beckhoff, Rockwell.

6.4.3 Changing the IP address software

The factory's IP address of the thermoregulator 192.168.0.55. The IP address and the netmask can be set via software from the master.
Alternatively, the easiest way to configure the parameters is through the device web page (see 8.1 - Changing the IP address).
There are some dedicated applications, such as HMS Anybus "IP Config". For downloading this tool, please refer to the HMS Anybus web site (www.anybus.com).

6.5 Powerlink

To connect to the thermoregulator, please follow these steps:

1. Connect the Ethernet cable to one of the two Ethernet connectors on the thermoregulator (see chapter 3 - CONNECTIONS AND DIP SWITCHES)
2. Check the thermoregulator's address (see chapter 3 - CONNECTIONS AND DIP SWITCHES)
3. Switch on the thermoregulator.
4. Download the proper XDD archive, for example "Thermosald ISX BUS Ethernet/IP EDS V5.zip", from the web site www.3e3e3e.com.
5. Extract the archive and install the XDD file in the Powerlink configuration tool used.

6.5.1 Installations

Thermosald has already been successfully integrated on different systems, among which B&R.

7 Communication protocols

The scenarios of interaction between the supervisor master and the thermoregulator are essentially two:

- Read/write of the variables listed at paragraph 9.1 - VARIABLES.
- Activation/deactivation of the commands listed at paragraph 9.2 - COMMANDS.

7.1 Commands 3 (read) and 6 (write) based on telegrams - RS485 MODBUS RTU HALF DUPLEX

Please see the dedicated telegrams described at paragraph 5.1 - Telegrams RS485 V5 MODBUS RTU HALF DUPLEX.

7.2 Commands 3 (read) and 6 (write) based on the DATA EXCHANGE AREA

Read command: write code 3 (decimal) at ***Code*** output and the identification code of the variable to be read at the ***ID*** output (see paragraph 9.1 - VARIABLES); the thermoregulator responds with code 3 (decimal) at the ***Echo Code*** input, with the required identification code echo at the ***Echo ID*** input, with the value (decimal) of the variable to be read at ***Echo Value*** input.

Write command: write code 6 (decimal) at the***Code*** output and the identification code of the variable to be written at the ***ID*** output (see paragraph 9.1 - VARIABLES) and the value of the variable to be written at the ***Value*** output; the thermoregulator responds with code 6 (decimal) at the ***Echo Code*** input, with the required identification code echo at the input ***Echo ID*** , with the value (decimal) of the variable to be written at the ***Echo Value*** input. Writing a command exactly corresponds to writing a variable the address of which is 0505H (1285 decimal) and the value of which depends on the command you wish to activate or deactivate (see paragraph 9.2 - COMMANDS).

Avoid continuous write commands as they might damage the thermoregulator inner EEPROM.

To send another write or read command you need to set the ***Code*** output to 0 value again.

For details of the byte size of ***Code, Echo Code, ID; Echo ID, Value, and Echo Value***, please refer to the exchange areas of the specific field bus.

7.3 Direct read /write of the DATA EXCHANGE AREA

7.3.1 Runtime data

At the master input exchange area, the thermoregulator supplies some runtime data of common use. For the details of the runtime data available on the specific field bus, please refer to the description of the specific exchange area (see paragraphs 0 and the following ones).
For the complete list of the runtime data, please refer to the paragraph 9.1 - VARIABLES.

7.3.2 Commands word

The commands word is available at the output exchange area from the master to the thermoregulator (see paragraph 0 and following ones.). It is possible to activate the thermoregulator commands by setting the single bits of such word. It is recommended to use this option instead of the commands management (see paragraph 9.2 - COMMANDS) which is based on the write command, as it is simpler and more efficient.

COMMANDS WORD	BIT	Description
BYTE HIGH	7	Reserved
	6	Reserved
	5	Reserved
	4	Reserved
	3	Master reset (level)
	2	Current loop on (level)
	1	Weld on (Level)
	0	Pre-heat on (level)
BYTE LOW	7	Save calibration data (pulse > 50ms)
	6	Emergency test (level)
	5	Burn-in off (pulse > 50ms)
	4	Burn-in on (pulse > 50ms)
	3	Read data from EEPROM (not active from V5.1 software, see 512 and 513 variables par. 9.1) 9.1)
	2	Save data in EEPROM (not active from V5.1 software, see 512 and 513 variables par. 9.1) 9.1)
	1	Calibration (pulse > 50ms)
	0	Alarms reset (pulse > 50ms)

8 Slave device web page

If the specific field bus contemplates the IP level, the device shows a web page from which it is possible to configure the network parameters and to monitor the information at the input data exchange area received from the Thermosald. To access the device web page, type the IP address of the thermoregulator in the browser. We suggest to point-to-point connect the PC directly to the thermoregulator and assign the PC an IP address of the same class of the thermoregulator.
If, for example the thermoregulator IP address is 192.168.0.55, you can use any IP address of the type 192.168.0.X different from 192.168.0.55 and from the 192.168.0.255. broadcast address.

8.1 Changing the IP address

After typing the thermoregulator IP address in the browser, select the “Network interface” link and then “Network configuration”. This link allows you to change the IP address and the subnet mask, as shown in the Figure 3.

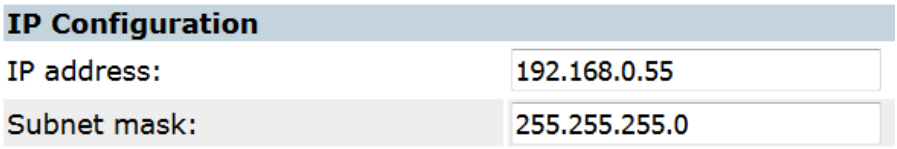


Figure 3

8.2 Monitoring the input exchange area coming from the thermoregulator

After typing the thermoregulator IP address in the browser, select the link "Parameter Data". This link displays the status of the input exchange area from the device, as shown in the Figure 4. Data are updated using the browser refresh function.

Parameter data

Number of parameters per page: 100 Set

#	Parameter	Value
1	Code	0
2	Address	0
3	Data	0
4	Command	0
5	Code Echo	0
6	Address Echo	0
7	Data	0
8	Run Time Temperature	0
9	Run Time Alarm	33
10	Run Time State	0
11	Run Time-I eff.	0
12	Run Time-Resistance (R x 100)	0
13	Run Time-V eff.	0
14	Run Time-P eff.	0
15	Steady work.cond. %	0
16	Calibration-I eff.	0
17	Calibr.-Resistance (R x 100)	0
18	Calibration-V eff.	0
19	Calibration-P eff.	0
20	Calibration-Temp.	30
21	Max weld Temp.	250
22	Set pre-heat Temp.	100
23	Set weld Temp.	150

Figure 4

9 VARIABLES AND COMMANDS

- The default values are outlined in the “USE AND MAINTENANCE MANUAL”
- All exchanged data are words (2 bytes)
- The data are read with code 3 and written with code 06.

9.1 VARIABLES

ID or Address (Dec)	ID or Address (Hex)	Variable name	Value or Data	Read Write
MACHINE DATA				
0	0000H	Heating ramp degrees/100ms	(UNSIGNED INT 16) [xxx]	(R/W)
1	0001H	KV Gain	(UNSIGNED INT 16) [xxx]	(R/W)
2	0002H	KINT Gain (x10)	(UNSIGNED INT 16) [xx.x]	(R/W)
3	0003H	Final KINT threshold	(UNSIGNED INT 16) [xxx]	(R/W)
4	0004H	Partial short circuit factor (x10)	(UNSIGNED INT 16) [xx.x]	(R/W)
5	0005H	Mode Configuration	(UNSIGNED INT 16) [000]= pulse weld	(R/W)
6	0006H	Display Configuration	(UNSIGNED INT 16) [000]=analogic [001]=analogic + panel [002]=panel or FIELDBUS	(R/W)
7	0007H	Rated current	(UNSIGNED INT 16) [xxx]	(R)
8	0008H	KD derivative gain	(UNSIGNED INT 16) [xxx]	(R/W)
9	0009H	Alarm disable 1	(UNSIGNED INT 16) [xxx]	(R/W)
10	000AH	Bus type	(UNSIGNED INT 16) RS485 [000]=Disabled [001]=9600 Bauds [002]=19200 Bauds [003]=28800 Bauds [004]=38400 Bauds [005]=48000 Bauds [006]=57600 Bauds PROFIBUS [011=PROFIBUS] PROFINET [021=PROFINET]	(R/W) (R) (R) (R)

			ETHERNET/IP [031=ETHERNET/IP] POWERLINK [051=POWERLINK]	(R)
11	000BH	Slave address	(UNSIGNED INT 16) RS485 (Selection via dip switch SW2[1..7]) PROFIBUS (Selection via dip switch SW2[1-8]) PROFINET [Do not use] ETHERNET/IP (Selection via dip switch SW2[1..8]) POWERLINK (Selection via dip switch SW2[1..8])	 (R) (R) (R) (R) (R)
12	000CH	Master reset done	(UNSIGNED INT 16) [001]=Done [000]=Not done	(R)
13	000DH	Alarm disable 2	(UNSIGNED INT 16) [xxx]	(R/W)
14	000EH	Temperature coefficient (PPM)	(UNSIGNED INT 16) [xxx]	(R/W)
15	000FH	Units per degree	(UNSIGNED INT 16) [xxx]	(R)
16	0010H	Primary	(UNSIGNED INT 16) [xxx]	(R)
17	0011H	Low voltage	(UNSIGNED INT 16) [xxx]	(R)
18	0012H	PLC enable	(UNSIGNED INT 16) [xxx]	(R/W)
19	0013H	Password	(UNSIGNED INT 16) [xxx]	(R/W)
20	0014H	Key password (1-9999)	(UNSIGNED INT 16) [000]=Disabled [001]=Partial [002]=Total	(R/W)
21	0015H	Model	(UNSIGNED INT 16) [010]=Thermosald ISX	(R)
22	0016H	Not assigned	(UNSIGNED INT 16) [xxx]	(R)
23	0017H	I2T - I effective for max 1	(UNSIGNED INT 16)	(R/W)

		sec.	[xxx]	
24	0018H	Temperature probe enable	(UNSIGNED INT 16) [xxx]	(R/W)
25	0019H	Tmargin_read (v4.4)	(UNSIGNED INT 16) [xxx]	(R/W)
26	001AH	Initial KINT threshold (from v4.4)	(UNSIGNED INT 16) [xxx]	(R/W)
27	001BH	Fs KINT threshold (from v4.4)	(UNSIGNED INT 16) [xxx]	(R/W)
28	001CH	Not assigned	(UNSIGNED INT 16) [xxx]	(R)
SETTING DATA				
256	0100H	Burn-in No. Cycles	(UNSIGNED INT 16) [xxx]	(R/W)
257	0101H	Language	(UNSIGNED INT 16) [xxx]	(R/W)
258	0102H	Calibration temperature (°C)	(UNSIGNED INT 16) [xxx]	(R/W)(*A)
259	0103H	Degree unit of measure on panel	(UNSIGNED INT 16) [000]= °C [001]= °F	(R/W)
260	0104H	Temperature Burn-in (°C)	(UNSIGNED INT 16) [xxx]	(R/W)
261	0105H	Heating Time Burn-in (sec.)	(UNSIGNED INT 16) [xxx]	(R/W)
262	0106H	Max. weld temperature (°C)	(UNSIGNED INT 16) [xxx]	(R/W)(*A)
263	0107H	Max.weld time (x 10)	(UNSIGNED INT 16) [xx.x]	(R/W)
264	0108H	Cooling gradient during bal. (degrees/10sec.)	(UNSIGNED INT 16) [xxx]	(R/W)
265	0109H	Warn66 display time (sec.)	(UNSIGNED INT 16) [xxx]	(R/W)
266	010AH	Weld temperature increase	(UNSIGNED INT 16) [xxx]	(R/W)
267	010BH	Increase no. of welds	(UNSIGNED INT 16) [xxx]	(R/W)
268	010CH	Set End of weld temperature	(UNSIGNED INT 16) [000]=Not enabled [001]=Enabled	(R/W)
269	010DH	Set Preheat temperature (°C)	(UNSIGNED INT 16) [xxx]	(R/W)(*A)
270	010EH	Set weld temperature (°C)	(UNSIGNED INT 16) [xxx]	(R/W)(*A)
271	010FH	Not assigned	[Do not use]	(R)
272	0110H	RS485 Stop Bit	(UNSIGNED INT 16) RS485 (Selection via dip switch	(R)

			SW2[8]) [000]=1 stop bit, [001]=2 stop bits OTHER BUSES [Do not use]	(R)
273	0111H	Not assigned	[Do not use]	(R)
274	0112H	RS485 Idle char	(UNSIGNED INT 16) RS485 [001]=(10 ms), … [100]=(1s) OTHER BUSES [Do not use]	(R)
275	0113H	Not assigned	[Do not use]	(R)
276	0114H	Weld delay timer (x 100)	(UNSIGNED INT 16) [x.xx]	(R/W)
277	0115H	Bars closing timer (x 100)	(UNSIGNED INT 16) [x.xx]	(R/W)
278	0116H	Weld timer (x 100)	(UNSIGNED INT 16) [x.xx]	(R/W)
279	0117H	Cooling timer (x 100)	(UNSIGNED INT 16) [x.xx]	(R/W)
280	0118H	Weld range timer (x100)	(UNSIGNED INT 16) [x.xx]	(R/W)
281	0119H	Set temperature at page 1	(UNSIGNED INT 16) [x.xx]	(R/W)
282	011AH	Set% flat tw. cab. on floor for alm.69	(UNSIGNED INT 16) [x.xx]	(R/W)
283	011BH	Set current loop value	(UNSIGNED INT 16) [x.xx]	(R/W)
284	011CH	Increase time to restore (sec.)	(UNSIGNED INT 16) [x.xx]	(R/W)
STARTUP DATA				
512	0200H	Software major release (ASCII)	(UNSIGNED INT 16) [xxx]	(R)
513	0201H	Software minor release (ASCII)	(UNSIGNED INT 16) [xxx]	(R)
514	0202H	Ohm x sq. mm/mt (x 1000)	(UNSIGNED INT 16) [xxx]	(R/W)
515	0203H	Flat twin cable length (mm)	(UNSIGNED INT 16) [xxx]	(R/W)
516	0204H	Flat twin cable thickness (mm x 100)	(UNSIGNED INT 16) [x.xx]	(R/W)
517	0205H	Wire diameter (mm x 100)	(UNSIGNED INT 16) [x.xx]	(R/W)
518	0206H	Flat twin cable width (mm x 100)	(UNSIGNED INT 16) [xx.x]	(R/W)

519	0207H	Amperes/sq.mm (A/sq. mm)	(UNSIGNED INT 16) [xxx]	(R/W)
520	0208H	No. of flat twin cables in parallel (u)	(UNSIGNED INT 16) [xxx]	(R/W)
521	0209H	Nr. of flat twin cables in series (u)	(UNSIGNED INT 16) [xxx]	(R/W)
522	020AH	Duty cycle (x 10)	(UNSIGNED INT 16) [xx.x]	(R/W)
523	020BH	Theoretical-I effective full wave (A)	(UNSIGNED INT 16) [xxx]	(R)
524	020CH	Theoretical R (ohm x 100)	(UNSIGNED INT 16) [x.xx]	(R)
525	020DH	Theoretical-I effective full wave (V)	(UNSIGNED INT 16) [xxx]	(R)
526	020EH	Theoretical P effective full wave (VA)	(UNSIGNED INT 16) [xxx]	(R)
527	020FH	I0 effective full wave first calibration (A)	(UNSIGNED INT 16) [xxx]	(R)(*B)
528	0210H	R0 first calibration (ohm x100)	(UNSIGNED INT 16) [x.xx]	(R)(*B)
529	0211H	V0 effective full wave first calibration (V)	(UNSIGNED INT 16) [xxx]	(R)(*B)
530	0212H	P0 effective full wave first calibration (A)	(UNSIGNED INT 16) [xxx]	(R)(*B)
531	0213H	Max I effective for alarm 90 (A)	(UNSIGNED INT 16) [xxx]	(R)
RUN TIME DATA				
768	0300H	Current Temperature (+C)	(SIGNED INT 16) [xxx]	(R)(*A)
769	0301H	Alarm/warning number	(UNSIGNED INT 16) [xxx]	(R)(*A)
770	0302H	I effective full wave (A)	(UNSIGNED INT 16) [xx.x]	(R)(*B)
771	0303H	R (ohm x100)	(UNSIGNED INT 16) [x.xx]	(R)(*B)
772	0304H	V effective full wave (V)	(UNSIGNED INT 16) [xxx]	(R)(*B)
773	0305H	P effective full wave (VA)	(UNSIGNED INT 16) [xxx]	(R)(*B)
774	0306H	Thermoregulator status	(UNSIGNED INT 16) [000]=[0x00]=Power off [017]=[0x11]=Not Calibrated [096]=[0x60]=Balancing [100]=[0x64]=Current loop [112]=[0x70]=Preheat [128]=[0x80]=Weld [136]=[0x88]=Master reset in progress [153]=[0x99]=Calibration in progress	(R)(*A)

			[154]=[0x9A] =Wait for scaling [170]=[0xAA]=Burn-in in progress [187]=[0xBB]=Wait for coprocessor calibration [238]=[0xEE]=Alarm	
775	0307H	I effective	(UNSIGNED INT 16) [xxx]	(R)
776	0308H	Active temperature probe	(UNSIGNED INT 16) [xxx]	(R)
777	0309H	Bar temperature probe	(SIGNED INT 16) [xxx]	(R)
778	030AH	Steady working conditions % (updated every 10 seconds)	(UNSIGNED INT 16) [xxx]	(R)(*B)

(*A) Essential data to be handled in the fieldbus interface
(*B) Recommended data to be handled in the fieldbus interface

9.2 COMMANDS

ID or Address (Dec)	ID or Address (Hex)	Variable name	Value or Data	Read Write
1285	0505H	Command code	(UNSIGNED INT 16) Alarms reset=[014] Calibration=[015] Save data to EEPROM=[016] (not active from V5.1 software, see 512 and 513 variables) Read data from EEPROM=[017] (not active from V5.1 software, see 512 and 513 variables) Burn-in on=[018] Burn-in off=[019] Emergency test=[020] Save calibration data=[26] Save coprocessor data=[27]	(W)

			(not active from V5.1 software, see 512 and 513 variables) Disable coprocessor. alarms=[28] (not active from V5.1 software, see 512 and 513 variables) Pre-heat on=[031] Pre-heat off=[032] Weld on=[033] Weld off=[034] Current loop on=[035] Current loop off=[036] Master reset=[099]	

It is advisable to use the commands of commands word if available. Please also see 7.3.2 - Commands word).

Note: command 26 “save calibration data” allows you to store the data of the last calibration; it is advisable to use this command after the machine's first commissioning in order to store calibration data after factory testing. This figure, compared with RUN TIME data, will be used later to make a remote diagnosis of the machine.

9.3 Note RS485 MODBUS RTU HALF DUPLEX

In the case of a Proface panel, program 1-1286 in order to direct 0-1285.