ModBUS® serial communication protocol for KM/KR/KX series temperature controllers with timer and programmer

(KM1-KM3-KR1-KR3-KX1-KX3)

this document is related to the firmware version 4.3.1

22.11 - Code: ISTR_P_K-1-3series_E_03_--

KUBE FAMILY COMMUNICATION PROTOCOL

INDEX

1 PREFACE

Ascon Tecnologic uses the ModBUS® communication protocol in the RTU variant because it is one of the most widespread in industrial communication, so much so that it has become a de facto standard. It is a royalties-free protocol, easy to be implemented and on which there is a vast literature.

The ModBUS® RTU protocol uses serial communications and represents all data in compact form of hexadecimal type.

The commands/data are necessarily followed by a check-sum of the CRC (cyclic redundancy check) type.

Each connected device is assigned a unique address. The protocol provides for a single Master and up to 255 slaves.

Only the Master can initiate transmission by sending a command that contains the address of the device with which it wants to communicate and only the latter will act on the command, although the others also receive it.

All commands contain control information, which ensures that the command arrived is correct.

The transmission characteristics are usually user programmable:

- Device address: From 1 to 254.
- Baud rate: bit per second.
- Byte format:
  - 1 start bit;
  - 8 data bits;
  - 2 final bits composed as follows:
    - 1 parity bit (even or odd);
    - 1 stop bit;

or

- no parity bit;
- 2 stop bits.

The Kube series allow to configure:

- Address (1 ÷ 254);
- Baud rate (1200/2400/9600/19200/38400).

The byte format is fixed: 8 bits without parity and 1 stop bit.

This document is intended to describe the Kube series controllers using the MODBUS protocol in their communication capability and is mainly directed to technicians, system integrators and software developers.

2 PHYSICAL CONNECTION

2.1 Interface

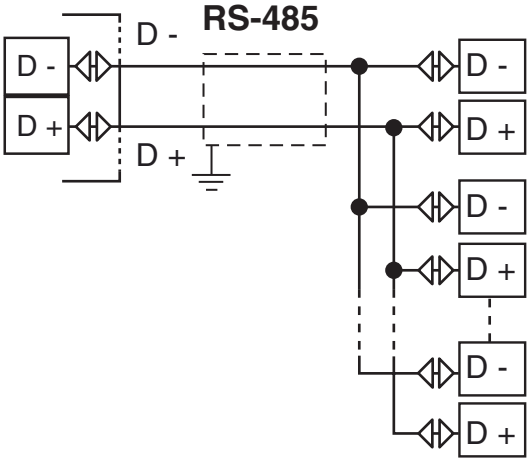
Kube series controllers are provided with a RS485 serial communication interface, insulated so that any problem arising from ground potential is removed.

If the computer or PLC should use a communication interface other than RS485, it will be necessary to install a converter to allow the data exchange between the controllers and the supervisor.

While at rest, the instruments are in a receive condition and switch to transmission after a correct message has been decoded that matches the configured address.

2.2 Line

The instruments are equipped with 2 terminals named **D+** and **D-**. The connection between Kube s has to be carried on in parallel, i.e. all **D+** terminals have to be connected between them and in the same way all those indicated with label **D-**.



The communication speeds adopted (1200 ÷ 34800 baud), while allowing very satisfactory performance, remain well below the limits set by the RS485 standard. This fact allows the line to be wired with a simple medium quality twisted pair (the total capacity of the line must not exceed 200 nF). The line can be up to 1000 meters long.

The characteristics of asynchronous transmission are: 8 bits, no parity, one stop bit.

3 COMMUNICATION PROTOCOL

The MODBUS® RTU communication protocol requires that only the unit selected as the master can start the communication. Slave units can only transmit after receiving a request from the master.

The generic format for the transmission between master and slave is:

Data	Number of bytes
Slave address	1
Function code	1
Data	n
Checksum (CRC-16)(MSB = Most Significant byte)	1
Checksum (CRC-16)(LSB = Less Significant byte)	1

The MODBUS® RTU communication protocol provides that the end of a message is determined when the interval in the transmission of two successive characters is greater than 3.5 T.U. (Time Unit = Time required to transmit a character).

Given the latency times associated with current supervision devices and their operating systems, it is very difficult to calculate the silence time with precision.

The communication protocol function codes implemented provide for messages with a fixed length, the end of the message is therefore determined by the character count. A fixed delay will be respected for the start of the response in order to respect the silence period required by the various baud rate configurations.

3.1 Cyclic redundancy check (CRC)

CRC is a check word that allows to verify a message integrity. All messages, sent or received, have in the two last characters the CRC check word.

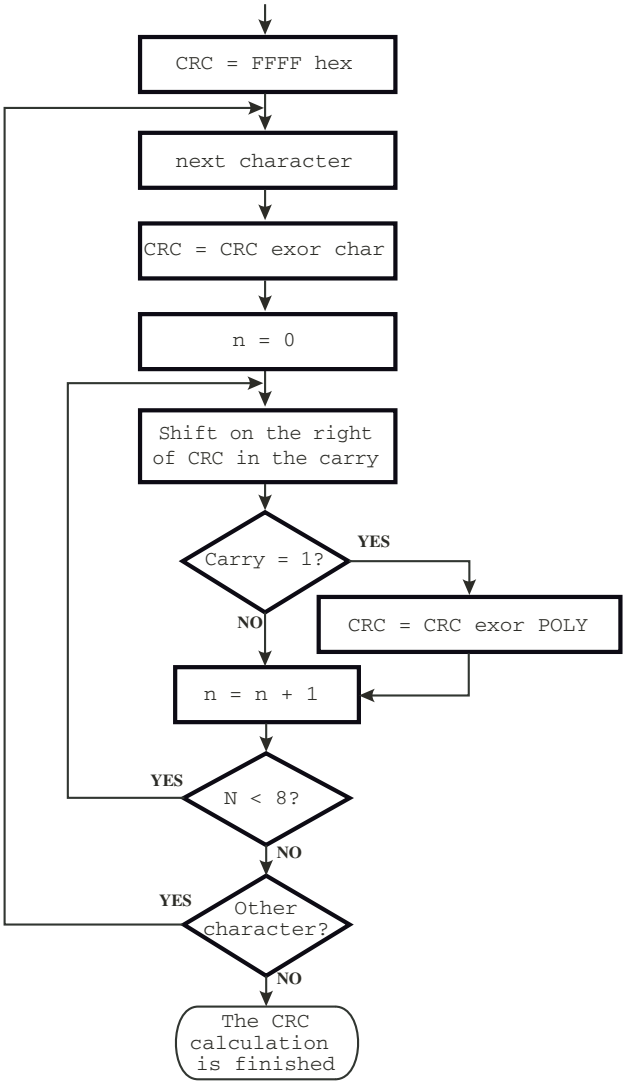
The CRC-16 value is calculated by the transmitting device. This value is appended to the message. After receiving a request, the controller checks the validity of the received message comparing the received CRC with the calculated one. The two values must be identical. When the reply is ready the controller calculates the CRC word and adds two characters to the prepared message.
CRC calculation is performed on every character of the message, excluding the last two.

CRC-16 calculation procedure:

0 = Initialize the word (16 bits) used to store the CRC-16 with the value 0xFFFF;
1 = Perform an exclusive OR (XOR) between the first byte of the message and the lower part of the CRC-16 by putting the result in the CRC-16;
2 = Move the CRC-16 one position to the right, towards the Least Significant Byte (LSB) by inserting the value zero in the Most Significant Byte (MSB). Examine the Least Significant Byte.
3 = If = 0: Repeat step 3 (move to another position),
If = 1: Perform an exclusive OR (XOR) between the CRC-16 and the polynomial value 0xA001;
4 = Repeat steps 3 and 4 until 8 moves have been made. At this point an entire byte will have been processed;
5 = Repeat the procedure from step 2 to step 5 for the next bytes of the message;
6 = The final content of CRC-16 word is the value of CRC-16.

The lower part of the word containing the CRC-16 (16 bytes) is always transmitted first and then the upper part.

The CRC-16 calculation algorithm is summarized in the following diagram:



Where **POLY** (value of the polynomial used) is 0xA001 (1010 0000 0000 0001).
Note: The first transmitted character of the CRC word is the least significant between the 2 calculated bytes.

A subroutine written in “C language” capable of calculating the CTC-16 follows.

```
/* ----------------------------------------------------------------
crc_16   CRC-16 calculation

Input:
   buffer:  character string on which CRC is calculated
   length:  string length in bytes

Output:  crc_16
---------------------------------------------------------------- */
unsigned int crc_16 (unsigned char *buffer, unsigned int length)
{
      unsigned int i, j, temp_bit, temp_int, crc;
      crc = 0xFFFF;
      for (i = 0; i < length; i++ ){
            temp_int = (unsigned char) *buffer++;
            crc ^= temp_int;
            for ( j = 0; j < 8; j++ ) {
                  temp_bit = crc & 0x0001;
                  crc >>= 1;
                  if ( temp_bit != 0 )
                        crc ^= 0xA001;
            }
      }
      return (crc);
}
```

Note: All numerical values in the format 0x❑❑❑❑ are expressed in hexadecimal format.

4 FUNCTION CODES

The ModBUS® RTU protocol provides a truly complete set of function codes capable of allowing the supervisor to interact perfectly with the devices connected to it.

These commands, able to cover the most diverse and generic needs, can however make heavy the code that must necessarily be implemented on the devices. For this reason Ascon Tecnologic has decided to use a small subset of the function codes of the ModBUS® RTU protocol to communicate with the Kube family devices:

Function	Description
Function 3	Multiple reading (max. 16 consecutive registers)
Function 6	Writing of 1 single register
Function 16	Multiple writing (max. 16 consecutive registers)

The correct use of these function codes allows the remote master to perform the control and supervision function completely, being able to read and modify any information present in the slave device.. The communication is based on messages sent by the master station (host) to the slave stations (Kube) and viceversa. The slave station that recognises the message as sent to its own address, analyses the content and, if it is formally and semantically correct, generates a reply message directed to the master.

The communication process involves four type of messages:

From master to slave	From slave to master
Function 3: read n registers request	Function 3: read n registers reply
Function 6: preset one register request	Function 6: preset one register reply
Function 16: preset multiple registers request	Function 16: preset multiple registers reply
	Exception reply (as reply to all functions in abnormal conditions)

Every message contains four fields:

◊ Slave address (1 ÷ 254): MODBUS RTU reserves address **0** for broadcasting messages and it is implemented in the Kube series;
◊ Function code: contains 3, 6 or 16 depending on the specified function;
◊ Information field: contains data like word addresses and word values as required by function in use;
◊ Control word: a cyclic redundancy check (CRC) performed with particular rules for CRC-16.

4.1 Function code 3: Read multiple registers (maximum 16 consecutive registers)

This function code is used by the master to read a group of sequential registers present in the slave.

Master request	
Data	**Byte**
Slave address (1 ÷ 254)	1
Function code (3)	1
First register address (MSB = Most Significant Byte)	1
First register address (LSB = Less Significant Byte)	1
Number of requested registers (MSB)	1
Number of requested registers (LSB)	1
CRC-16 (LSB)	1
CRC-16 (MSB)	1

Slave reply	
Data	**Byte**
Slave address (1 ÷ 254)	1
Function code (3)	1
Byte number (n)	1
Data	n
CRC-16 (LSB)	1
CRC-16 (MSB)	1

In the “Data” field the values of the requested registers are presented in word format [2 bytes]: the first byte represents the MSB (Most Significant Byte) while the second byte represents the LSB (Less Significant Byte). This mode will be the same for all the requested locations.
Example: The master requires to the slave at address 1 the value contained at 2 sequential registers (or locations) [25 (0x19) e 26 (01A)].

Master request	
Data	**Byte (Hex)**
Slave address	01
Function code (3 = read)	03
First register address (MSB)	00
First register address (LSB)	19
Number of requested registers (MSB)	00
Number of requested registers (LSB)	02
CRC-16 (LSB)	15
CRC-16 (MSB)	CC

Slave reply	
Data	**Byte (Hex)**
Slave address	01
Function code (3 = read)	03
Number of Bytes	04
Value of the first register (MSB)	00
Value of the first register (LSB)	0A
Value of the second register (MSB)	00
Value of the second register (LSB)	14
CRC-16 (LSB)	DA
CRC-16 (MSB)	3E

The slave replay means:
The value of the register at location is 25 = 10 (0x000A hexadecimal);
The value of the register at location is 26 = 20 (0x0014 hexadecimal).

4.2 Function code 6: write a single register

This function code is used by the master to write a value to a single register of a slave

Master request	
Data	**Byte**
Slave address (1 ÷ 254)	1
Function code (6)	1
Register address (MSB)	1
Register address (LSB)	1
Value to write (MSB)	1
Value to write (LSB)	1
CRC-16 (MSB)	1
CRC-16 (LSB)	1

Slave reply	
Data	**Byte**
Slave address (1 ÷ 254)	1
Function code (6)	1
Register address (MSB)	1
Register address (LSB)	1
Written value (MSB)	1
Written value (LSB)	1
CRC-16 (MSB)	1
CRC-16 (LSB)	1

Example: The master unit asks to the slave at address 1 to write in the register at location 770 (0x302) the value 10 (0x0A).

Master request	
Data	**Byte (Hex)**
Slave address	01
Function code (6)	06
Register address (MSB)	03
Register address (LSB)	02
Value to write (MSB)	00
Value to write (LSB)	0A
CRC-16 (MSB)	A8
CRC-16 (LSB)	49

Slave reply	
Data	**Byte (Hex)**
Slave address	01
Function code (6)	06
Register address (MSB)	03
Register address (LSB)	02
Written value (MSB)	00
Written value (LSB)	0A
CRC-16 (MSB)	A8
CRC-16 (LSB)	49

4.3 Function code 16: preset multiple registers (maximum 16 consecutive registers)

This function code is used by the master to write a value to multiple consecutive registers in a slave instrument.

Master request	
Data	**Byte**
Slave address (1 ÷ 254)	1
Function code (16)	1
First register address (MSB)	1
First register address (LSB)	1
Number of requested registers (MSB)	1
Number of requested registers (LSB)	1
Bytes count	1
Values	n
CRC-16 (LSB)	1
CRC-16 (MSB)	1

Slave reply	
Data	**Byte**
Slave address (1 ÷ 254)	1
Function code (16)	1
First register address (MSB)	1
First register address (LSB)	1
Number of written registers (MSB)	1
Number of written registers (LSB)	1
CRC-16 (LSB)	1
CRC-16 (MSB)	1

Example: The master unit requires to the slave 1 to write in the registers 10314 (0x284A) and 10315 (0x284B) the values 100 (0x64) and 200 (0xC8)

Master request	
Data	Byte (Hex)
Slave address	01
Function code (16)	10
First register address (MSB)	28
First register address (LSB)	4A
Number of requested registers (MSB)	00
Number of requested registers (LSB)	02
Byte count	4
Value 1 (MSB)	00
Value 1 (LSB)	64
Value 2 (MSB)	00
Value 2 ((LSB)	C8
CRC-16 (LSB)	C9
CRC-16 (MSB)	A8

Slave reply	
Data	Byte (Hex)
Slave address	01
Function code (16)	10
First register address (MSB)	28
First register address (LSB)	4A
Number of written registers (MSB)	00
Number of written registers (LSB)	02
CRC-16 (LSB)	69
CRC-16 (MSB)	BE

4.4 The exception reply

Kube instruments reply with an exception when the request is formally correct, but cannot be satisfied standing particular situations; the reply contains a code indicating the cause of the missing regular reply, the frame is:

Exception replay	
Data	**Byte (Hex)**
Slave address	1
Function code (3 or 6 + 0x80)	1
Error code	1
CRC-16 (LSB)	1
CRC-16 (MSB)	1

Kube series adopts a subset of MODBUS RTU exception codes:

Exception replay	
Error code	**Meaning**
1	Unknown function code
2	Invalid memory address
3	Invalid data field
6	Data not ready (controller not ready)

Note: Error code 6: The instrument sends an exception response with error code 6:

- Upon a request to read or write an address not available in the current configuration,
- When a read/write request arrives while the instrument is in the parameter display/programming phase.

5 DATA EXCHANGE

This section contains informations about data exchanged with Kube series controllers concerning numerical and not numerical data, with their formats and limits.

5.1 Some definitions

5.1.1 Data formats

All exchanged data are in the form of 16 bit words. Two types of data are distinguished: numerical and symbolic (or not numerical).

– Numerical data represent the value of a quantity (e.g.: the measured variable, the set point, etc.).

– Symbolic data represent a particular value in a set of values (e.g.: the thermocouple type in the set of the available ones: J, K, S, etc.).

Both data type are encoded as integers and represented by word. A word consists of 2 bytes. The information is transferred using a word in which the first byte transmitted represents the most significant part.

The “2’s complement” format is used for the transmission of negative values.

Examples:

– The value 2046 (7FE in hexadecimal) is transmitted as 0x7, 0xFE;

– The value -1250 (2’s complement = FB1E in hexadecimal) is transmitted as 0xFB, 0x1E.

5.1.2 Decimal data

Due to the protocol characteristics, the decimal point cannot appear in the transmitted data. The attribution of the decimal point must therefore take place outside the communication protocol. For addresses that represent values with fixed decimals and established in advance, reference must be made to the technical specifications and/or the user manual. For those addresses instead that represent values with a variable number of decimals, the address of the parameter is specified in the relative table determines the number.

5.1.3 Writing addresses

The value sent by the master during a write session must be within the limits set for the corresponding register. Otherwise, the new value will be rejected and the previous value remains valid.

5.1.4 Performance

After receiving a valid request, an instrument of the Kube series prepares the response and sends it to the master station, according to the methods specified below:

Between the end of reception and the start of transmission, a minimum time of three characters is guaranteed to allow line switching.
An online silence time of 20 ms is necessary to recover anomalous conditions or incorrect messages: this means that the time between two consecutive characters of the same message must be less than 20 ms.

6 ADDRESS MAP

The devices of the KUBE family use only word addresses, divided as follows:

Initial address		Final address		Meaning
Hex	Dec	Hex	Dec	
0	0	1D	29	Numerical values and states, calculated and dynamically updated. Available in read and write operations.
200	512	250	592	Group of variables compatible with the old Ascon Tecnologic's instruments (before Kube series): Numerical values and states, calculated and dynamically updated. Available in read and write operations.
280	640	31B	795	Configuration parameters: Numeric and symolic values. Available in read and write operations.
800	2048	82C	2092	Instrument identification parameters. Read Only parameters.
2800	10240	289B	10395	Repetition of the configuration parameters: Numeric and symolic values. Available in read and write operations.
CF08	53000	CF5E	53086	Instrument identification parameters common to all new devices. Available for reading only

6.1 Common Variables

no.	Address		Description	Dec. Point	r/w
	Hex	Dec			
0A	0	0	**Broadcast mode activation** 0x44BB Broadcast function activation 0x55AA Beactivation of the broadcast function	0	w
1A	1	1	**PV: Measured value** **Note:** When a measuring error is detected the instrument sends: -10000 = Underrange; 10000 = Overrange; 10001 = Overflow of the A/D converter; 10003 = Variable not available	dp	r
2A	2	2	**Number of decimal digits of the measured value**	0	r
3A	3	3	**Operative set point (value)**	dp	r
4A	4	4	**Power output** **Range:** -10000 ÷ 10000 (%) **Note:** This parameter is ever writeable but it will be active only when the instrument operates in Manual mode.	2	r/w
5A	5	5	**Active set point selection** 0 SP 1 SP 2 2 SP 3 3 SP 4	0	r/w
6A	6	6	**SP** **Range:** SPLL ÷ SPLH	dp	r/w
7A	7	7	**SP 2** **Range:** SPLL ÷ SPLH	dp	r/w
8A	8	8	**SP 3** **Range:** SPLL ÷ SPLH	dp	r/w
9A	9	9	**SP 4** **Range:** SPLL ÷ SPLH	dp	r/w
10A	A	10	**Alarms status** Bit-managed word: bit 0 Alarm 1 status bit 1 Alarm 2 status bit 2 Alarm 3 status bit 3 ÷ 8 Reserved bit 9 LBA status bit 10 Power failure indicator bit 11 Generic error bit 12 Overload alarm bit 13 ÷15 Reserved	0	r

no.	Address		Description	Dec. Point	r/w
	Hex	Dec			
11A	B	11	**Outputs status (physical outputs)** Bit-managed word: bit 0 Output 1 status bit 1 Output 2 status bit 3 Output 3 status bit 4 Output 4 status bit 5 ÷ 15 Reserved When an output is driven by serial link, the relative bit remains = 0.	0	r
12A	C	12	**Instrument status** Bit-managed word: bit 0 Automatic bit 1 Manual bit 2 Standby bit 3 Remote Set point (temporary) used bit 4 Auto-tuning active bit 5 ÷ 6 Reserved bit 7 Timer running bit 8 Soft start running bit 9 Ramp for set point change (up or down) running bit 10 Delay at start up (od) running bit 11 Program running bit 12 Measure status (0 = OK; when 1 = error) bit 13 ÷ 15 Reserved	0	r
13A	D	13	**Alarms reset** 0 Not reset 1 Reset	0	r/w
14A	E	14	**Alarms acknowledge** 0 Not acknowledged 1 Aknowledged	0	r/w
15A	F	15	**Control status** 0 Automatic 1 Manual 2 Stand-by	0	r/w
16A	10	16	**Temporary set point (from serial link)** **Range:** SPLL ÷ SPLH **Note:** This value is not stored (charged in RAM).	dp	r/w
17A	11	17	**Auto tuning activation** 0 Not active 1 Active	0	r/w
18A	12	18	**Power output used when a measuring error is detected** **Range:** -100 ÷ 100 **Note:** This value is not stored (charged in RAM).	0	r/w
19A	13	19	**Default parameters loading.** -481 Default parameter loading	0	r/w
20A	14	20	**Parameters table identification code** **Range:** 0 ÷ 65535 **Note:** The word is composed by two parts: - Low byte – Version of the parameter table - High byte – Version of the family protocol	0	r
21A	15	21	**Instrument identification code** 20 KM1/KM3 25 KX1/KX3 26 KR1/KR3	0	r
22A	16	22	**First temporary code for fast configuration** The code is composed by two distinct 4 digits subcodes: **AABB** where: **AA** Input type. **Range:** 0 ÷ 25 **BB** Control type and service functions. **Range:** 0 ÷ 21 **Notes: 1.** 10000 = Temporary value not inserted. **2.** The programmed codes will be activated only after both have been correctly be programmed. The order has no importance.	0	r/w

no.	Address		Description	Dec. Point	r/w
	Hex	Dec			
23A	17	23	**Second temporary code for fast configuration** The code is composed by two distinct 4 digits subcodes: **CDEF** where: **C** Alarm type 1. **Range:** 0 ÷ 9 **D** Alarm type 2. **Range:** 0 ÷ 9 **E** Alarm type 3. **Range:** 0 ÷ 9 **F** Enabling service functions. **Range:** 0 ÷ 4 **Notes: 1.** 10000 = Temporary value not inserted. **2.** The programmed codes will be activated only after both have been correctly be programmed. The order has no importance.	0	r/w
24A	18	24	**First final code for fast configuration** When programmed, the code is composed by two distinct 4 digits subcodes: **AABB** where: **AA** Input type. **Range:** 0 ÷ 25 **BB** Control type and service functions. **Range:** 0 ÷ 21 If not programmed, the return value is -1 (Code not programmed).	0	r
25A	19	25	**Second temporary code for speed configuration** When programmed, the code is composed by two distinct 4 digits subcodes: **CDEF** where: **C** Alarm type 1. **Range:** 0 ÷ 9 **D** Alarm type 2. **Range:** 0 ÷ 9 **E** Alarm type 3. **Range:** 0 ÷ 9 **F** Enabling service functions. **Range:** 0 ÷ 4 If not programmed, the return value is -1 (Code not programmed).	0	r
26A	1A	26	**Time to end of running program segment** **Range:** 0 ÷ 9959 (hh.mm or mm.ss) **Note:** When the program is not active, the return value is 0.	0	r
27A	1B	27	**Manual autotuning start request pending for od or Soft start** **Range: 0** No pending request waiting for the execution; **1** Pending request waiting for the execution.	0	r
28A	1C	28	**Autotuning start request pending for setpoint change for od or Soft start** **Range: 0** No pending request waiting for the execution; **1** Pending request waiting for the execution.	0	r
29A	1D	29	**Value to be retransmitted on the analogue output** **Range:** Ao1L ÷ Ao1H	0	r/w

6.2 Group of variables compatible with the old Ascon Tecnologic's instruments (before Kube series)

no.	Address		Description	Dec. Point	r/w
	Hex	Dec			
1B	0200	512	**PV : Measured value** As Modbus address 1	dp	r
2B	0201	513	**Number of decimal digits of the measured value** As Modbus address 2	0	r
3B	0202	514	**Power output** As Modbus address 4	2	r
4B	0203	515	**Power output of the heating output** **Range:** 0 ÷ 10000 (%)	2	r
5B	0204	516	**Power output of the cooling output** **Range:** 0 ÷ 10000 (%)	2	r
6B	0205	517	**Alarm 1 status** **0** OFF **1** ON	0	r
7B	0206	518	**Alarm 2 status** **0** OFF **1** ON	0	r
8B	0207	519	**Alarm 3 status** **0** OFF **1** ON	0	r
9B	0208	520	**Operative set point** As Modbus address 3	dp	r

no.	Address		Description	Dec. Point	r/w
	Hex	Dec			
10B	020A	522	**LBA alarm status** **0** OFF **1** ON	0	r
11B	020E	526	**Overload alarm status** **0** OFF **1** ON		
12B	020F	527	**Controller status** **0** Stand-by **1** Auto **2** Tuning **3** Manual	0	r
13B	0224	548	**Status/Remote control of the Output 1** **0** OFF **1** ON **Note:** This parameter is writeable when Out 1 is “not used” by the controller (o1F = nonE). This parameter is not stored.	0	r/w
14B	0225	549	**Status/Remote control of the Output 2** **0** OFF **1** ON **Note:** This parameter is writeable when out 2 is “not used” by the controller (o2F = nonE). This parameter is not stored (charged in RAM).	0	r/w
15B	0226	550	**Status/remote control of the Output 3** **0** OFF **1** ON **Note:** This parameter is writeable when out 3 is “not used” by the controller (o3F = nonE). This parameter is not stored (charged in RAM).	0	r/w
16B	0227	551	**Status/remote control of the Output 4** **0** OFF **1** ON **Note:** This parameter is writeable when out 4 is “not used” by the controller (o4F = nonE). This parameter is not stored (charged in RAM).	0	r/w
17B	0240	576	**Digital input 1 status** **0** OFF **1** ON **Note:** Digital input 1status can be read from the serial port even if the input is not used by the controller	0	r/w
18B	0241	577	**Digital input 2 status** **0** OFF **1** ON **Note:** Digital input 2 status can be read from the serial port even if the input is not used by the controller	0	r/w
19B	0244	580	**Program status** **0** Not configured **1** Reset (not running) **2** Run **3** Hold **4** Wait (system) **5** End (system) **6** Hold + Wait (system) **7** Continue	0	r/w
20B	0245	581	**Timer status** **0** Not configured **1** Reset (stop) **2** Run **3** Hold **4** End (Read only)	0	r/w
21B	0246	582	**Program step in execution** **0** Program not active **1** Ramp step 1 **2** Soak step 1 **3** Ramp step 2 **4** Soak step 2 **5** Ramp step 3 **6** Soak step 3 **7** Ramp step 4 **8** Soak step 4 **9** END	0	r

no.	Address		Description	Dec. Point	r/w
	Hex	Dec			
22B	0247	583	**Remaining time to program end** **Range:** 0 ÷ 65535 (**minutes** when Pru = hh.mm, **seconds** when Pru = mm.ss) **Note:** When the program is not running the return code is 0.	2	r
23B	248	584	**Program events status** 0 E1 = 0 E2 = 0 1 E1 = 1 E2 = 0 2 E1 = 0 E2 = 1 3 E1 = 1 E2 = 1	0	r
24B	249	585	**Remaining time to the timer end** **Range:** 0 ÷ 65535 (**hours** when Tru = hh.mm, **minutes** when Tru = mm.ss)	2	r
			0 ÷ 9959 (**tenth of seconds** when Tru = SSS.d) **Note:** When the timer is not active the return code is 0.	1	
25B	24A	586	**Wattmeter:** The meaning of this parameter is defined by the Co.ty parameter setting. Co.ty 0ff 0 Co.ty 1 Instantaneous power (kW); Co.ty 2 Consumed energy (kWh); Co.ty 3 Energy used during program execution (kWh); Co.ty 4/6 Total worked days; Co.ty 5/7 Total worked hours; Co.ty 8/10 Totalizer of control relay worked days; Co.ty 9/11 Totalizer of control relay worked hours.	0	r
26B	24B	587	**Duration of first program ramp** **Range:** 0 ÷ 9999 s	0	r
27B	24C	588	**Days counted with the controller Powered ON** **Range:** 0 ÷ 9999	0	r
28B	250	592	**Power output when the instrument is in manual mode** Range:-10000 ÷ 10000 (%)	2	r/w

6.3 Instrument identification parameters

no.	Address		Description	Dec. Point	r/w
	Hex	Dec			
Instrument identifier					
1	800	2048	**Reserved**	0	r
...	...	...	...	0	r
8	807	2055	**Reserved**	0	r
Instrument firmware revision - in ASCII format **Example: revision r4.35**					
9	808	2056	**Instrument Firmware Revision - First part** E.g.: 0x7234 - ‘ r4’	0	r
10	809	2057	**Instrument Firmware Revision - Second part** E.g.: 0x3335 - ‘35’	0	r
Product code					
11	80A	2058	**Model Code – Instrument type 1** **Range:** 0x4B = ‘K’	0	r
12	80B	2059	**Model Code – Instrument type 2** **Range:** 0x4D = ‘M’ - KM 0x52 = ‘R’ - KR 0x58 = ‘X’ - KX	0	r
13	80C	2060	**Model Code – Instrument type 3** **Range:** 0x31 = ‘1’ - KM1, KR1, KX1 0x33 = ‘3’ - KM3, KR3, KX3	0	r
14	80D	2061	**Model Code – Optional functions** **Range:** 0x2D = ‘-’ - No functions 0x54 = ‘T’ - Timer 0x50 = ‘P’ - Timer + Programmer	0	r
15	80E	2062	**Model Code – Power supply type** **Range:** 0x48 = ‘H’ - 110 ÷ 240 Vac/Vdc 0x4C = ‘L’ - 24 Vac/Vdc	0	r

no.	Address		Description	Dec. Point	r/w
	Hex	Dec			
16	80F	2063	**Model Code – Measure input type** **Range:** 0x43 = 'C' - Tc, Pt100, Pt1000, mA, mV, V + Digital Input 1 0x45 = 'E' - Tc, PTC, NTC, mA, mV, V + Digital Input 1	0	r
17	810	2064	**Model Code – Output 1 type** **Range:** 0x49 = 'I' - Analogue Output 0x4F = 'O' - SSR 0x52 = 'R' - Relay	0	r
18	811	2065	**Model Code – Output 2 type** **Range:** 0x2D = '-' - Not present 0x4D = 'M' – Servomotor command relay 0x4F = 'O' - SSR 0x52 = 'R' - Relay	0	r
19	812	2066	**Model Code – Output 3 type** **Range:** 0x2D = '-' - Not present 0x4D = 'M' – Servomotor command relay 0x4F = 'O' - SSR 0x52 = 'R' - Relay	0	r
20	813	2067	**Model Code – Output 4 type** **Range:** 0x43 = 'D' - Output 4 (VDC for SSR)/Sensor Power Supply/Digital Input DI2	0	r
21	814	2068	**Model Code – Serial communication type** **Range:** 0x2D = '-' - TTL 0x53 = 'S' - Rs485 Modbus	0	r
22	815	2069	**Model Code – Terminal type** **Range:** 0x2D = '-' - Standard (screw terminals not removable) 0x45 = 'E' - Removable screw terminals 0x4D = 'M' - Removable spring terminals 0x4E = 'N' - Removable terminals (the fixed part only)	0	r
23	816	2070	**Reserved**	0	r
...	...	...	...	0	r
38	825	2085	**Reserved**	0	r
Serial Number **Example: 1.237.422=0x12E1AE**					
39	826	2086	**Serial Number – First part (LL)** E.g.: 0x00AE	0	r
40	827	2087	**Serial Number – Second part (L)** E.g.: 0x00E1	0	r
41	828	2088	**Serial Number – Third part (H)** E.g.: 0x0012	0	r
42	829	2089	**Serial Number – Fourth part (HH)** E.g.: 0x0000	0	r
Calibration date **Example: 28 January 2016**					
43	82A	2090	**Calibration Date – Day** E.g.: 28	0	r
44	82B	2091	**Calibration Date – Month** E.g.: 01	0	r
45	82C	2092	**Calibration Date – Year** E.g.: 2016	0	r

6.4 Parameters Setting: Addresses form 280 hex (640 dec) and 2800 hex (10240 dec)

6.4.1 3 inP GROUP - Input parameters

no.	Param.	Address Hex	Address Dec	Description	Values	Dec. Point	r/w
1	SEnS	280 2800	640 10240	**Model C** (Pt100, Pt1000)	**0** TC J (-50 ÷ +1000°C/-58 ÷ +1832°F); **1** TC K (-50 ÷ +1370°C/-58 ÷ +2498°F); **2** TC S (-50 ÷ +1760°C/-58 ÷ +3200°F); **3** TC R (-50 ÷ +1760°C/-58 ÷ +3200°F); **4** TC T (-70 ÷ +400°C/-94 ÷ +752°F); **5** Exergen IRS J (-46 ÷ +785°C/-50 ÷ +1445°F); **6** Exergen IRS K (-46 ÷ +785°C/-50 ÷ +1445°F); **7** RTD Pt 100 (-200 ÷ +850°C/-328 ÷ +1562°F); **8** RTD Pt 1000 (-200 ÷ +500°C/-328 ÷ +932°F); **9** 0.60 0 ÷ 60 mV, **10** 12.60 12 ÷ 60 mV, **11** 0.20 0 ÷ 20 mA, **12** 4.20 4 ÷ 20 mA, **13** 0.5 0 ÷ 5 V, **14** 1.5 1 ÷ 5 V, **15** 0.10 0 ÷ 10 V, **16** 2.10 2 ÷ 10 V	0	r/W
				Model E (Ptc, Ntc)	**0** TC J (-50 ÷ +1000°C/-58 ÷ +1832°F); **1** TC K (-50 ÷ +1370°C/-58 ÷ +2498°F); **2** TC S (-50 ÷ +1760°C/-58 ÷ +3200°F); **3** TC R (-50 ÷ +1760°C/-58 ÷ +3200°F); **4** TC T (-70 ÷ +400°C/-94 ÷ +752°F); **5** Exergen IRS J (-46 ÷ +785°C/-50 ÷ +1445°F); **6** Exergen IRS K (-46 ÷ +785°C/-50 ÷ +1445°F); **7** PTC (-55 ÷ 150°C/-67 ÷ 302°F); **8** NTC (-50 ÷ 110°C/-58 ÷ 230°F); **9** 0.60 0 ÷ 60 mV, **10** 12.60 12 ÷ 60 mV, **11** 0.20 0 ÷ 20 mA, **12** 4.20 4 ÷ 20 mA, **13** 0.5 0 ÷ 5 V, **14** 1.5 1 ÷ 5 V, **15** 0.10 0 ÷ 10 V, **16** 2.10 2 ÷ 10 V		
2	dP	281 2801	641 10241	**Decimal point position (linear inputs)** **Decimal Point Position (sensors)**	0 ÷ 3 0/1	0	r/w
3	SSC	282 2802	642 10242	**Initial scale read-out for linear inputs**	-1999 ÷ 9999	dp	r/w
4	FSc	283 2803	643 10243	**Full Scale Readout for linear inputs**	-1999 ÷ 9999	dp	r/w
5	unit	284 2804	644 10244	**Measurement temperature unit**	**0** C = °C **1** F = °F	0	r/w
6	FiL	285 2805	645 10245	**Digital filter on the measured value** **Note:** This filter affects the control action, the PV retransmission and the alarms action.	**0** OFF 1 ÷ 200 (seconds)	1	r/w
7	inE	286 2806	646 10246	**Sensor error used to enable the safety output value**	**0** or: Over range **1** ou: Under range **2** our: Over and under range	0	r/w
8	oPE	287 2807	647 10247	**Safety output value in case of measurement error (% of the output)**	-100 ÷ 100	0	r/w
9	io4F	288 2808	648 10248	**I/O 4 function**	**0** on: Output used as PWS for TX, **1** out4: Output 4 (digital output 4), **2** dG2c: Digital input 2 driven by contact, **3** dG2U: Digital input 2 driven by voltage	0	r/w

no.	Param.	Address Hex	Address Dec	Description	Values	Dec. Point	r/w
10	diF1	289 2809	649 10249	**Digital Input 1 function**	**0** oFF = Not used, **1** Alarm reset, **2** Alarm acknowledge (ACK), **3** Hold of the measured value, **4** Stand by mode, **5** Manual mode, **6** HEAt with SP1 and CooL with SP2, **7** Timer RUN/Hold/Reset, **8** Timer Run, **9** Timer Reset, **10** Timer Run/Hold, **11** Timer Run/Reset, **12** Timer Run/Reset with lock, **13** Program Start, **14** Program Reset, **15** Program Hold, **16** Program Run/Hold, **17** Program Run/Reset, **18** Sequential SP selection, **19** SP1 - SP2 selection, **20** SP1 ÷ SP4 binary selection, **21** Digital inputs in parallel to ▲ and ▼ keys	0	r/w
11	diF2	28A 280A	650 10250	**Digital Input 2 function**		0	r/w
12	diA	31E 289E	798 10398	**Digital inputs action** **Note:** The addresses related to this parameter are inserted after the last parameter set [157] tSd2	**0** DI1 direct action, DI2 direct action; **1** DI1 reverse action, DI2 direct action; **2** DI1 direct action, DI2 reverse action; **3** DI1 reverse action, DI2 reverse action.		

6.4.2 OUt GROUP - Outputs parameters

no.	Param.	Address Hex	Address Dec	Description	Values	Dec. Point	r/w
13	oAt	28B 280B	651 10251	**Output 1 type** (when Out 1 is an analogue output KM3 only)	**0** 0-20: 0-20 mA **1** 4-20: 4-20 mA **2** 0-10: 0-10 V **3** 2-10: 2-10 V	0	r/w
14	oAF	28C 280C	652 10252	**Out 1 function** (when Out 1 is a linear output)	**0** NonE: Output not used **1** H.rEG: Heating output **2** c.rEG: Cooling output **3** r.inP: Measure retransmission **4** r.Err: Error (sp - PV) retransmission **5** r.SP: Set point retransmission **6** r.SEr: Serial value retransmission	0	r/w
				Out 1 function (when Out1 is a digital output)	**0** NonE: Output not used **1** H.rEG: Heating output **2** c.rEG: Cooling output **3** AL: Alarm output **4** t.out: Timer output **5** t.HoF: Timer out -OFF in hold **6** P.End: Program end indicator **7** P.HLd: Program hold indicator **8** P.uit: Program wait indicator **9** P.run: Program run indicator **10** P.Et1: Program Event 1 **11** P.Et2: Program Event 2 **12** or.bo: Out-of-range or burn out indicator **13** P.FAL: Power failure indicator **14** bo.PF: Out-of-range, burn out and Power failure indicator **15** St.bY: Stand by status indicator **16** diF.1: The output repeats the digital input 1 status **17** diF.2: The output repeats the digital input 2 status **18** on: Out 1 always ON		
15	Ao1L	28D 280D	653 10253	**Initial scale value of the analog retransmission** (K❑3 only)	-1999 ÷ Ao1H	dp	r/w
16	Ao1H	28E 280E	654 10254	**Full scale value of the analog retransmission** (K❑3 only)	Ao1L ÷ 9999	dp	r/w

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
17	o 1AL	28F 280F	655 10255	**Alarms linked up with the out 1**	0 ÷ 63 **+1** Alarm 1 **+2** Alarm 2 **+4** Alarm 3 **+8** Loop break alarm **+16** Sensor Break **+32** Overload on output 4	0	r/w
18	o 1Ac	290 2810	656 10256	**Out 1 action**	**0** dir: Direct action **1** rEU: Reverse action **2** dir.r: Direct with reversed LED **3** ReU.r: Reverse with reversed LED	0	r/w
19	o2F	291 2811	657 10257	**Out 2 function**	See the values of 13 = o1F parameter	0	r/w
20	o2AL	292 2812	658 10258	**Alarms linked up with the out 2**	See the values of 16 = o1AL parameter	0	r/w
21	o2Ac	293 2813	659 10259	**Out 2 action**	See the values of 17 = o1Ac parameter	0	r/w
22	o3F	294 2814	660 10260	**Out 3 function**	See the values of 13 = o1F parameter	0	r/w
23	o3AL	295 2815	661 10261	**Alarms linked up with the out 3**	See the values of 16 = o1AL parameter	0	r/w
24	o3Ac	296 2816	662 10262	**Out 3 action**	See the values of 17 = o1Ac parameter	0	r/w
25	o4F	297 2817	663 10263	**Out 4 function**	See the values of 13 = o1F parameter	0	r/w
26	o4AL	298 2818	664 10264	**Alarms linked up with the out 4**	See the values of 16 = o1AL parameter	0	r/w
27	o4Ac	299 2819	665 10265	**Out 4 action**	See the values of 17 = o1Ac parameter	0	r/w

6.4.3 AL 1 GROUP - Alarm 1 (AL1) parameters

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
28	AL 1t	29A 281A	666 10266	**Alarm 1 type**	**0** nonE: Alarm not used **1** LoAb: Absolute low alarm **2** HiAb: Absolute high alarm **3** LHAo: Windows alarm in alarm outside the windows **4** LHAI: Windows alarm in alarm inside the windows **5** SE.br: Sensor Break **6** LodE: Deviation low alarm (relative) **7** HidE: Deviation high alarm (relative) **8** LHdo: Relative band alarm in alarm out of the band **9** LHdi: Relative band alarm in alarm inside the band	0	r/w
29	Ab 1	29B 281B	667 10267	**Alarm 1 function**	0 ÷ 15 **+1** Not active at power up **+2** Latched alarm (manual reset) **+4** Acknowledgeable alarm **+8** Relative alarm not active at set point change	0	r/w
30	AL 1L	29C 281C	668 10268	- **For High and low alarms, AL1L is the low limit of the AL1 threshold;** - **For band alarm, AL1L is low alarm threshold**	From -1999 to AL1H (E.U.)	dp	r/w
31	AL 1H	29D 281D	669 10269	- **For High and low alarms, AL1H is the high limit of the AL1 threshold;** - **For band alarm, AL1H is high alarm threshold**	From AL1L to 9999 (E.U.)	dp	r/w
32	AL 1	29E 281E	670 10270	**AL1 threshold**	From AL1L to AL1H (E.U.)	dp	r/w
33	HAL 1	29F 281F	671 10271	**AL1 hysteresis**	1 ÷ 9999 (E.U.)	dp	r/w
34	AL 1d	2A0 2820	672 10272	**AL1 delay**	From 0 (oFF) to 9999 (s)	0	r/w
35	AL 1o	2A1 2821	673 10273	**Alarm 1 enabling during Stand-by mode and out of range conditions**	**0** Disabled during Stand by and out of range **1** Enabled in stand by mode **2** Enabled in out of range condition **3** Enabled in stand by mode and in over range	0	r/w

6.4.4 ²AL2 GROUP - Alarm 2 (AL2) parameters

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
36	AL2t	2A2 2822	674 10274	**Alarm 2 type**	**0** nonE: Alarm not used **1** LoAb: Absolute low alarm **2** HiAb: Absolute high alarm **3** LHAo: Windows alarm in alarm outside the windows **4** LHAI: Windows alarm in alarm inside the windows **5** SE.br: Sensor Break **6** LodE: Deviation low alarm (relative) **7** HidE: Deviation high alarm (relative) **8** LHdo: Relative band alarm in alarm out of the band **9** LHdi: Relative band alarm in alarm inside the band	0	r/w
37	Ab2	2A3 2823	675 10275	**Alarm 2 function**	0 ÷ 15 **+1** Not active at power up **+2** Latched alarm (manual reset) **+4** Acknowledgeable alarm **+8** Relative alarm not active at set point change	0	r/w
38	AL2L	2A4 2824	676 10276	- **For High and low alarms, AL2L is the low limit of the AL2 threshold;** - **For band alarm, AL2L is low alarm threshold**	From -1999 to AL2H (E.U.)	dp	r/w
39	AL2H	2A5 2825	677 10277	- **For High and low alarms, AL2H is the high limit of the AL2 threshold;** - **For band alarm, AL2H is high alarm threshold**	From AL2L to 9999 (E.U.)	dp	r/w
40	AL2	2A6 2826	678 10278	**AL2 threshold**	From AL2L to AL2H (E.U.)	dp	r/w
41	HAL2	2A7 2827	679 10279	**AL2 hysteresis**	1 ÷ 9999 (E.U.)	dp	r/w
42	AL2d	2A8 2828	680 10280	**AL2 delay**	From 0 (oFF) to 9999 (s)	0	r/w
43	AL2o	2A9 2829	681 10281	**Alarm 2 enabling during Stand-by mode and out of range conditions**	**0** Disabled during Stand by and out of range **1** Enabled in stand by mode **2** Enabled in out of range condition **3** Enabled in stand by mode and in over range	0	r/w

6.4.5 ²AL3 GROUP - Alarm 3 (AL3) parameters

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
44	AL3t	2AA 282A	682 10282	Alarm 3 type	**0** nonE: Alarm not used **1** LoAb: Absolute low alarm **2** HiAb: Absolute high alarm **3** LHAo: Windows alarm in alarm outside the windows **4** LHAI: Windows alarm in alarm inside the windows **5** SE.br: Sensor Break **6** LodE: Deviation low alarm (relative) **7** HidE: Deviation high alarm (relative) **8** LHdo: Relative band alarm in alarm out of the band **9** LHdi: Relative band alarm in alarm inside the band	0	r/w
45	Ab3	2AB 282B	683 10283	Alarm 3 function	0 ÷ 15 **+1** Not active at power up **+2** Latched alarm (manual reset) **+4** Acknowledgeable alarm **+8** Relative alarm not active at set point change	0	r/w
46	AL3L	2AC 282C	684 10284	- For High and low alarms, AL3L is the low limit of the AL3 threshold; - For band alarm, AL3L is low alarm threshold	From -1999 to AL3H (E.U.)	dp	r/w
47	AL3H	2AD 282D	685 10285	- For High and low alarms, AL3H is the high limit of the AL3 threshold; - For band alarm, AL3H is high alarm threshold	From AL3L to 9999 (E.U.)	dp	r/w
48	AL3	2AE 282E	686 10286	AL3 threshold	From AL3L to AL3H (E.U.)	dp	r/w
49	HAL3	2AF 282F	687 10287	AL3 hysteresis	1 ÷ 9999 (E.U.)	dp	r/w

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
50	AL3d	2B0 2830	688 10288	AL3 delay	From 0 (oFF) to 9999 (s)	0	r/w
51	AL3o	2B1 2831	689 10289	Alarm 3 enabling during Stand-by mode and out of range conditions	**0** Disabled during Stand by and out of range **1** Enabled in stand by mode **2** Enabled in out of range condition **3** Enabled in stand by mode and in over range	0	r/w

6.4.6 ?LbA GROUP - Loop Break Alarm Parameters

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
52	LbAt	2B2 2832	690 10290	LBA time	0 (oFF) ÷ 9999 (s)	0	
53	LbSt	2B3 2833	691 10291	Delta measure used by LBA during Soft start	0 (oFF) ÷ 9999 (E.U.)	dp	
54	LbAS	2B4 2834	692 10292	Delta measure used by LBA	1 ÷ 9999 (E.U.)	dp	
55	LbcA	2B5 2835	693 10293	Condition for LBA enabling	**0** uP: Active when Pout: 100% **1** dn: Active when Pout: -100% **2** both: Active in both cases	0	

6.4.7 ?rEG GROUP - Control Parameters

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
56	cont	2B6 2836	694 10294	**Control type:** when a heating and a cooling output are programmed.	**0** Pid: PID (heat and/or) **1** nr: Heat/Cool ON/OFF control with neutral zone	0	r/w
				Control type: when heating or cooling outputs are programmed and servo motor control cannot be programmed.	**0** Pid: PID (heat and/or) **1** On.FA: ON/OFF asymmetric hysteresis **2** On.FS: ON/OFF symmetric hysteresis		
				Control type: when programming heating or cooling outputs and servo motor control can be programmed.	**0** Pid: PID (heat and/or) **1** On.FA: ON/OFF asymmetric hysteresis **2** On.FS: ON/OFF symmetric hysteresis **3** nr: Heat/Cool ON/OFF control with neutral zone **4** 3Pt: 3 point servomotor control (no feedback)		
57	Auto	2B7 2837	695 10295	**Autotuning selection**	**-4** Oscillating autotune with automatic restart at power up and after all point change **-3** Oscillating autotune with manual start **-2** Oscillating tune with automatic start at 1st power up only **-1** Oscillating autotune with automatic restart at all power ups **0** Not used **1** Fast auto tuning with automatic restart at all power ups **2** Fast auto-tune with automatic start 1st power up only **3** FAST auto-tune with manual start **4** FAST auto-tune with automatic restart at power up and after a set point change **5** Evo-tune with automatic restart at every power up **6** Evo-tune with automatic start the first power up only **7** Evo-tune with manual start **8** Evo-tune with automatic restart at power up and after a set point change	0	r/w
58	tunEr	2B8 2838	696 10296	**Manual start of the Autotuning**	**0** oFF: Autotuning not active **1** on: Autotuning active	0	r/w
59		2B9 2839	697 10297	**Reserved**			
60	HSEt	2BA 283A	698 10298	**Hysteresis of the ON/OFF control**	0 ÷ 9999 (E.U.)	dp	
61	cPdt	2BB 283B	699 10299	**Time for compressor protection**	0 (oFF) ÷ 9999 (s)	0	r/w
62	Pb	2BC 283C	700 10300	**Proportional band**	1 ÷ 9999 (E.U.)	dp	
63	t i	2BD 283D	701 10301	**Integral time**	0 (oFF) ÷ 9999 (s)	0	r/w
64	td	2BE 283E	702 10302	**Derivative time**	0 (oFF) ÷ 9999 (s)	0	r/w

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
65	FuoC	2BF 283F	703 10303	**Fuzzy overshoot control**	0 ÷ 200	2	r/w
66	tcH	2C0 2840	704 10304	**Heating output cycle time**	10 ÷ 1300 (s)	1	r/w
67	rcG	2C1 2841	705 10305	**Power ratio between heating and cooling action**	1 ÷ 9999	2	r/w
68	tcc	2C2 2842	706 10306	**Cooling output cycle time**	1 ÷ 1300 (s)	1	r/w
69	rS	2C3 2843	707 10307	**Manual reset (Integral preload)**	-1000 ÷ +1000 (%)	1	r/w
70	Str.t	2C4 2844	708 10308	**Servomotor stroke time**	5 ÷ 1000 seconds	0	r/w
71	db.S	2C5 2845	709 10309	**Servomotor dead band**	0 ÷ 100%	1	r/w
72	od	2C6 2846	710 10310	**Delay at power up**	**0** oFF 1 ÷ 9959 (hh.mm)(+inF)	2	r/w
73	St.P	2C7 2847	711 10311	**Maximum power output used during soft start**	-100 ÷ 100 (%)	0	r/w
74	SSt	2C87 2848	712 10312	**Soft start time**	**0** oFF: Soft start not used 1 ÷ 759 (h.mm) 800 inF: Soft start always actie	2	r/w
75	SSEH	2C9 2849	713 10313	**Threshold for soft start disabling**	-2000 oFF -1999 ÷ 9999 (E.U.)	dp	r/w

6.4.8 2SP GROUP - Set point parameters

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
76	nSP	2CA 284A	714 10314	**Number of used set points**	1 ÷ 4	0	r/w
77	SPLL	2CB 284B	715 10315	**Minimum set point value**	From -1999 to SPHL	dp	r/w
78	SPHL	2CC 284C	716 10316	**Maximum set point value**	From SPLL to 9999	dp	r/w
79	SP	2CD 284D	717 10317	**Set point 1**	From SPLL to SPLH	dp	r/w
80	SP 2	2CE 284E	718 10318	**Set point 2**	From SPLL to SPLH	dp	r/w
81	SP 3	2CF 284F	719 10319	**Set point 3**	From SPLL to SPLH	dp	r/w
82	SP 4	2D0 2850	720 10320	**Set point 4**	From SPLL to SPLH	dp	r/w
83	RSP	2D1 2851	721 10321	**Selection of the active set point**	**0** SP **1** SP 2 **2** SP 3 **3** SP 4	0	r/w
84	SPrt	2D2 2852	722 10322	**Remote set point type**	**0** RSP: The value coming from serial link is used as remote set point **1** trin: The value will be added to the local set point selected by A.SP and the sum becomes the operative set point **2** PErc: The value will be scaled on the input range and this value will be used as remote SP	0	r/w
85	SPLr	2D3 2853	723 10323	**Local/remote set point selection**	**0** Loc: Local **1** rEn: Remote	0	r/w
86	SPu	2D4 2854	724 10324	**Rate of rise for POSITIVE set point change (ramp UP)**	1 ÷ 9999 Eng. units per minute 10000: inF	2	r/w
87	SPd	2D5 2855	725 10325	**Rate of rise for NEGATIVE set point change (ramp DOWN)**	1 ÷ 9999 Eng. units per minute 10000: inF	2	r/w

6.4.9 tim GROUP - Timer function parameters

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
88	trF	2D6 2856	726 10326	**Independent timer function**	**0** NonE: Timer not used **1** i.d.A: Delayed start timer **2** i.uP.d: Delayed start at power up **3** i.d.d: Feed-through timer **4** i.P.L: Asymmetrical oscillator with start OFF **5** i.L.P: Asymmetrical oscillator with start ON	0	r/w
89	tru	2D7 2857	727 10327	**Timer unit**	**0** hh.nn: Hours and minutes **1** nn.SS: Minutes and seconds **2** SSS.d: Second and tenth of seconds	0	r/w
90	tr.t1	2D8 2858	728 10328	**Time 1**	When tr.u = 0: 1 ÷ 9959 (hh.mm)	2	r/w
					When tr.u = 1: 1 ÷ 9959 (mm.ss)		
					When tr.u = 2: 1 ÷ 9959 (tenth of seconds)	1	
91	tr.t2	2D9 2859	729 10329	**Time 2**	When tr.u = 0: From 0 (oFF) to 9959 (inF) (hh.mm)	2	r/w
					When tr.u = 1: From 0 (oFF) to 9959 (inF) (mm.ss)		
					When tr.u = 2: From 0000 (oFF) to 9959 (inF) (tenth of seconds)	1	
92	tr.St	2DA 285A	730 10330	**Timer status**	**0** rES: Timer reset **1** run: Timer run **2** HoLd: Timer hold	0	r/w

6.4.10 Prg GROUP - Programmer function parameters

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
93	PrF	2DB 285B	731 10331	**Program action at power up**	**0** nonE: Programmer not used **1** S.uP.d: Start at power up with 1st step in stand-by **2** S.uP.S: Start at power up **3** u.diG: Start at Run command detection only **4** u.dG.d: Start at Run command with 1st s step in stand-by	0	r/w
94	Pru	2DC 285C	732 10332	**Time unit of the soaks**	**0** hh.nn: Hours and minutes **1** nn.SS: Minutes and seconds	0	r/w
95	PrE	2DD 285D	733 10333	**Instrument behaviour at the end of the program execution**	**0** cnt: Continue **1** A.SP: Go to the set point selected by A.SP **2** St.by: Go to stand-by mode	0	r/w
96	PrEt	2DE 285E	734 10334	**Time of the end program indication**	**0** OFF 1 to 9959 minutes and seconds inF: Always ON.	2	r/w
97	Pr.S1	2DF 285F	735 10335	**Set point of the first soak**	From SPLL to SPHL -8000 Program End	dp	r/w
98	Pr.G1	2E0 2860	736 10336	**Gradient of the first ramp**	1 ÷ 9999 Engineering Unit/minute 10000 inF: Step transfer	1	r/w
99	Pr.t1	2E1 2861	737 10337	**Time of the 1st soak**	0 ÷ 9959 Time unit of the soaks	2	r/w
100	Pr.b1	2E2 2862	738 10338	**Wait band of the 1st soak**	**0** OFF 1 to 9999 (E.U.)	0	r/w
101	Pr.E1	2E3 2863	739 10339	**Events of the 1st group**	0000 ÷ 1111	2	r/w
102	Pr.S2	2E4 2864	740 10340	**Set point of the 2nd soak**	From SPLL to SPHL -8000 Program End	dp	r/w
103	Pr.G2	2E5 2865	741 10341	**Gradient of the 2nd ramp**	1 ÷ 9999 Engineering Unit/minute 10000 inF: Step transfer	1	r/w
104	Pr.t2	2E6 2866	742 10342	**Time of the 2nd soak**	0 ÷ 9959 Time unit of the soaks	2	r/w
105	Pr.b2	2E7 2867	743 10343	**Wait band of the 2nd soak**	**0** OFF 1 to 9999 (E.U.)	0	r/w
106	Pr.E2	2E8 2868	744 10344	**Events of the 2nd group**	0000 ÷ 1111	2	r/w
107	Pr.S3	2E9 2869	745 10345	**Set point of the 3rd soak**	From SPLL to SPHL -8000 Program End	dp	r/w

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
108	Pr.G3	2EA 286A	746 10346	**Gradient of the 3rd ramp**	1 ÷ 9999 Engineering Unit/minute 10000 inF: Step transfer	1	r/w
109	Pr.t3	2EB 286B	747 10347	**Time of the 3rd soak**	0 ÷ 9959 Time unit of the soaks	2	r/w
110	Pr.b3	2EC 286C	748 10348	**Wait band of the 3rd soak**	**0** OFF 1 to 9999 (E.U.)	0	r/w
111	Pr.E3	2ED 286D	749 10349	**Events of the 3rd group**	0000 ÷ 1111	2	r/w
112	Pr.S4	2EE 286E	750 10350	**Set point of the 4th soak**	From SPLL to SPHL -8000 Program End	dp	r/w
113	Pr.G4	2EF 286F	751 10351	**Gradient of the 4th ramp**	1 ÷ 9999 Engineering Unit/minute 10000 inF: Step transfer	1	r/w
114	Pr.t4	2F0 2870	752 10352	**Time of the 4th soak**	0 ÷ 9959 Time unit of the soaks	2	r/w
115	Pr.b4	2F1 2871	753 10353	**Wait band of the 4th soak**	**0** OFF 1 to 9999 (E.U.)	0	r/w
116	Pr.E4	2F2 2872	754 10354	**Events of the 4th group**	0000 ÷ 1111	2	r/w
117	Pr.St	2F3 2873	755 10355	**Program status**	**0** rES: Program reset **1** run: Program start **2** HoLd: Program hold	0	r/w

6.4.11 ³PAn GROUP - Operator HMI parameters

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
118	PAS2	2F4 2874	756 10356	**Level 2 password (limited access level)**	oFF (Level 2 not protected by password) 1 ÷ 200	0	r/w
119	PAS3	2F5 2875	757 10357	**Level 3 password (complete configuration level)**	3 ÷ 200	0	r/w
120	PAS4	2F6 2876	758 10358	**Level 4 password (CODE configuration level)**	201 ÷ 400	0	r/w
121	uSrb	2F7 2877	759 10359	**button function during RUN TIME**	**0** nonE: No function **1** tunE: Auto-tune enabling **2** oPLo: Manual mode **3** AAc: Alarm reset **4** ASi: Alarm acknowledge **5** chSP: Sequential set point selection **6** St.by: Stand by mode **7** Str.t: Timer run/hold/reset **8** P.run: Program run **9** P.rES: Program reset **10** P.r.H.r: Program run/hold/reset	0	r/w
122	d iSP	2F8 2878	760 10360	**Display management**	**0** nonE: Standard display **1** Pou: Power output **2** SPF: Final set point **3** Spo: Operative set point **4** AL1: Alarm 1 threshold **5** AL2: Alarm 2 threshold **6** AL3: Alarm 3 threshold **7** Pr.tu: During a soak, the instrument shows the soak elapsed time; **8** Pr.td: During a soak, the instrument shows the soak remaining time (count down). **9** P.t.tu: The display shows the total elapsed time of the program **10** P.t.td: The display shows the program total remaining time (count down) **11** ti.uP: The display shows the timer counting up **12** ti.du: The display shows the timer counting down **13** PErc: Percent of the power output used during soft start **14** Pos: Servomotor valve position		r/w

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
123	dicL	2F9 2879	761 10361	**Display colour (note)**	**0** The display colour changes to signal the actual deviation (PV - SP) **1** Display red (fix) **2** Display green (fix) **3** Display orange (fix)		
124	AdE	2FA 287A	762 10362	**Deviation for display colour management (note)**	1 ÷ 9999	Dp	r/w
125	diSt	2FB 287B	763 10363	**Display Timeout**	**0** oFF (display always ON) 1 ÷ 9959 (mm.ss)	2	r/w
126	FiLd	2FC 287C	764 10364	**Filter on the displayed value**	**0** oFF (filter disabled) 0.01 ÷ 20.0 (s)	Dp	r/w
127	bGF	2FD 287D	765 10365	**Bar graph Function (KX3 only)**	**0** nonE: Bargraph not lit **1** Pou: PID Output power **2** Po.h: Energy Used (kWh) **3** Pr.tu: Elapsed time of the program in execution **4** Pr.td: Time to end of the program in execution **5** Pr.tS: Time to end of the program segment in execution **6** ti.uP: Elapsed time of timer (T1 and T2) **7** ti.du: Time to end of timer (T1 and T2) **8** r.iSP: Time to preventive maintenance	0	r/w
128	dSPu	2FE 287E	766 10366	**Instrument status at power ON**	**0** AS.Pr: Starts in the same way it was prior to the power down **1** Auto: Starts in Auto mode **2** oP.0: Starts in manual mode with a power output equal to zero **3** St.bY: Starts in stand-by mode	0	r/w
129	oPrE	2FF 287F	767 10367	**Operative modes enabling**	**0** ALL: All modes are selectable by oPEr parameter **1** Au.oP: Auto and manual (oPLo) mode are selectable by oPEr parameter **2** Au.Sb: Auto and Stand-by modes are selectable by parameter oPEr	0	r/w
130	oPEr	300 2880	768 10368	**Operative mode selection**	**0** Auto: Auto mode **1** oPLo: Manual mode **2** St.bY: Stand by mode	0	r/w

Note: Not available on those controllers with white display.

6.4.12 SEr GROUP - Serial link parameters

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
131	Add	301 2881	769 10369	**Instrument address**	**0** oFF (serial communication not used) 1 ÷ 254	0	r/w
132	bAud	302 2882	770 10370	**baud rate**	**0** 1200: 1200 baud **1** 2400: 2400 baud **2** 9600: 9600 baud **3** 19.2: 19200 baud **4** 38.4: 38400 baud	0	r/w
133	trSP	303 2883	771 10371	**Selection of the value to be retrans-mitted (Master)**	**0** nonE: Retransmission not used (the instrument is a slave) **1** rSP: The instrument is a Master and retransmits the operative set point **2** PErc: The instrument is a Master and retransmits the power output	0	r/w

6.4.13 PCOn group - Consumption parameters

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
134	CoTy	304 2884	772 10372	**Measurement type**	**0** oFF: Not used **1** Instantaneous power (kW) **2** Power consumption (kW/h) **3** Energy used during program execution. This measure starts from 0 when a program runs and stops at the end of the program. A new program execution resets the value **4** Total worked days with threshold. It is the number of hours that the instrument is turned ON divided for 24 **5** Total worked hours with threshold. It is the number of hours that the instrument is turned ON **6** Total worked days with threshold: number of hours the instrument is turned ON divided by 24, the controller is forced in stand-by when Co.ty value reaches the threshold set in [137] h.Job **7** Total worked hours with threshold: number of hours that the instrument is turned ON, the controller is forced in stand-by when Co.ty value reaches the threshold set in [137] h.Job **8** Totalizer of control relay worked days: number of hours the control relay has been in ON condition, divided by 24 **9** Totalizer of control relay worked hours: number of hours the control relay has been in ON condition **10** Totalizer of control relay worked days with threshold: number of hours the control relay has been in ON condition divided by 24, the controller is forced in stand-by when Co.ty value reaches the threshold set in [137] h.Job **11** Totalizer of control relay worked hours with threshold: number of hours the control relay has been in ON condition, the controller is forced in stand-by when Co.ty value reaches the threshold set in [137] h.Job.	0	r/w
135	UoLt	305 2885	773 10373	**Nominal Voltage of the load**	1 ÷ 9999 (V)	0	r/w
136	cur	306 2886	774 10374	**Nominal current of the load**	1 ÷ 999 (A)	0	r/w
137	h.Job	307 2887	775 10375	**Threshold of the working period**	**0** oFF: Not used 1 ÷ 999 days (when [134] Coty = 4); 1 ÷ 999 hour (when [134] Coty = 5).	0	r/w
138	t.Job	308 2888	776 10376	**Worked time (not resettable)**	0 ÷ 9999	0	r

6.4.14 PCAL GROUP - User calibration parameters

no.	Param.	Address		Description	Values	Dec. Point	r/w
		Hex	Dec				
139	AL.P	309 2889	777 10377	**Adjust Low Point**	From -1999 to (AH.P - 10) (E.U.)	dp	r/w
140	AL.o	30A 288A	778 10378	**Adjust Low Offset**	-300 ÷ +300 (E.U.)	dp	r/w
141	AH.P	30B 288B	779 10379	**Adjust High Point**	From (AL.P + 10) ÷ 9999 (E.U.)	dp	r/w
142	AH.o	30C 288C	780 10380	**Adjust High Offset**	-300 ÷ +300 (E.U.)	dp	r/w

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