# Serial communication protocol
# ModBUS® for KM1E/KR1E

## This document is related to the firmware version FW4_2_0

# KM1E/KR1E COMMUNICATION PROTOCOL

## INDEX

# 1 PREFACE

Ascon Tecnologic uses the ModBUS® RTU communication protocol. It is a royalty free protocol easy to be implemented.

For the ModBus RTU protocol exists a vast literature, available also in internet.

The ModBus protocol represent all data in hexadecimal format.

All communication strings finish with a check sum type CRC (Cyclic Redundancy Check).

All devices on a line must have different addresses.

The protocol allows one master only and up to 255 slaves

Only the Master unit can start the transmission by sending on the physical line the address of the slave and the command that is to be executed. Only the unit having the called address will answer to the master. While at rest, the instruments are in a receive condition and are switched to transmission after a correct message has been decoded that matches the configured address.

The transmission characteristics are usually programmable:

Device address: From 1 to 255.

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 K□1E allows 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 K□1E 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.

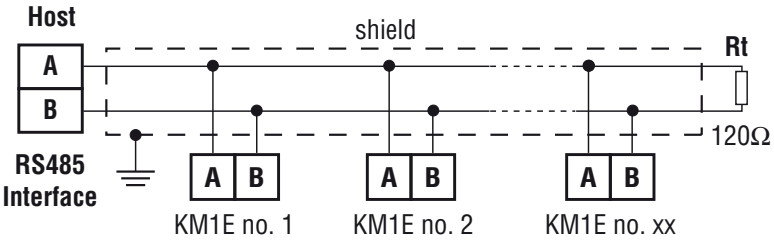
To connect the Kube series controller to a supervision Personal Computer an RS485/RS232 converter/adaper must be provided.

## 2.2 Line

Each instrument is equipped with 2 terminals named **A** and **B**.

The connection between Kubes has to be carried on in parallel, i.e. all **A** terminals have to be connected between them so as **B** terminals.

A termination resistor of 120Ω (Rt) is required to maintain the quiescent condition on the line.




Adopted baud rates range 1200... 38400 baud, that is very satisfactory for application performances, yet very slow for RS485 interface. This fact allows the wiring of the line with a medium quality twisted pair cable: total capacity of the line should not exceed 200 nF. The line can be up to 1000 meters long.

# 3 COMMUNICATION PROTOCOL

The protocol adopted by Kube series is a subset of the widely used MODBUS RTU (JBUS, AEG Schneider Automation, Inc. registered trademark) protocol, so that connections are easy for many commercial PLCs and supervisory programs.

For users that need to develop their own communication software, all information is available as well as implementation hints.

The MODBUS RTU (JBUS) communication functions implemented in Kube series are:

Function 3 Read n register;
Function 6 Preset one register;
Function 16 Preset multiple registers.

These functions allow the supervisory program to read and modify any data of the controller. The communication is based on messages sent by the master station (host) to the slave stations (K□1E) and viceversa. The slave station that recognises the message as sent to it, analyses the content and, if it is formally and semantically correct, generates a reply message directed back to the master.

The communication process involves five types 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) |

Each message contains four fields:

◊ Slave address (1... 255): MODBUS RTU (JBUS) reserves address 0 for broadcasting messages and it is implemented in the Kube series;

◊ Function code: contains 3, 6 or 16 for specified functions;

◊ Fnformation 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 CRC16.

The characteristics of the asyncronous transmission are 8 bits, no parity, one stop bit.

## 3.1 Function code 3: read multiple registers (maximum 16 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... 255) | 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... 255) | 1 |
| Function code (3) | 1 |
| Byte number (n) | 1 |
| Data(s) | 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 byte]: 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 address 1 the value of the locations 25 and 26 (0x19 and 0x1A).

| 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 |
| Byte number | 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 location 25 = 10 (0x000A hexadecimal)

The value of the location 26 = 20 (0x0014 hexadecimal)

## 3.2 Function code 6: write a single word (one location)

| 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 (1-255) | 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 Slave 1 to write in the memory 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 |

## 3.3 Function code 16: preset multiple registers (maximum 16 registers)

This function code allows to preset 16 registers at a time.

| Master request | |
|---|---|
| Data | Byte (Hex) |
| 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 |
| Byte count | 1 |
| Values | n |
| CRC-16 (LSB) | 1 |
| CRC-16 (MSB) | 1 |

| Slave reply | |
|---|---|
| Data | Byte (Hex) |
| 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 Slave 1 to write in the registers 10314 (0x284A) and 10315 (0x284B) the values 100 (0x64) and 200 (oxC8)

| 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 |
| | |
| | |
| | |
| | |
| | |

## 3.4 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 | 1 |
| Error code | 1 |
| CRC-16 (LSB) | 1 |
| CRC-16 (MSB) | 1 |

Kube series adopts a subset of MODBUS RTU (JBUS) exception code:

– Unknown function code 1
– Invalid memory address 2
– Invalid data field 3
– Controller not ready 6

## 3.5 Cyclic redundancy check (CRC)

CRC is a check word that permits to verify the integrity of a message.

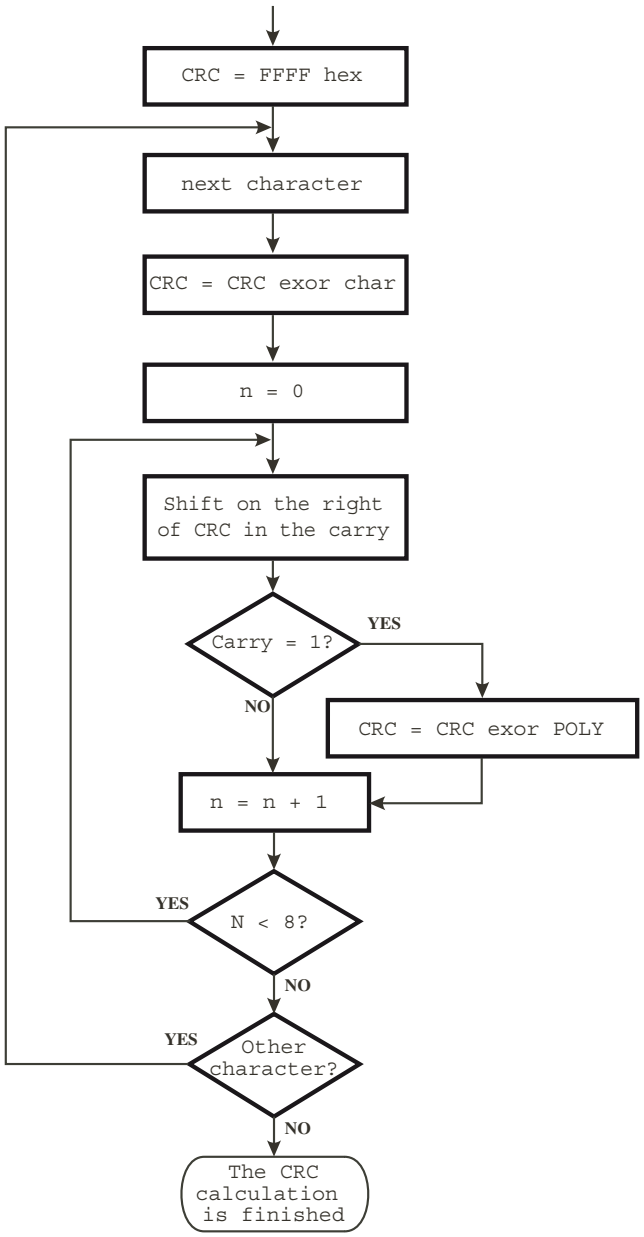
Every message, sent or received, has in the two last characters the CRC check word.

After receiving a request, the controller checks the validity of the received message comparing the received CRC with the calculated one.

When a 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.

Being MODBUS RTU (JBUS) compatible, Kube series controllers adopt an identical algorithm for CRC calculation, sketched in following diagram:




The polinomial adopted by MODBUS RTU (JBUS) is 1010 0000 0000 0001.

**Note:**The first transmitted character of the CRC word is the least significant between calculated bytes.

Follows a subrutine made with “C” able to calculate the CTC-16.

```
/* ----------------------------------------------------------------
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 DATA EXCHANGE

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

## 4.1 Some definitions

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 represents the value of a quantity (e.g. the measured variable, the set point).

Symbolic data represents a particular value in a set of values.

Both types are coded as integers number : signed numbers for numerical and unsigned numbers for symbolic.

A numerical data, coded as an integer, is coupled with appropriate number of decimal digits to represent a quantity with the same engineering units adopted aboard the instrument.

Numerical data are in fixed point representation; however we make a distinction between two kinds of data:

◊ The first kind has determined and unmodifiable decimal point position;

◊ The second has programmable decimal point position (dP parameter).

## 4.2 Memory zones

All readable and writable data appear to be allocated as 16 bit words in the memory of the instrument.

The memory map has three zones:

◊ Varaibles,

◊ Parameters,

◊ Instrument identification code.

Following parameters explore the characteristics of each zone.

## 4.3 Variables zones

In this zone there is a collection of main Kube controller variables, it is a group of frequently computed or updated data residing in volatile memory.

## 4.4 Most important changes

**A)** During parameter modification by push-button, the serial interface continue to operate without any “limit” (you can see by serial link the value of all parameters and you can set it also).

**B)** When you write a value in a location the instrument will operate as follows:

- **B.1)** If you write a value within parameter range, the instrument will accept it; the new value will be memorized and the instrument will send back the standard answer.
- **B.2)** If you try to write a value OUT of parameter range, the instrument will refuse the new value; the new value will NOT be memorized and the instrument will send an exception message to the master.

These are available data:

# 5 ADDRESS MAP

All Kube instruments use only words:

| Initial address | | Final address | | Meaning |
|---|---|---|---|---|
| Hex | Dec | Hex | Dec | |
| 1 | 1 | 1D | 29 | Group of variables common to all new Ascon Tecnologic's instruments: numeric values calculated and dinamically 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): numeric values calculated and dinamically 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 |
| 2800 | 10240 | 289B | 10395 | Repetition of the configuration parameters: Numeric and symolic values. Available in read and write operations |

## 5.1 Common Variables

| no. | Address | | Description | Dec. Point | r/w |
|---|---|---|---|---|---|
| | Hex | Dec | | | |
| 1A | 1 | 1 | **PV: Measured value**<br>**Note:** When a measuring error is detected the instrument sends:<br>• 10000 = Underrange<br>• 10000 = Overrange<br>• 10001 = Overflow of the A/D converter<br>• 10003 = Variable not available | | r |
| 2A | 2 | 2 | **Number of decimal figures of the measured value** | 0 | r |
| 3A | 3 | 3 | **Operative set point (value)** | dP | r |
| 4A | 4 | 4 | **Power output**<br>**Range:** -100.00 ÷ +100.00 (%)<br>**Note:** This parameter is ever writeable but it will be active only when the instrument operate in Manual mode. | 2 | r/w |
| 5A | 5 | 5 | **Active set point selection**<br>0 SP<br>1 SP 2 | | r/w |
| 6A | 6 | 6 | **SP**<br>**Range:** SPLL ÷ SPLH | dP | r/w |
| 7A | 7 | 7 | **SP 2**<br>**Range:** SPLL ÷ SPLH | dP | r/w |
| 10A | A | 10 | **Alarms status**<br>bit 0 = Alarm 1 status<br>bit 1 Alarm 2 status<br>bit 2 Alarm 3 status<br>bit 3 ÷ 8 Reserved<br>bit 9 LBA status<br>bit 10 Power failure indicator<br>bit 11 Generic error<br>bit 12 Overload alarm<br>bit 13 ÷15 Reserved | 0 | r |
| 11A | B | 11 | **Outputs status (physical outputs)**<br>bit 0 = Output 1 status<br>bit 1 Output 2 status<br>bit 3 Output 3 status<br>bit 4 Output 4 status<br>bit 5÷15 Reserved<br>When an output is driven by serial link, the relative bit remains equal to 0. | 0 | r |
| 12A | C | 12 | **Instrument status**<br>bit 0 Automatic<br>bit 1 Manual<br>bit 2 Standby<br>bit 3 Remote Set point (temporary) used<br>bit 4 Auto-tuning active<br>bit 5 Self tuning active<br>bit 6÷7 Reserved<br>bit 8 Soft start running<br>bit 9 Ramp for set point change (up or down) running<br>bit 10 Delay at start up (od) running<br>bit 11 Reserved<br>bit 12 Measure status (0 = OK while 1 = error).<br>bit 13÷15 Reserved | 0 | r |

| no. | Address | | Description | Dec. Point | r/w |
|---|---|---|---|---|---|
| | Hex | Dec | | | |
| 13A | D | 13 | **Alarms reset**<br>0 Not resetted<br>1 Resetted | 0 | r/w |
| 14A | E | 14 | **Alarms acknowledge**<br>0 Not acknowledge<br>1 acknowledge | 0 | r/w |
| 15A | F | 15 | **Control status**<br>0 Automatic<br>1 Manual<br>2 Stand-by | 0 | r/w |
| 19A | 13 | 19 | **Default parameters loading.**<br>-481 = Default parameter loading | 0 | r/w |
| 20A | 14 | 20 | **Parameters table identification code**<br>**Range:** 0 ÷ 65535<br>**Note:** The word is composed by two parts:<br>- Low byte – Version of the parameter table<br>- High byte – Version of the family protocol | 0 | r |
| 21A | 15 | 21 | **Instrument identification code**<br>20 KM1/KM3 (KM1E)<br>25 KX1/KX3<br>26 KR1/KR3 (KR1E) | 0 | r |
| 22A | 31 | 49 | **Control mode**<br>0 Heat<br>1 Cool<br>2 H/C | 0 | r/W |

## 5.2 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**<br>As Modbus address 1 | dP | r |
| 2B | 0201 | 513 | **Number of decimal figure of the measured value**<br>As Modbus address 2 | 0 | r |
| 3B | 0202 | 514 | **Power output**<br>As Modbus address 4 | 2 | r |
| 4B | 0203 | 515 | **Power output of the heating output**<br>**Range:** 0 ÷ 100.00 (%) | 2 | r |
| 5B | 0204 | 516 | **Power output of the cooling output**<br>**Range:** 0 ÷ 100.00 (%) | 2 | r |
| 6B | 0205 | 517 | **Alarm 1 status**<br>0 OFF<br>1 ON | 0 | r |
| 7B | 0206 | 518 | **Alarm 2 status**<br>0 OFF<br>1 ON | 0 | r |
| 8B | 0207 | 519 | **Alarm 3 status**<br>0 OFF<br>1 ON | 0 | r |
| 9B | 0208 | 520 | **Operative set point**<br>As Modbus address 3 | DP | r |
| 11B | 020E | 526 | **Overload alarm status**<br>0 OFF<br>1 ON | | |
| 12B | 020F | 527 | **Controller status**<br>0 Stand-by<br>1 Auto<br>2 Tuning<br>3 Manual | 0 | r |
| 13B | 0224 | 548 | **Status/remote control of the Output 1**<br>0 OFF<br>1 ON<br>**Note:** This parameter is writeable when out 1 is "not used" by the controller (o1F output 1 function = nonE). This parameter is stored in RAM | 0 | r/w |

| no. | Address | | Description | Dec. Point | r/w |
|---|---|---|---|---|---|
| | Hex | Dec | | | |
| 14B | 0225 | 549 | **Status/remote control of the Output 2**<br>0 OFF<br>1 ON<br>**Note:** This parameter is writeable when out 2 is “not used” by the controller (o2F output 1 function = nonE). This parameter is stored in RAM | 0 | r/w |
| 15B | 0226 | 550 | **Status/remote control of the Output 3**<br>0 OFF<br>1 ON<br>**Note:** This parameter is writeable when out 3 is “not used” by the controller (o3F output 1 function = nonE). This parameter is stored in RAM | 0 | r/w |
| 16B | 0227 | 551 | **Status/remote control of the Output 4**<br>0 OFF<br>1 ON<br>This parameter is writeable when out 4 is “not used” by the controller (o4F output 1 function = nonE). This parameter is stored in RAM | 0 | r/w |
| 17B | 0240 | 576 | **Digital input 1 status**<br>0 OFF<br>1 ON<br>**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**<br>0 OFF<br>1 ON<br>**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 | **Reserved** | | |
| 20B | 0245 | 581 | **Reserved** | | |
| 21B | 0246 | 582 | **Reserved** | | |
| 22B | 0247 | 583 | **Reserved** | | |
| 23B | 248 | 584 | **Reserved** | | |
| 24B | 249 | 585 | **Reserved** | | |
| 25B | 24A | 586 | **Wattmeter:**<br>The meaning of this parameter is defined by the CO.ty parameter setting.<br>CO.ty = OFF 0<br>CO.ty = 1 Instantaneous power (kW);<br>CO.ty = 2 Consumed energy (kWh);<br>CO.ty = 3 Reserved;<br>CO.ty = 4/6 Total worked days;<br>CO.ty = 5/7 Total worked hours;<br>CO.ty = 8/10 Totalizer of control relay worked days;<br>CO.ty = 9/11 Totalizer of control relay worked hours. | 0 | r |
| 26B | 24B | 587 | **Reserved** | | |
| 28B | 250 | 592 | **Power output when the instrument is in manual mode**<br>Range:-10000 ÷ 10000 (%) | 2 | r/w |

## 5.3 Instrument identification parameters

| no. | Address | | Description | Dec. Point | r/w |
|---|---|---|---|---|---|
| | Hex | Dec | | | |
| 1 | 800 | 2048 | **Reserved** | 0 | r |
| 2 | 801 | 2049 | **Reserved** | 0 | r |
| 3 | 802 | 2050 | **Reserved** | 0 | r |
| 4 | 803 | 2051 | **Reserved** | 0 | r |
| 5 | 804 | 2052 | **Reserved** | 0 | r |
| 6 | 805 | 2053 | **Reserved** | 0 | r |
| 7 | 806 | 2054 | **Reserved** | 0 | r |
| 8 | 807 | 2055 | **Reserved** | 0 | r |
| 9 | 808 | 2056 | Instrument Firmware Revision - First part | 0 | r |
| 10 | 809 | 2057 | Instrument Firmware Revision - Second part | 0 | r |
| 11 | 80A | 2058 | Model Code – Instrument type 1<br>**Range:** 0x4B = ‘K’ | 0 | r |

| no. | Address | | Description | Dec. Point | r/w |
|---|---|---|---|---|---|
| | Hex | Dec | | | |
| 12 | 80B | 2059 | Model Code – Instrument type 2<br>**Range:** 0x4D = 'M' - KM<br>0x52 = 'R' - KR<br>0x58 = 'X' - KX | 0 | r |
| 13 | 80C | 2060 | Model Code – Instrument type 3<br>**Range:** 0x31 = '1' - KM1, KR1, KX1<br>0x33 = '3' - KM3, KR3, KX3 | 0 | r |
| 14 | 80D | 2061 | Model Code – Optional functions<br>**Range:** 0x2D = '-' - No functions | 0 | r |
| 15 | 80E | 2062 | Model Code – Power supply type<br>**Range:** 0x48 = 'H' - 110 ÷ 240 Vac/Vdc<br>0x4C = 'L' - 24 Vac/Vdc | 0 | r |
| 16 | 80F | 2063 | Model Code – Measure input type<br>**Range:** 0x43 = 'D' - Pt100, Pt1000, mA, mV, V, Tc + Digital Input 1<br>0x45 = 'P' - PTC, NTC, mA, mV, V, Tc + Digital Input 1 | 0 | r |
| 17 | 810 | 2064 | Model Code – Output 1 type<br>0x4F = 'O' - SSR<br>0x52 = 'R' - Relay | 0 | r |
| 18 | 811 | 2065 | Model Code – Output 2 type<br>**Range:** 0x2D = '-' - Not present<br>0x4F = 'O' - SSR<br>0x52 = 'R' - Relay | 0 | r |
| 19 | 812 | 2066 | Model Code – Output 3 type<br>**Range:** 0x2D = '-' - Not present<br>0x4F = 'O' - SSR<br>0x52 = 'R' - Relay | 0 | r |
| 20 | 813 | 2067 | Model Code – Output 4 type<br>**Range:** 0x43 = 'D' - Output 4 (VDC for SSR)/Sensor Power Supply/Digital Input DI2 | 0 | r |
| 21 | 814 | 2068 | Model Code – Serial communication type<br>**Range:** 0x2D = '-' - TTL<br>0x53 = 'S' - Rs485 Modbus | 0 | r |
| 22 | 815 | 2069 | Model Code – Terminal type<br>**Range:** 0x2D = '-' - Standard (screw terminals not removable)<br>0x45 = 'E' - Removable screw terminals<br>0x4D = 'M' - Removable spring terminals<br>0x4E = 'N' - Removable terminals (the fixed part only) | 0 | r |
| 23 | 816 | 2070 | **Model Code – Reserved** | 0 | r |
| 24 | 817 | 2071 | **Model Code – Reserved** | 0 | r |
| 25 | 818 | 2072 | **Model Code – Reserved** | 0 | r |
| 26 | 819 | 2073 | **Model Code – Reserved** | 0 | r |
| 27 | 81A | 2074 | **Model Code – Reserved** | 0 | r |
| 28 | 81B | 2075 | **Model Code – Reserved** | 0 | r |
| 29 | 81C | 2076 | **Model Code – Reserved** | 0 | r |
| 30 | 81D | 2077 | **Model Code – Reserved** | 0 | r |
| 31 | 81E | 2078 | **Model Code – Reserved** | 0 | r |
| 32 | 81F | 2079 | **Model Code – Reserved** | 0 | r |
| 33 | 820 | 2080 | **Model Code – Reserved** | 0 | r |
| 34 | 821 | 2081 | **Model Code – Reserved** | 0 | r |
| 35 | 822 | 2082 | **Model Code – Reserved** | 0 | r |
| 36 | 823 | 2083 | **Model Code – Reserved** | 0 | r |
| 37 | 824 | 2084 | **Model Code – Reserved** | 0 | r |
| 38 | 825 | 2085 | **Model Code – Reserved** | 0 | r |
| 39 | 826 | 2086 | Serial Number – First part (LL) | 0 | r |
| 40 | 827 | 2087 | Serial Number – Second part (L) | 0 | r |
| 41 | 828 | 2088 | Serial Number – Third part (H) | 0 | r |
| 42 | 829 | 2089 | Serial Number – Fourth part (HH) | 0 | r |
| 43 | 82A | 2090 | Calibration Date – Day<br>**Range:** 1 ÷ 31 | 0 | r |
| 44 | 82B | 2091 | Calibration Date – Month<br>**Range:** 1 ÷ 12 | 0 | r |
| 45 | 82C | 2092 | Calibration Date – Year | 0 | r |

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

### 5.4.1 inP GROUP - Main and auxiliary input configuration

| no. | Param. | Address | | Description | Values | Dec. Point | r/w |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| 1 | node | 280<br>2800 | 640<br>10240 | Operative mode selection | 1 Heat (SP on Out1) or Cool (SP2 on Out1),<br>2 Heat (SP on Out1) or Cool (SP2 on Out2),<br>3 Heat (SP on Out1) and Cool (SP2 on Out2),<br>4 Heat (SP on Out1) or Cool (SP2 on Out2) or Heat (SP on Out1) and Cool (SP2 on Out2),<br>5 Heat (SP on Out1) or Cool (SP on Out1),<br>6 Heat (SP on Out1) or Cool (SP on Out2),<br>7 Heat (SP on Out1) and Cool (SP on Out2),<br>8 Heat (SP on Out1) or Cool (SP on Out2) or Heat (SP on Out1) and Cool (SP on Out2). | 0 | r/w |
| 2 | SEnS | 281<br>2801 | 641<br>10241 | Model D (Pt100, Pt1000) | 0 J = TC J,<br>1 crAL = TC K,<br>2 S = TC S,<br>3 r = TC R,<br>4 t = TC T,<br>5 ir.J = IRS J,<br>6 ir.cA = IRS K,<br>7 Pt1 = RTD Pt100,<br>8 Pt10 = RTD Pt1000,<br>9 0.60 = 0... 60 mV,<br>10 12.60 = 12... 60 mV,<br>11 0.20 = 0... 20 mA,<br>12 4.20 = 4... 20 mA,<br>13 0.5 = 0... 5 V,<br>14 1.5 = 1... 5 V,<br>15 0.10 = 0... 10 V,<br>16 2.10 = 2... 10 V | 7 | r/W |
| | | | | Model P (Ptc, Ntc) | 0 J = TC J,<br>1 crAL = TC K,<br>2 S = TC S,<br>3 r = TC R,<br>4 t = TC T,<br>5 ir.J = IRS J,<br>6 ir.cA = IRS K,<br>7 Ptc = PTC KTY81-121,<br>8 ntc = NTC 103-AT2,<br>9 0.60 = 0... 60 mV,<br>10 12.60 = 12... 60 mV,<br>11 0.20 = 0... 20 mA,<br>12 4.20 = 4... 20 mA,<br>13 0.5 = 0... 5 V,<br>14 1.5 = 1... 5 V,<br>15 0.10 = 0... 10 V,<br>16 2.10 = 2... 10 V | 7 | |
| 3 | dp | 282<br>2802 | 642<br>10242 | Decimal Point Position (linear inputs)<br>Decimal Point Position (different than linear inputs) | 0... 3<br>0/1 | 0 | r/w |
| 4 | SSC | 283<br>2803 | 643<br>10243 | Initial scale read-out for linear inputs | -1999... 9999 | dP | r/w |
| 5 | FSc | 284<br>2804 | 644<br>10244 | Full Scale Readout for linear inputs | -1999... 9999 | dP | r/w |
| 6 | unit | 285<br>2805 | 645<br>10245 | Engineering unit | 0 C = °C<br>1 F = °F | 0 | r/w |
| 7 | Fil | 286<br>2806 | 646<br>10246 | Digital filter on the measured value<br>**Note:** This filter affects the control action, the PV retransmission and the alarms action. | 0 OFF<br>1... 200 (seconds) | 1 | r/w |
| 8 | IO4.F | 287<br>2807 | 647<br>10247 | I/O 4 function | 0 on = Output used as PWS for TX<br>1 out4 = Output 4 (digital output 4)<br>2 dG2c = Digital input 2 driven by contact<br>3 dG2U = Digital input 2 driven by voltage | 0 | r/w |

| no. | Param. | Address Hex | Address Dec | Description | Values | Dec. Point | r/w |
|---|---|---|---|---|---|---|---|
| 9 | diF1 | 288<br>2808 | 648<br>10248 | Digital Input 1 function | 0 oFF = Not used<br>1 Alarm reset<br>2 Alarm acknowledge (ACK)<br>3 Hold of the measured value<br>4 Stand by mode (transition)<br>5 Stand by mode (status)<br>6 HEAt with SP1 and CooL with SP2 (transition)<br>7 HEAt with SP1 and CooL with SP2 (status) | 0 | r/w |
| 10 | diF2 | 289<br>2809 | 649<br>10249 | Digital Input 2 function | | 0 | r/w |
| 11 | di.A | 28A<br>280A | 650<br>10250 | Digital Inputs Action | 0 DI1 direct action, DI2 direct action<br>1 DI1 reverse action, DI2 direct action<br>2 DI1 direct action, DI2 reverse action<br>3 DI1 reverse action, DI2 reverse action | 0 | r/w |

### 5.4.2 Out group

| no. | Param. | Address Hex | Address Dec | Description | Values | Dec. Point | r/w |
|---|---|---|---|---|---|---|---|
| 12 | o1.Ac | 28D<br>280D | 653<br>10253 | Out 1 action | 0 dir = Direct action<br>1 rEU = Reverse action<br>2 dir.r = Direct with reversed LED<br>3 ReU.r = Reverse with reversed LED | | r/w |
| 13 | o2F | 28E<br>280E | 654<br>10254 | Out 2 function | 0 nonE = Output not used<br>1 AL = Alarm output<br>2 or.bo = Out-of-range or burn out indicator<br>3 P.FAL = Power failure indicator<br>4 bo.PF = Out-of-range, Burnout and Power failure indicator<br>5 St.By = Standby status indicator<br>6 on = Out2 always ON<br>7 riSP = Inspection request | | r/w |
| 14 | o2AL | 28F<br>280F | 655<br>10255 | Alarms linked up with out 2 | 0... 15<br>+1 Alarm 1<br>+2 Alarm 2<br>+4 Sensor break (burn out)<br>+8 Overload on Out4 (short circuit on Out4) | | r/w |
| 15 | o2.Ac | 290<br>2810 | 656<br>10256 | Out 2 action | 0 dir = Direct action<br>1 rEU = Reverse action<br>2 dir.r = Direct with reversed LED<br>3 ReU.r = Reverse with reversed LED | | r/w |
| 16 | o3F | 291<br>2811 | 657<br>10257 | Out 3 function | 0 nonE = Output not used<br>1 AL = Alarm output<br>2 or.bo = Out-of-range or burn out indicator<br>3 P.FAL = Power failure indicator<br>4 bo.PF = Out-of-range, Burnout and Power failure indicator<br>5 St.By = Standby status indicator<br>6 on = Out3 always ON<br>7 riSP = Inspection request | | r/w |
| 17 | o3AL | 292<br>2812 | 658<br>10258 | Alarms linked up with out 3 | 0... 15<br>+1 Alarm 1<br>+2 Alarm 2<br>+4 Sensor break (burn out)<br>+8 Overload on Out4 (short circuit on Out4) | | r/w |
| 18 | o3Ac | 293<br>2813 | 659<br>10259 | Out 3 action | 0 dir = Direct action<br>1 rEU = Reverse action<br>2 dir.r = Direct with reversed LED<br>3 ReU.r = Reverse with reversed LED | | r/w |
| 19 | o4F | 294<br>2814 | 660<br>10260 | Out 4 function | 0 nonE = Output not used<br>1 AL = Alarm output<br>2 or.bo = Out-of-range or burn out indicator<br>3 P.FAL = Power failure indicator<br>4 bo.PF = Out-of-range, Burnout and Power failure indicator<br>5 riSP = Inspection request | 0 | r/w |
| 20 | o4AL | 295<br>2815 | 661<br>10261 | Alarms linked up with out 4 | 0... 15<br>+1 Alarm 1<br>+2 Alarm 2<br>+4 Sensor break (burn out)<br>+8 Overload on Out4 (short circuit on Out4) | 0 | r/w |
| 21 | o4Ac | 296<br>2816 | 662<br>10262 | Out 4 action | 0 dir = Direct action<br>1 rEU = Reverse action<br>2 dir.r = Direct with reversed LED<br>3 ReU.r = Reverse with reversed LED | 0 | r/w |

### 5.4.3 AL1 group

| no. | Param. | Address | | Description | Values | Dec. Point | r/w |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| 22 | AL1t | 297<br>2817 | 663<br>10263 | Alarm 1 type | 0 nonE = Alarm not used<br>1 LoAb = Absolute low alarm<br>2 HiAb = Absolute high alarm<br>3 LHAo = Windows alarm in alarm outside the windows<br>4 LHAI = Windows alarm in alarm inside the windows<br>5 SE.br = Sensor Break | | r/w |
| 23 | Ab1 | 298<br>2818 | 664<br>10264 | Alarm 1 function | 0... 7<br>+1 Not active at power up<br>+2 Latched alarm (manual reset)<br>+4 Acknowledgeable alarm | | r/w |
| 24 | AL1L | 299<br>2819 | 665<br>10265 | - For High and low alarms, it is the low limit of the AL1 threshold;<br>- For band alarm, it is low alarm threshold | From -1999 to AL1H (E.U.) | dP | r/w |
| 25 | AL1H | 29A<br>281A | 666<br>10266 | - For High and low alarms, it is the high limit of the AL1 threshold;<br>- For band alarm, it is the high alarm threshold | From AL1L to 9999 (E.U.) | dP | r/w |
| 26 | AL1 | 29B<br>281B | 667<br>10267 | AL1 threshold | From AL1L to AL1H (E.U.) | dP | r/w |
| 27 | HAL1 | 29C<br>281C | 668<br>10268 | AL1 hysteresis | 1... 9999 (E.U.) | dP | r/w |
| 28 | AL1d | 29D<br>281D | 669<br>10269 | AL1 delay | 0 oFF<br>1... 9999 (s) | 0 | r/w |
| 29 | AL1o | 29E<br>281E | 670<br>10270 | Alarm 1 enabling during Stand-by mode and out of range conditions | 0 Alarm 1 disabled during Stand by and out of range<br>1 Alarm 1 enabled in stand by mode<br>2 Alarm 1 enabled in out of range condition<br>3 Alarm 1 enabled in stand by mode and in over range condition | 0 | r/w |

### 5.4.4 AL2 group

| no. | Param. | Address | | Description | Values | Dec. Point | r/w |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| 31 | AL2t | 29F<br>281F | 671<br>10272 | Alarm 2 type | 0 nonE = Alarm not used<br>1 LoAb = Absolute low alarm<br>2 HiAb = Absolute high alarm<br>3 LHAo = Windows alarm in alarm outside the windows<br>4 LHAI = Windows alarm in alarm inside the windows<br>5 SE.br = Sensor Break | | r/w |
| 32 | Ab2 | 2A0<br>2820 | 672<br>10272 | Alarm 2 function | 0... 7<br>+1 Not active at power up<br>+2 Latched alarm (manual reset)<br>+4 Acknowledgeable alarm | | r/w |
| 33 | AL2L | 2A1<br>2821 | 673<br>10273 | - For High and low alarms, it is the low limit of the AL2 threshold;<br>- For band alarm, it is low alarm threshold | From -1999 to AL2H (E.U.) | dP | r/w |
| 34 | AL2H | 2A2<br>2822 | 674<br>10274 | - For High and low alarms, it is the high limit of the AL2 threshold;<br>- For band alarm, it is the high alarm threshold | From AL2L to 9999 (E.U.) | dP | r/w |
| 35 | AL2 | 2A3<br>2823 | 675<br>10275 | AL2 threshold | From AL2L to AL2H (E.U.) | dP | r/w |
| 36 | HAL2 | 2A4<br>2824 | 676<br>10276 | AL2 hysteresis | 1... 9999 (E.U.) | dP | r/w |
| 37 | AL2d | 2A5<br>2825 | 677<br>10277 | AL2 delay | 0 oFF<br>1... 9999 (s) | 0 | r/w |
| 38 | AL2o | 2A6<br>2826 | 678<br>10278 | Alarm 2 enabling during Stand-by mode and out of range conditions | 0 Alarm 1 disabled during Stand by and out of range<br>1 Alarm 1 enabled in stand by mode<br>2 Alarm 1 enabled in out of range condition<br>3 Alarm 1 enabled in stand by mode and in over range condition | 0 | r/w |

### 5.4.5 rEG group - Control Parameters

| no. | Param. | Address | | Description | Values | Dec. Point | r/w |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| 39 | HSt.H | 2A7<br>2827 | 679<br>10279 | Hysteresis of the Heating action | 1... 9999 Engineering units | | |
| 40 | HSt.C | 2A8<br>2828 | 680<br>10280 | Hysteresis of the Cooling action | 1... 9999 Engineering units | | |
| 41 | od | 2A9<br>2829 | 681<br>10281 | Delay at power up | 0.00 oFF<br>0.01... 99.59 (hh.mm) | 2 | r/w |

### 5.4.6 SP group - Set point parameters

| no. | Param. | Address | | Description | Values | Dec. Point | r/w |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| 41 | SPLL | 2AA<br>282A | 682<br>10282 | Minimum set point value | From -1999 to SPHL | dP | r/w |
| 42 | SPHL | 2AB<br>282B | 683<br>10283 | Maximum set point value | From SPLL to 9999 | dP | r/w |
| 43 | SP | 2AC<br>282C | 684<br>10284 | Set point 1 | From SPLL to SPLH | dP | r/w |
| 44 | SP 2 | 2AD<br>282D | 685<br>10285 | Set point 2 | From SPLL to SPLH | dP | r/w |
| 45 | SP.u | 2AE<br>282E | 686<br>10286 | Rate of rise for **POSITIVE** set point change (ramp UP) | 0.01... 99.99 Eng. units per minute<br>inF Ramp disabled (step transfer) | 2 | r/w |
| 46 | SP.d | 2AF<br>282F | 687<br>10287 | Rate of rise for **NEGATIVE** set point change (ramp DOWN) | 0.01... 99.99 Eng. units per minute<br>inF Ramp disabled (step transfer) | 2 | r/w |

### 5.4.7 PAn group - Operator HMI parameters

| no. | Param. | Address | | Description | Values | Dec. Point | r/w |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| 47 | PAS2 | 2B0<br>2830 | 688<br>10288 | Level 2 password (limited access level) | - oFF (Level 2 not protected by password)<br>- 1... 200 | 0 | r/w |
| 48 | PAS3 | 2B1<br>2831 | 689<br>10289 | Level 3 password (complete configuration level) | 3... 200 | 0 | r/w |
| 49 | uSrb | 2B2<br>2832 | 690<br>10290 | ↻ button function during RUN TIME | 0 nonE = No function<br>1 AAc = Alarm reset<br>2 ASi = Alarm acknowledge<br>3 St.by = Stand by mode<br>4 1H.2C = Heat with SP1 or Cool with SP2 without Standby<br>5 Hc.Sb = Heat or Cool or Standby | 0 | r/w |
| 50 | diSP | 2B3<br>2833 | 691<br>10291 | Secondary display management | 0 nonE = Standard display<br>1 Pou = Power output<br>2 SP1 = Set point 1<br>3 SP2 = Set Point 2<br>4 SPo = Operative Set point (changes the Set point displayed according to the action in progress H or C)<br>5 AL1 = Alarm 1 threshold<br>6 AL2 = Alarm 2 threshold | | r/w |
| 51 | di.St | 2B4<br>2834 | 692<br>10292 | Display Timeout | 0 oFF (display always ON)<br>1... 9959 (mm.ss) | 2 | r/w |
| 52 | fiLd | 2B5<br>2835 | 693<br>10293 | Filter on the displayed value | 0 oFF (filter disabled)<br>1... 100 | Dp | r/w |
| 53 | dSPu | 2B6<br>2836 | 694<br>10294 | Instrument status at power ON | 0 AS.Pr = Starts in the same way it was prior to the power down<br>1 Auto = Starts in Auto mode<br>2 St.bY = Starts in stand-by mode | 0 | r/w |
| 54 | oPEr | 2B7<br>2837 | 695<br>10295 | Operative mode selection | 0 Auto = Auto mode<br>1 St.bY = Stand by mode | 0 | r/w |

### 5.4.8 Ser group - Serial link parameters

| no. | Param. | Address | | Description | Values | Dec. Point | r/w |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| 55 | Add | 2B8<br>2838 | 696<br>10296 | Instrument address | 0 oFF (Serial interface not used)<br>1... 254 | 0 | r/w |
| 56 | bAud | 2B9<br>2839 | 697<br>10297 | baud rate | 0 1200 = 1200 baud<br>1 2400 = 2400 baud<br>2 9600 = 9600 baud<br>3 19.2 = 19200 baud<br>4 38.4 = 38400 baud | 0 | r/w |

### 5.4.9 COn group - Consumption parameters

| no. | Param. | Address | | Description | Values | Dec. Point | r/w |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| 57 | Co.tY | 2BA<br>283A | 698<br>10298 | Measurement type | 0 oFF = Not used<br>1 Total worked days: no. of hours the instrument is turned ON divided by 24<br>2 Total worked hours: no. of hours that the instrument is turned ON<br>3 Total worked days with threshold: no. of hours the instrument is turned ON divided by 24<br>4 Total worked hours with threshold: no. of hours that the instrument is turned ON<br>5 Totalizer of control relay worked days: no. of hours the control relay has been in ON condition, divided by 24<br>6 Totalizer of control relay worked hours: no. of hours the control relay has been in ON condition<br>7 Totalizer of control relay worked days with threshold: no. of hours the control relay has been in ON condition divided by 24<br>8 Totalizer of control relay worked hours with threshold: no. of hours the control relay has been in ON condition | 0 | r/w |
| 58 | h.Job | 2BB<br>283B | 699<br>10299 | Threshold of the working period | 0 oFF<br>0 1... 9999 | 0 | r/w |
| 59 | t.Job | 2BC<br>283C | 700<br>10300 | Worked time (not resettable) | 0... 9999 | 0 | r |

### 5.4.10 CAl group - User calibration parameters

| no. | Param. | Address | | Description | Values | Dec. Point | r/w |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| 60 | AL.P | 2BD<br>283D | 701<br>10301 | Adjust Low Point | From -1999 to (AH.P - 10) (E.U.) | dP | r/w |
| 61 | AL.o | 2BE<br>283E | 702<br>10302 | Adjust Low Offset | -300... +300 (E.U.) | dP | r/w |
| 62 | AH.P | 2BF<br>283F | 703<br>10303 | Adjust High Point | From (AL.P + 10)... 9999 (E.U.) | dP | r/w |
| 63 | AH.o | 2C0<br>2840 | 704<br>10304 | Adjust High Offset | -300... +300 (E.U.) | dP | r/w |

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