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MODBUS PROTOCOL FOR K2P TEMPERATURE CONTROLLER / PROGRAMMER

Valid from Version nr. 0 of product's firmware

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This document complies with ENG.417E
The first page of this document is for R&D use only.
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Communication Software Revision 0

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Introduction

This document is derived from Eng.901E. All differences are shaded (on Rev 0 only)

This half-duplex protocol accepts one master and one slave. or more slaves
The physical interface is of the RS232 type without hardware handshake.

Transmission format

The protocol uses the RTU (Remote terminal unit) mode of transmission.
RTU is a binary method with byte format composed as follows:

Serial data for device in CPI mode
(The CPI mode can be forced by keyboard or connecting CPI)
Address = 255
Baud rate = 9600
Byte format = 1 start bit, 8 data bit without parity,1 stop bit

Otherwise
Address = As configured by P97
Baud rate = As configured by P98
Byte format = 1 start bit, as configured by P99,1 stop bit

Communication procedure

Only the master unit can initiate the communication; the slave units can transmit only after a query has been received from the master.
The general format for the transmission from master to slave is the following:

RANGE	BYTE
Slave address	1
Function code	1
Data	n
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

The slave detects the start of a query frame when the delay time between two characters is greater than 3.5 T.U. (Time Unit = Time necessary to transmit one character).

Error check (CRC-16 Cyclical Redundancy Check)

The CRC-16 value is calculated by the transmitting device. This value is appended to the message. The receiving device recalculates a CRC-16 and compares the calculated value to the received value. The two values must be equal.
The CRC-16 is started by first pre-loading a 16-bit register to all 1's. Then a process begins of applying successive the bytes of the message to the current contents of the register.
Only the eight bits of data in each character are used for generating the CRC-16. Start and stop bits, and the parity bit if one is used, do not apply to the CRC-16.
During generation of the CRC-16, each byte is exclusive ORed with the register contents. Then the result is shifted to the right, with a zero filled into the most significant bit (MSB) position. If the LSB was a 1, the register is then exclusive ORed with a preset, fixed value. If the LSB was a 0, no exclusive OR takes place.
This process is repeated until eight shifts have been performed. After the last shift, the next byte is exclusive ORed with the register's current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the characters of the message have been applied, are the CRC-16 value.

A procedure for generating a CRC-16 is:

1) Load a 16-bit register (CRC-16 register) with FFFFh (all 1's).

2) Exclusive OR the first byte of the message with the low byte of the CRC-16 register. Put the result in the CRC-16 register.

3) Shift the CRC-16 register one bit to the right (toward the LSB), zero-filling the MSB. Extract and examine the LSB.

4) (If the LSB was 0): Repeat Step 3 (another shift).
(If the LSB was 1): Exclusive OR the CRC-16 register with the polynomial value A001h (1010 0000 0000 0001b).

5) Repeat Steps 3 and 4 until 8 shifts have been performed. When this is done, a complete byte will have been processed.

6) Repeat Steps 2 through 5 for the next byte of the message.
Continue doing this until all bytes have been processed.

7) The final contents of the CRC-16 register is the CRC-16 value.

When the CRC-16 (16 bytes) is transmitted in the message, the low byte will be transmitted first, followed by the high byte.

An example of a C language function performing CRC generation is shown below.

```
/* ----------------------------------------------------------------
crc_16         calculate the crc_16 error check field

Input parameters:
  buffer: string to calculate CRC
  length: bytes number of the string

This function returns the CRC value.
---------------------------------------------------------------- */
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

The numerical values present in this text are expressed as:
Binary values if they are followed by b
Decimal values if they are not followed by any letter
Hexadecimal values if they are followed by h

Function code 3 and 4: Words reading

These function codes are used by the master unit to read a consecutive group of words (16 bit) which contain the value of the variable of the slave unit.
The master can require a maximum of 10 words at a time.

Request from master to slave	
Range	Byte
Slave address (1-255)	1
Function code (03-04)	1
Word starting address (high byte)	1
Word starting address (low byte)	1
Number of word (high byte)	1
Number of word (low byte)	1
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

Reply from slave to master	
Range	Byte
Slave address (1-255)	1
Function code (03-04)	1
Byte count (n)	1
Data	n
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

The "Data" field contains the requested words in the following format: high bytes of the first word, low byte of the first word, high byte of the second word, and so on.
The "Data" field contains 8000h for not implemented addresses or for information not relevant in the actual device configuration.

Example:
Ask to slave the value of 3 words (3h) starting from word 178 (B2h)

Request from master to slave	
Range	Byte
Slave address	FFh
Function code	03h
Word starting address (high byte)	00h
Word starting address (low byte)	B2h
Number of words (high byte)	00h
Number of words (low byte)	03h
Error check (CRC-16) (low byte)	B0h
Error check (CRC-16) (high byte)	32h

Reply from slave to master	
Range	Byte
Slave address	FFh
Function code	03h
Byte count	06h
Data	FFh
Data	9Ch
Data	80h
Data	00h
Data	05h
Data	5Ah
Error check (CRC-16) (low byte)	xxh
Error check (CRC-16) (high byte)	xxh

The 6 bytes in "Data" field (FFh, 9Ch, 80h, 00h, 05h, 5Ah) are 3 words whose meaning is:

word 178 value = -100 (FF9Ch)
word 179 value = not implemented or not relevant (8000h)
word 180 value = 1370 (55Ah)

Function code 6: Single word writing

By using this command, the master unit can change the value of one word (16 bit) of the slave unit.

Command from master to slave	
Range	Byte
Slave address (0*-255)	1
Function code (06)	1
Word address (high byte)	1
Word address (low byte)	1
Data	2
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

Reply from slave to master	
Range	Byte
Slave address (0*-255)	1
Function code (06)	1
Word address (high byte)	1
Word address (low byte)	1
Data	2
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

* To use the address 0, see note 9 (“Broadcast” address) in the “Notes” section.

The 8000h value, present in the "data" field, should be considered as a don’t care value, that is, the value present in the device at this address will not be modified.

Example:
Set word 2006 (7D6h) of the slave with value 1250 (4E2h)

Command from master to slave	
Range	Byte
Slave address	FFh
Function code	06h
Word address (high byte)	07h
Word address (low byte)	D6h
Data	04h
Data	E2h
Error check (CRC-16) (low byte)	FEh
Error check (CRC-16) (high byte)	11h

Reply from slave to master	
Range	Byte
Slave address	FFh
Function code	06h
Word address (high byte)	07h
Word address (low byte)	D6h
Data	04h
Data	E2h
Error check(CRC-16) (low byte)	FEh
Error check (CRC-16) (high byte)	11h

Function code 8: Diagnostic

By using this command, the master unit can check the communication system to Slaves.

Request from master to slave	
Range	Byte
Slave address (1-255)	1
Function code (08)	1
Sub-function (high byte)	1
Sub-function (low byte)	1
Data	2
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

Reply from slave to master	
Range	Byte
Slave address (1-255)	1
Function code (08)	1
Sub-function (high byte)	1
Sub-function (low byte)	1
Data	2
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

The Sub-function code will not be processed by Slave, any code is accept.
The Sub-function code and data passed in the request is returned (looped back) in the slave replay. The entire replay message is identical to the request

Example:

Request from master to slave	
Range	Byte
Slave address	FFh
Function code	08h
Sub-function (high byte)	00h
Sub-function (low byte)	00h
Data	55h
Data	AAh
Error check (CRC-16) (low byte)	4Ah
Error check (CRC-16) (high byte)	FAh

Reply from slave to master	
Range	Byte
Slave address	FFh
Function code	08h
Sub-function (high byte)	00h
Sub-function (low byte)	00h
Data	55h
Data	AAh
Error check (CRC-16) (low byte)	4Ah
Error check (CRC-16) (high byte)	FAh

Function code 16: Multiple words writing

This function code is used by the master unit to write a consecutive group of words.
The master unit can change a maximum of 10 words at a time.

Command from master to slave	
Range	Byte
Slave address (0*-255)	1
Function code (16)	1
Word starting address (high byte)	1
Word starting address (low byte)	1
Number of words (high byte)	1
Number of words (low byte)	1
Byte counter	1
Data	n
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

Reply from slave to master	
Range	Byte
Slave address (0*-255)	1
Function code (16)	1
Word starting address (high byte)	1
Word starting address (low byte)	1
Number of words (high byte)	1
Number of words (low byte)	1
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

* To use the address 0, see note 9 (“Broadcast” address) in the “Notes” section.

The data imposed for read only words will be ignored.
The command will be processed starting from the first word and it will be executed or not executed depending on the actual device status.
At the first error found, the command will be aborted and the slave will answer with an error.
The 8000h value, present in the "data" field, should be considered as a don’t care value, this is, the value present in the device at this address will not be modified.

Example:
Set words 1301 (515h), 1302 (516h), 1303 (517h) of the slave with 300 (12Ch), don’t care (8000h) and 200 (C8h) values.

Command from master to slave	
Range	Byte
Slave address	FFh
Function code	10h
Word starting address(high byte)	05h
Word starting address (low byte)	15h
Number of words (high byte)	00h
Number of words (low byte)	03h
Byte counter	06h
Data	01h
Data	2Ch
Data	80h
Data	00h
Data	00h
Data	C8h
Error check (CRC-16) (low byte)	08h
Error check (CRC-16) (high byte)	F7h

Reply from slave to master	
Range	Byte
Slave address	FFh
Function code	10h
Word starting address (high byte)	05h
Word starting address (low byte)	15h
Number of words (high byte)	00h
Number of words (low byte)	03h
Error check (CRC-16) (low byte)	xxh
Error check (CRC-16) (high byte)	xxh

Error replay

If the "error check" is wrong or the function code is not implemented or a buffer over flows has been received, the slave does not send any reply to the master.
If other errors are detected in the request or command frame, or the slave cannot reply with the requested values or it cannot accept the requested sets because it is in error condition, the slave replies by forcing at "1" the bit 7 of the "Function code" byte followed by an error code.

Error reply (from slave to master):

RANGE	BYTE
Slave address	1
Function code (+80h)	1
Error code	1
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

List of error codes:

ERROR Nr.	DESCRIPTION
2	Illegal data address
3	Illegal data value
9	Illegal number of data required
10	The word indicated cannot be modified

Note

1. Device communication parameter

When connected with CPI or forced in CPI mode by keyboard, the device is always set with the following parameters:

Address	255
Baud rate	9600
Bits	8
Parity	None

In other case the device is set in according to P97-P98-P99 parameters

2. Words format

All the parameters are represented by words.
Every time the information transfer is performed by using 2 bytes (1 word of 16 bits), the first byte transmitted is the most significant one. For the negative numbers the "two complement" format is used.

3. Reply time

The slave will start to send a reply from 3.5 T.U. to 700 ms after the end of the incoming frame detected by counting the received bytes.

4. Decimal digits

The decimal point that may be present in the value is ignored.

Example:
The value 204.6 is transmitted as 2046 (07FEh)
The value -12.50 is transmitted as -1250 (FB1Eh)

5. Device status

When the factory com cable is inserted into device connector the device go automatically into checked configuration mode.

6. Parameters reading and writing mode.

Two different mode to accept data are allowed:

a) **Checked mode**
<u>This is the unique method available in operative mode</u>
This method must be advised like the normal method of reading and writing.
The flow chart in the following pages show the rules applied by the device in reading and writing mode.

In writing mode if the data is accepted, it is stored into EEPROM and the device change, if required, the content of the other parameters correlated with itself.
(I.e.: If the input type (P1) is changed, the device changes, if needed, the value of setpoint limits, the range values, the alarm threshold).
Therefore, after each change, the user program must reread the current value of all parameters or at least those that they could be changed.
This mode is selected by the word 153.

b) **Unchecked mode**

The flow chart in the following pages show the rules applied by the device in reading and writing mode.
In writing mode no test is done on the incoming data and no change is performed on correlated parameters.
This mode is selected by the word 153.

This mode must be used only with data formerly checked and only in Configuration mode.

It is faster than the precedent, it don't require a defined sequence of download and it could be used for example for download the formerly file, built and saved by the configuration program.

7. Test of the parameters.

The correctness of the stores data could be done on application request

Sending a request of reading the content of word 152, it is ordered to the device to effect a check of correctness of the all parameters.
If the result of the check is correct the content of the word will be 0 otherwise it will be equal to the modbus address of the first wrong parameter found.

The execution of these test results important:

- At starting time, when the device is connected to the factory com, to verify that the received data don't require corrections.
- At the end of an editing session in not protected mode, for audit the correctness of the data.

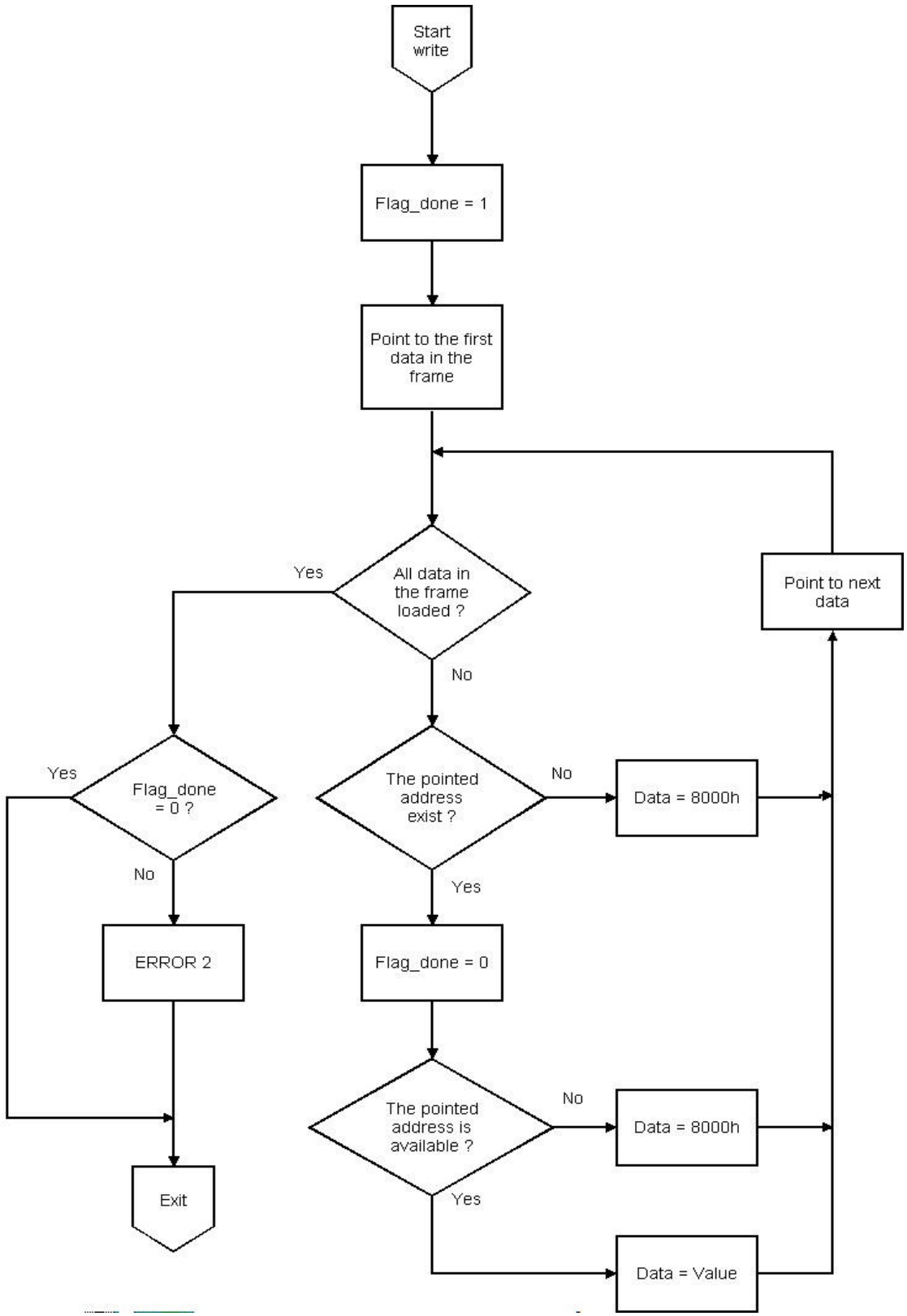
8. Read / write access permissions

The access permissions are stated for each parameter in the description tables by means of two columns named “read” and “write” according the following meaning:
O transaction allowed in operative mode
C transaction allowed in configuration mode
L transaction allowed in calibration mode
F transaction allowed in factory test mode

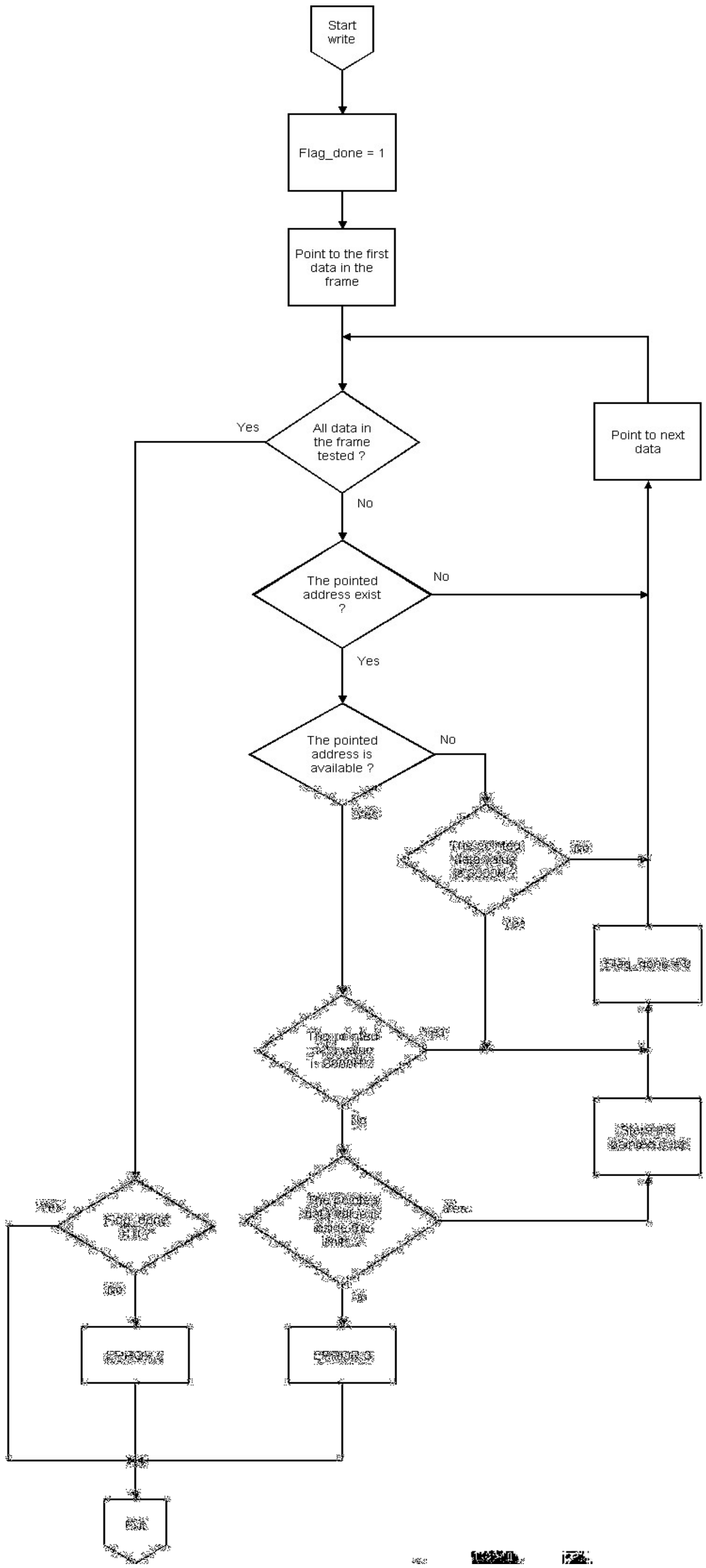
9. Broadcast" address

When using the writing codes (6 and 16) the slave address 0 is permitted:
In this case all the slaves connected accept the command but do not give any reply.

Checked mode reading data rules

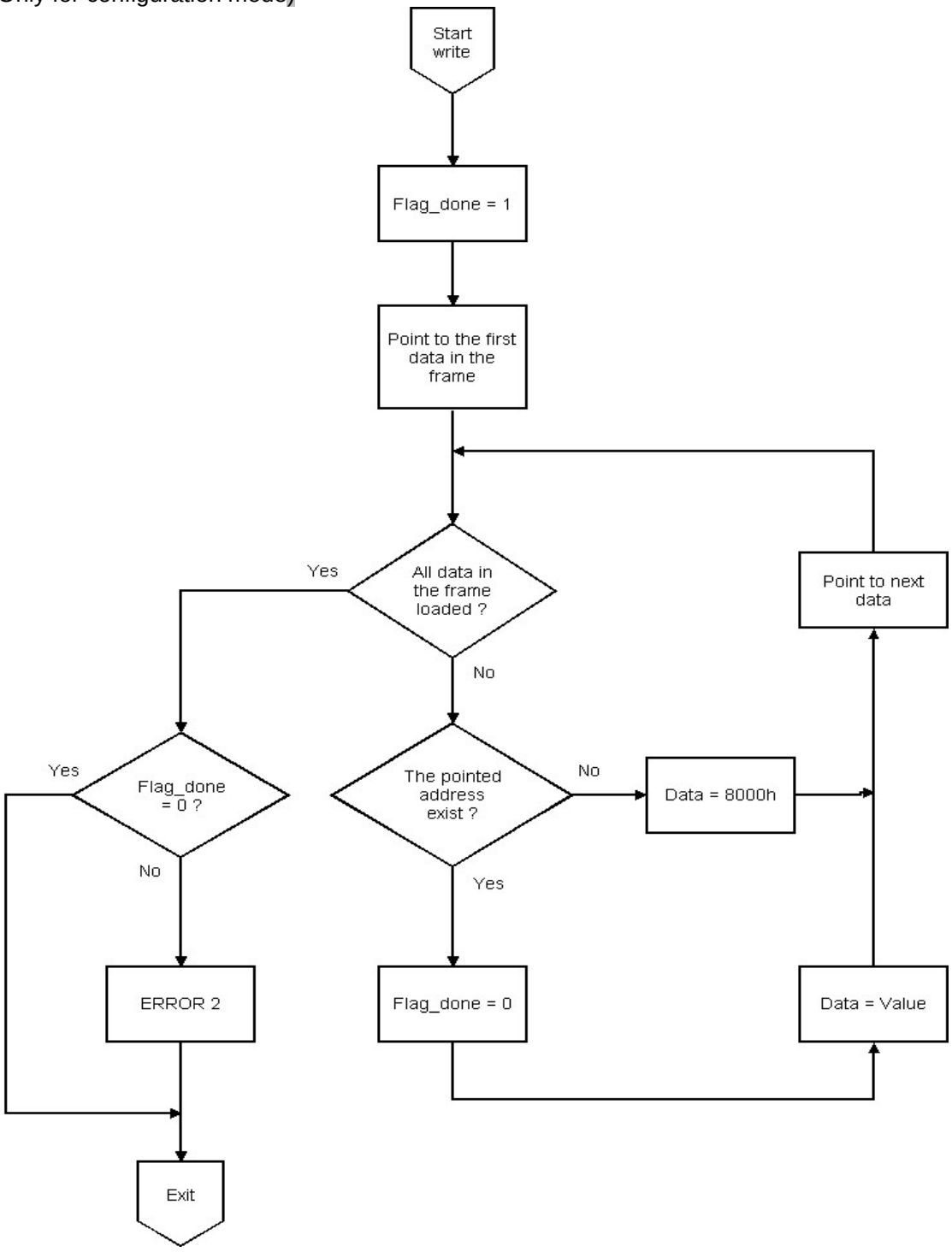


Checking mode writing data validation rules



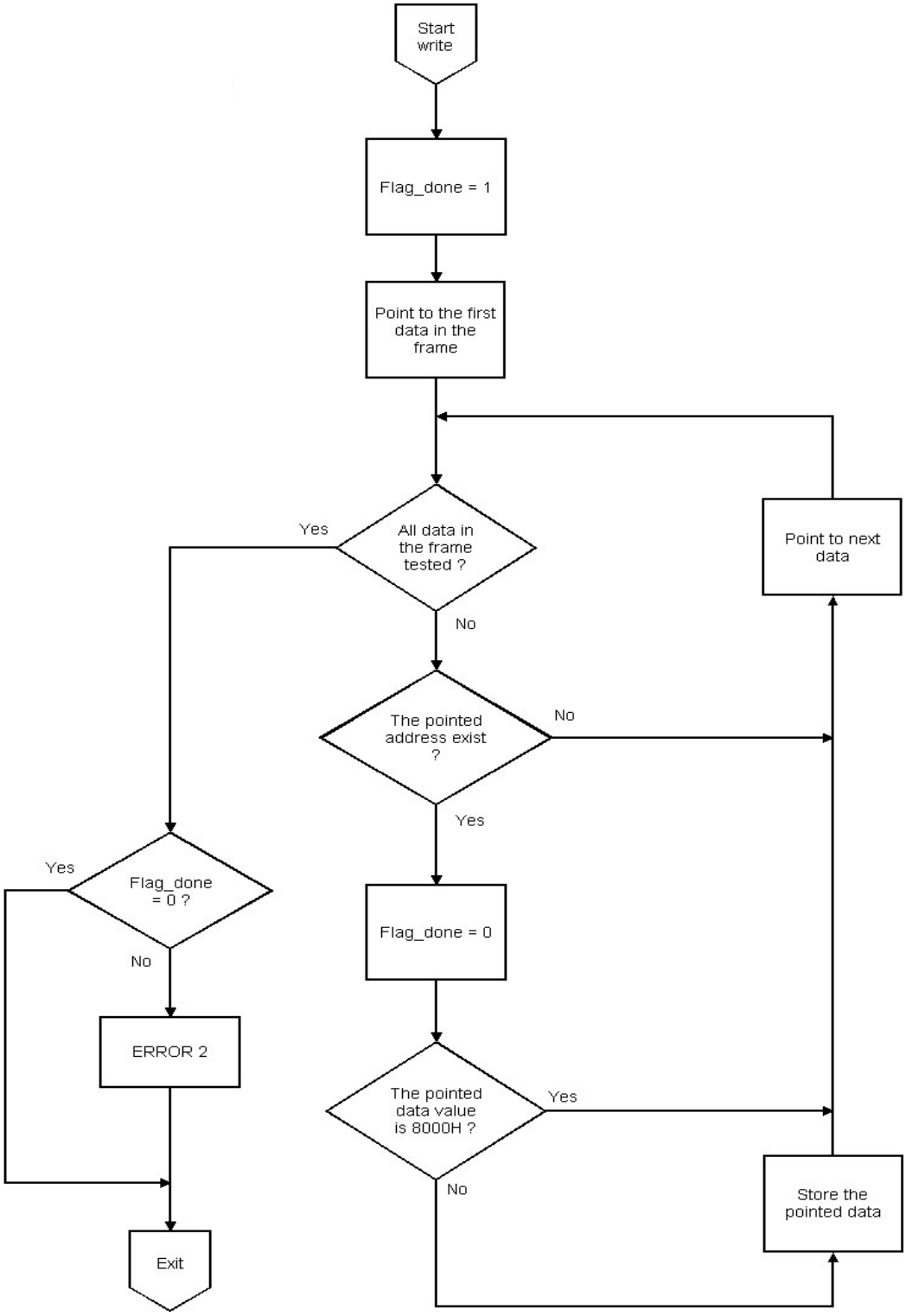
Unchecked mode reading data rules

(Only for configuration mode)



Unchecked mode writing data validation rules

(Only for configuration mode)



Modbus parameters address (Operative and Configuration)

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
117	**Firmware Device class** Availability: Always Value: 430 for K2P		OCLF	
118	**Firmware Device letter** Availability: Always Value: 'A' (41h)		OCLF	
119	**Firmware revision** Availability: Always Value: Nr. of firmware revision		OCLF	

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
120	**Manufacturer trade mark** Availability: Always Value: 50 (32h)		OCLF	
121	**Device identification code** Availability: Always. Value: Identification code 40982 (0A016h) for K2P		OCLF	
122	**Serial FW identification code** Availability: Always. Value: 0 (Nr. of comm. software revision)		OCLF	
150	**Alarm Reset** Availability: If at least one alarm has a manual reset function. Range: 1 = To reset alarm Note: When read returns 0		O	O
151	**Load default value** Availability: Always Range: 1 = Load default European table 2 = Load default American table Note: When read returns 0		OCLF	C
152	**Parameters test result** Availability: Always. Range: 0 = OK xxx = Wrong parameter address Note: This word reports only the first error found by the test routine If mode different from Checked-Unchecked configuration, returns always 0 without any test		OCLF	

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
153	**Device status** Availability: Always Range: 0 = Operative 1 = Input Calibration 2 = Checked Configuration 3 = Unchecked Configuration 4 = Factory test Note: When in operative mode only choices 2, 3 are allowed. After answer at choice 0 the device is reset and restarts using communication parameters set at P97-P98-P99 The choice 0 will not be accepted if CPI device is connected. See the mode description in the previous chapter.		OCLF	OCLF
155	**Enable/disable control output command** Availability: Always Range: 0 = Control disabled 1 = Control enable Note: The control output is disabled also in IDLE mode due to value of “iTSP” In this case cannot be enabled by this command When control output is disabled the programmer is forced in IDLE If set in Configuration, this status will be activated only when return in Operative mode.		OC	OC

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
156	**Smart Command** Availability: If P15=1, 2 and Pb > 0 Range: 0 = Off 1 = On 2 = Reload PID default value Note: If in Operative mode: - The set is not allowed if control is disabled or if program is "RUN" - The value 2 is not allowed if SMART is running If in Configuration mode: - The value 2 is not accepted. - The new status will be activated only when returned in Operative mode.		O C	O C
157	**Device running mode** Availability: Always Range: 0 = Basic operator mode 1 = Set up operator mode 2 = Programmer mode 3 = Two Point Calibration mode 4 = Configuration mode Note: This status will be activated only when return in Operative mode (The value 3 cannot be set)		O C	C
158	**SMART Option Status** Availability: Always Range: 0 = Option disabled 1 = Option enabled		O C L F	
159	**Two Point Calibration Option Status** Availability: Always Range: 0 = Option disabled 1 = Option enabled		O C L F	

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
161	**Serial link Option Status** Availability: Always Range: 0 = Option disabled 1 = Option enabled		OCLF	
164	**MULTIPROGRAM Option Status** Availability: Always Range: 0 = Option disabled 1 = Option enabled		OCLF	
201	**Input type and range value** Availability: Always Range : 0 = Tc L (- 100.0 ÷ 900.0°C) 1 = Tc J (- 100.0 ÷ 1000.0°C) 2 = Tc K (- 100.0 ÷ 1370.0°C) 3 = Tc N (- 100.0÷ 1400.0°C) 4 = Tc T (- 100.0 ÷ 400.0°C) 5 = Tc S (- 20.0 ÷ 1760.0°C) 6 = Tc R (- 20.0 ÷ 1760.0°C) 7 = Rtd Pt 100 (- 200.0 ÷ 800.0°C) 8 = Tc L (- 148.0 ÷ 1652.0°F) 9 = Tc J (- 148.0 ÷ 1832.0°F) 10 = Tc K (- 148.0 ÷ 2498.0°F) 11 = Tc N (- 148.0 ÷ 2552.0°F) 12 = Tc T (- 148.0 ÷ 752.0°F) 13 = Tc S (- 4.0 ÷ 3200.0°F) 14 = Tc R (- 4.0 ÷ 3200.0°F) 15 = Rtd Pt 100 (- 328.0 ÷ 1472.0°F) Note; All ranges are indicated with one decimal figure If P1 is modified then P2,P48 = min value of the selected scale P3,P49 = max value of the selected scale P27 = 0.2 of span P30 = 0.8 of span	("**P1**")	OC	C

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE

202	**Low scale range value**
	Availability:
	Always
	Range:
	As defined by P1
	Decimal figure:
	1
	Note:
	When this parameter is modified,P48, rL parameters will be aligned to it.
	P49 parameter will be checked and aligned to P3 if < P48.
	rH parameter will be checked and aligned to P3 if < rL.
	The span value established by the difference between P3-P2 must be equal or greater then 300 °C (540 °F) for TC ranges and 100 °C (180 °F) for RTD ranges.
	If (P5 =1) and AL1 < P2
	then AL1 = P2
	If (P22=1) and AL2 < P2
	then AL2 = P2
		("**P2**")	OC	C

203	**High scale range value**
	Availability:
	Always
	Range:
	As defined by P1
	Decimal figure:
	1
	Note:
	When this parameter is modified,P49, rH parameter will be aligned to it.
	P48 parameter will be checked and aligned to P2 if > P49.
	rL parameter will be checked and aligned to P2 if > rH.
	The span value established by the difference between P3-P2 must be equal or greater then 300 °C (540 °F) for TC ranges and 100 °C (180 °F) for RTD ranges.
	If (P5 =1) and AL1 > P3
	then AL1 = P3
	If (P22=1) and AL2 > P3
	then AL2 = P3
		("**P3**")	OC	C

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
204	**Out 1 action** Availability: Always Range: 0 = Direct action (Cooling action) 1 = Reverse action (Heating action)	("**P4**")	OC	C

205	**Out 3 function**
	Availability:
	Always
	Range:
	0 = Out3 not provided or used as event annunciator
	1 = Out3 used as Alarm 1 output - Process alarm
	2 = Out3 used as Alarm 1 output - Band alarm
	3 = Out3 used as Alarm 1 output - Deviation alarm
	4 = Out3 used as Alarm 1 output – Measure malfunctioning annunciator
	5 = Out3 used as Cooling output
	Note
	If P5 = 1 or 2 or 3 then
	If OLH < 0 then OLH = 100
	If IP < 0 then IP = 30
	If AL1 out of its limits then AL1 = its low limit.
	If P5 = 0 or 4 then
	If OLH < 0 then OLH = 100
	If IP < 0 then IP = 30
	If P5 = 5 then
	P4 = 1
	If P16 < P18 then P16 = P18
	If Pb < 1.5 and Pb <> 0 then Pb = 1.5
		("**P5**")	OC	C

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
206	**Alarm 1 or Cooling media Configuration** Availability: Only if P5 <> 0 Range: if P5 = 1 or 2 or 3 or 4 0 = High alarm with automatic reset 1 = Low alarm with automatic reset 2 = High alarm with manual reset 3 = Low alarm with manual reset Note: For band alarm, 0 / 2. Signifies outside band alarm, while 1 / 3 signifies inside band alarm. For measure malfunctioning annunciator (P5 = 4) the selection high or low has no effect. if P5 = 5 0 = Air as cooling element 1 = Oil as cooling element 2 = Direct water as cooling element Note: if P6 = 0 then C3 = 1 rC = 1.00 if P6 = 1 then C3 = 1 rC = 0.80 if P6 = 2 then C3 = 1 rC = 0.40	("**P6**")	O C	C

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
207	**Alarm 1 action** Availability: Only if P5 = 1 or 2 or 3 or 4 Range: 0 = Direct action 1 = Reverse action	("**P7**")	O C	C
208	**Alarm 1 Standby function** Availability: Only if P5 =1 or 2 or 3 Range: 0 = No standby function 1 = Standby function	("**P8**")	O C	C
211	**Display Autorange** Availability: Always Range: 0 = Display auto range disabled 1 = Display auto range enabled	**("P11")**	O C	C
212	**Filter on measure** Availability: Always. Range: 0 = Filter disabled 1 = Filter enabled	**("P12")**	O C	C
213	**Control output max rate of rise** Availability: Always Range : 1 / 25. 7FFFh = Infinite Decimal figure: 0	("**P13**")	O C	C

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
215	**Smart function** Availability: If option is available. Otherwise it is forced to 0 Range: 0 = SMART function disabled 1 = SMART function may be enabled (TUNE / ADAPTIVE) 2 = SMART function may be enabled (Only TUNE)	("**P15**")	OC	C
216	**Max value of the proportional band calculated by the smart** Availability: Only if P15 > 0 Range: P17 or P18 / 1000 Decimal figure: 1	("**P16**")	OC	C
217	**Min value of the proportional band calculated by the smart (one control output only)** Availability: Only if P15 > 0 and P5 <> 5 Range: 10 / P16 Decimal figure: 1	("**P17**")	OC	C
218	**Min value of the proportional band calculated by the smart (heating/cooling control)** Availability: Only if P15 > 0 and P5 = 5 Range: 15 / P16 Decimal figure: 1	("**P18**")	OC	C
219	**RCG calculation when in SMART** Availability: Only if P15 > 0 and P5 = 5 Range: 0 = OFF (SMART does not calculate RCG) 1 = On (SMART calculate RCG) Decimal figure: 0	("**P19**")	OC	C

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
220	**Min value of integral time calculated by the smart (in seconds)** Availability: Only if P15 > 0 Range: 1 / 120 Decimal figure: 0	("**P20**")	OC	C
221	**Inhibit reset band extension** Availability: Always. Range: -30 / 30 Decimal figure: 0	("**P21**")	OC	C
227	**Low auto-cal point** Availability: Only if option is available Range: As defined by P1 Decimal figure: 1	("**P27**")	OC	C
228	**Low auto-cal stability band** Availability: Only if option is available Range: 1 / 1000 Decimal figure: 1	("**P28**")	OC	C
229	**Low auto-cal stability time (in seconds)** Availability: Only if option is available Range: 1 / 5400 Decimal figure: 0	("**P29**")	OC	C

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
230	**High auto-cal point** Availability: Only if option is available Range: As defined by P1 Decimal figure: 1	("**P30**")	OC	C
231	**High auto-cal stability band** Availability: Only if option is available Range: 1 / 1000 Decimal figure: 1	("**P31**")	OC	C
232	**High auto-cal stability time (in seconds)** Availability: Only if option is available Range: 1 / 5400 Decimal figure: 0	("**P32**")	OC	C
233	**Access password – OP.S Operator Setup** Availability: Always Range: 0 / 999 (0 for no password)	("**P33**")	OC	C
234	**Access password – A.CL Auto (2 Pt) Calibration** Availability: Only if option is available Range: 0 / 999 (0 for no password)	("**P34**")	OC	C
235	**Access password – CnF Configuration or CPI mode** Availability: Always Range: 0 / 999 (0 for no password)	("**P35**")	OC	C
236	**Access password – I.CL Input calibration** Availability: Always Range: 0 / 999 (0 for no password)	("**P36**")	OC	C

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
237	**Access password – OP.P** **Program editing mode** Availability: Always Range: 0 / 999 (0 for no password)	("**P37**")	O C	C
241	**Number of Programs and Segments** Availability: Skipped if multi program option is not available Range: 0 = One program with 32 segments maximum 1 = Two programs with 16 segments maximum 2 = Four programs with 8 segments maximum Note: When this value is changed all programmer segments are checked and modified if found incongruent	("**P41**")	O C	C
242	**Start up feature** Availability: Always Range: 0 = At start up the programmer is forced in "Idle" state 1 = At start up the programmer restarts as at power down	("**P42**")	O C	C
243	**Servo to PV function** Availability: Always Range: 0 = Servo to PV function disabled 1 = Servo to PV function enabled	("**P43**")	O C	C
244	**Ramp tracking Low Limit** Availability: Always Range: 0 = No ramp tracking when the PV is below the set point 1/1000 = From 0.1 to 100.0 engineering units, Low limit for the ramp tracking function Decimal figure: 1	("**P44**")	O C	C

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
245	**Ramp tracking High Limit** Availability: Always Range: 0 = No ramp tracking when the PV is above the set point 1/1000 = From 0.1 to 100.0 engineering units, High limit for the ramp tracking function Decimal figure: 1	("**P45**")	O C	C
246	**Guaranteed Soak Limit** Availability: Always Range: 0 = No guaranteed soak function when the programmer executes dwell 1/1000 = From 0.1 to 100.0 engineering units, limit for the guaranteed soak function. This limit means the half-band for the guaranteed soak function. Decimal figure: 1	("**P46**")	O C	C
247	**Delta Temperature (For TUNE start up)** Availability: If P15 = 1 or 2 Range: 20 / 400 Decimal figure: 1	("**P47**")	O C	C
248	**SWP_LO_LIM (In TUNE)** Availability: If P15 = 1 or 2 Range: P2 / P49 Decimal figure: 1	("**P48**")	O C	C
249	**SWP_HI_LIM (In TUNE)** Availability: If P15 = 1 or 2 Range: P48 / P3 Decimal figure: 1	("**P49**")	O C	C

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
250	**Minimum Peak (In TUNE)** Availability: If P15 = 1 or 2 Range: 2 / 50 Decimal figure: 1	("**P50**")	OC	C
251	**System calibration – "b" Coefficient** Availability: Always Range: -1999 / 1999 Decimal figures: 1 Note: This value can be modified by Auto (2 Pt) calibration	("**P51**")	OC	C
252	**System calibration – "a" Coefficient** Availability: Always Range: 500 / 2000 Decimal figures: 3 Note: This value can be modified by Auto (2 Pt) calibration	("**P52**")	OC	C
253	**Analogue Output Selection** Availability: Always Range: 0 = 0-20 mA 1 = 4-20 mA 2 = 0-10 V 3 = 2-10 V 4 = OFF	("**P53**")	OC	C

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
285	**Increase Decrease Algorithm In Parameter Modification** Availability: Always Range: 0 = Increase or decrease in according to decade algorithm 1 = Increase or decrease in according to exponential algorithm	("**P85**")	O C	C
297	**Modbus Address** Availability: If option is available Range: 0 / 254 (0 for serial communication disabled)	("**P97**")	O C	C
298	**Baud Rate** Availability: If option is available and P97 > 0 Range: 0 = 600 baud 1 = 1200 baud 2 = 2400 baud 3 = 4800 baud 4 = 9600 baud 5 = 19200 baud	("**P98**")	O C	C
299	**Byte Format** Availability: If option is available and P97 > 0 Range: 0 = 8 bit + even parity 1 = 8 bit + odd parity 2 = 8 bit without parity	("**P99**")	O C	C

Note: The new values for serial communication will be activated when device returns in operative mode

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
404	**Alarm 1 threshold** Availability Only if P5 = 1 or 2 or 3 Range: Span limits (P2 / P3) if P5 = 1 0 / 5000 if P5 = 2 -2000 / 5000 if P5 = 3 Decimal figure: 1	("**AL1**")	OC	OC
405	**Alarm 1 hysteresis** Availability Only if P5 = 1 or = 2 or = 3 Range: 1 - 100 Decimal figure: 1	("**HS1**")	OC	OC
406	**Proportional band** Availability: Always. Range : 10 – 1000 if P5 <> 5 15 – 1000 if P5 = 5 0 if ON/OFF control. Decimal figure: 1 Note: In operative mode the writing is not allowed if SMART is ON	("**Pb**")	OC	OC
407	**Hysteresis** Availability: Only if Pb = 0 Range: 1 - 100 Decimal figure: 1	("**HS**")	OC	OC
408	**Integral time (in seconds)** Availability: Only if Pb > 0 Range: 1 / 1200 7FFFh = Integral action excluded Decimal figure: 0 Note: In operative mode the writing is not allowed if SMART is ON	("**ti**")	OC	OC

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
409	**Derivative time (in seconds)** Availability: Only if Pb > 0 Range: 0 / 600 Decimal figure: 0 Note: In operative mode the writing is not allowed if SMART is ON	("**td**")	OC	OC
410	**Integral pre-load** Availability Only if Pb > 0 Range: 0 / 100 if P5 <> 5 -100 / 100 if P5 = 5 Decimal figure: 0	("**IP**")	OC	OC
411	**Out 1 Cycle time (in seconds)** Availability: Only if Pb > 0 Range: 1 / 200 Decimal figure: 0	("**C**")	OC	OC
412	**Out 3 cycle time (in seconds)** Availability: Only if Pb > 0 and P5 = 5 Range: 1 / 200 Decimal figure: 0	("**C3**")	OC	OC
413	**Relative cooling gain** Availability: Only if Pb > 0 and P5 = 5 Range: 20 / 100 Decimal figure: 2 Note: In operative mode the writing is not allowed if SMART is ON and P19 = On	("**rC**")	OC	OC

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
414	**Dead band/overlap between heating/cooling output** Availability: Only if Pb > 0 and P5 = 5 Range: -20 / 50 Decimal figure: 0	("**OLP**")	OC	OC
415	**Set point low limit** Availability: Always Range: P2 / rH Decimal figure: 1 Note: When rL is modified, all program segments are checked and aligned if out of range .	("**rL**")	OC	OC
416	**Set point high limit** Availability: Always. Range: rL / P3 Decimal figure: 1 Note: When rL is modified, all program segments are checked and aligned if out of range .	("**rH**")	OC	OC
417	**Output high limiter** Availability: Only if Pb > 0. Range: 0 / 100 if heating -100 / 100 if heating/cooling Decimal figure: 0	("**OLH**")	OC	OC
421	**Timer Value (in sec)** Availability: Always Range: 1 / 999 Decimal figure: 0	("**t**")	OC	OC

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
422	**Fun Input Selection** Availability: Only if P53 is not = OFF Range: 0 / 101 Decimal figure: 0 Note: 101 means "Auto"	("**F.SEL**")	OC	OC
423	**Fun Input Gain** Availability: Only if P53 is not = OFF and "F.SEL" = 101(Auto) Range: 1 / 9999 Decimal figure: 2	("**F.Gn**")	OC	OC
424	**Fun Offset** Availability: Only if P53 is not = OFF Range: 0 / 50 Decimal figure: 0	("**F.OFS**")	OC	OC

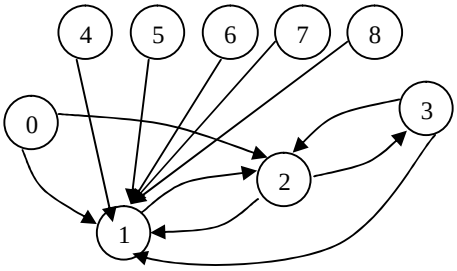
MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
601	**Measure value** Availability: Always When an error is detected on measure, these codes are sent: 30004 (7534h) = Under-range 30005 (7535h) = Over-range 30014 (753Eh) = Error on reference junction temperature (< -25 °C or > 75 °C) 30050 (7562h) = Auto-zero error Decimal figure: 1		O	
602	**Measure Status** Availability: Always Range: 0 = Measure ok 1 = Under-range 2 = Over-range 3 = Error on reference junction 4 = Auto-zero error		O	
603	**Alarm 1 Status** Availability: Only if alarm 1 is configured Range: 0 = No alarm 1 = Alarm		O	
~~604~~	~~**Alarm 2 Status**~~ ~~Availability:~~ ~~Only if alarm 2 is configured~~ ~~Range:~~ ~~0 = No alarm~~ ~~1 = Alarm~~		~~O~~	
605	**Buzzer Status** Availability: Always Range: 0 = Buzzer OFF 1 = Buzzer ON		O	
606	**Digital input 1 Status (Low Fluid)** Availability: Always Range: 0 = Fluid Ok (Contact open) 1 = Alarm (Contact closed)		O	

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
607	**Digital input 2 Status (Low flow)** Availability: Always Range: 0 = Flow Ok (Contact closed) 1 = Alarm (Contact open)		O	
608	**Digital input 3 Status (Over Temp)** Availability: Always Range: 0 = Temp Ok (Contact closed) 1 = Alarm (Contact open)		O	
609	**Status of Output 1** Availability: Always Range: 0 = Output not energized 1 = Output energized		O	
610	**Status of Output 2** Availability: Always Range: 0 = Output not energized 1 = Output energized		O	
611	**Status of Output 3** Availability: Always Range: 0 = Output not energized 1 = Output energized Note: Writing is allowed only if the output is not driven by an internal function (Alarm 1 or cooling)		O	O

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
612	**Led Status** Availability: Always For each led corresponds a bit in this word: Led bits: PROGRAM = bit 7 -> 80h LOW FLUID = bit 6 -> 40h LOW FLOW = bit 5 -> 20h OVER TEMP = bit 4 -> 10h PUMP SET = bit 3 -> 08h °F = bit 2 -> 04h HEAT = bit 1 -> 02h COOL = bit 0 -> 01h		O	
613	**SMART Status** Availability: If P15 > 0 and Pb > 0 Range: 0 = SMART Off 1 = TUNE On 2 = ADAPTIVE On		O	
614	**Heating Power Output Value** Availability: Always Decimal figure: 0		O	
615	**Cooling Power Output Value** Availability: If P5 = 5 Decimal figure: 0		O	
616	**PID Power Output Value** Availability: Always Decimal figure: 2		O	
617	**Proportional Power Output Value** Availability: Always Decimal figure: 2		O	

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
618	**Integral Power Output Value** Availability: Always Decimal figure: 2		O	
619	**Derivative Power Output Value** Availability: Always Decimal figure: 2		O	
620	**Control Output Status** Availability: Always Range: 0 = Control Disable 1 = Control Enable		O	
621	**Pump Restart** Availability: Always Range: 0 = No operation …..1 = Pump Restart Note: Always 0 when read		O	O
622	**Remaining Time Value (in sec)** Availability: Always Range: 999 to 0		O	

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
623	**Out 4 - Current output value** Availability: Always Range: - 200 to 10200 Note: Writing is allowed only if output is not used by an internal function (P53 = OFF). Decimal figure: 2		O	O
624	**Out 4 - Voltage output value** Availability: Always Range: - 200 to 10200 Note: Writing is allowed only if output is not used by an internal function (P53 = OFF). Decimal figure: 2		O	O

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
630	**Programmer Status** Availability: Always Range: 0 = Idle (Pulse buzzer) 1 = Idle (Buzzer is silent) 2 = Run 3 = Hold (Keyboard / Modbus Command) 4 = Hold 1 (On " time expired " from HOLD (3)) 5 = Hold 1 (On " time expired " from RUN (2)) 6 = Tracking 7 = Recovery 8 = Tracking during recovery Change status available by Modbus command:  Note: The state “2””3” is accepted only if time is not expired. The states 0, 4, 5, 6, 7, 8 can't be set		O	O
631	**Selected Program** Availability: Always Range> 1 (if P41 = 0 or multi program option is not available) 1, 2 (if P41 = 1) 1, 2, 3, 4 (if P41 = 2) Note: The write is possible only with program in “IDLE”	("**nPrG**")	OC	OC

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
632	**Segment in execution** Availability: If program is not in idle state Range> 1 up to 32 (if P41 = 0) 1 up to 16 (if P41 = 1) 1 up to 8 (if P41 = 2)	("**SEG**")	O	
633	**Operative Set Point** Availability: Always Range> rL / rH 32767 means disabled control output (for ITSP value) Decimal figure: 1 Note: The write is possible only with program in "IDLE" **Modifying this value will be modified also the "ITSP" of selected program**.		O	O
634	**Time remaining to end of program (hh)** Availability: If program is not in idle state	("**rt.**")	O	
635	**Time remaining to end of program (mm)** Availability: If program is not in idle state	("**rt.**")	O	
636	**Time remaining to end of program (ss)** Availability: If program is not in idle state	("**rt.**")	O	
637	**Time remaining to end of segment (hh)** Availability: If program is not in idle state		O	
638	**Time remaining to end of segment (mm)** Availability: If program is not in idle state		O	
639	**Time remaining to end of segment (ss)** Availability: If program is not in idle state		O	

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
640	**Repetitions remaining to the end)** Availability: If repetitions are configured(rPt > 0) and program is not in idle state Range> 0 / 9999 32767 means endless repetitions	("**r.rPt**")	O	
641	**Time remaining to end of program repetitions included (hh)** Availability: If repetitions are configured(rPt > 0) and program is not in idle state Range> 0 / 32500 32767 means endless repetitions	("**t.rPt**")	O	
642	**Time remaining to end of program repetitions included (mm)** Availability: If repetitions are configured(rPt > 0) and program is not in idle state Range> 0 / 59 32767 means endless repetitions	("**t.rPt**")	O	
643	**Time remaining to end of program repetitions included (ss)** Availability: If repetitions are configured(rPt > 0) and program is not in idle state Range> 0 / 59 32767 means endless repetitions	("**t.rPt**")	O	

Note: When remaining time is >= 32500 hours the transmitted value is fixed at 32500h 00m 00s

Modbus parameters address (Programmer Edit)

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
1000	**Initial Set Point of Program 1** Availability: Always Range> rL / rH 32767 means that control output will be disabled when program is in “IDLE” Decimal figure: 1 Note: The write is possible only with program in “IDLE”	(“**itSP**”)	OC	OC
1001	**Number of First No-Programmed Segment on Program 1** Availability: Always Range> 2-32 if P41=0 2-16 if P41=1 2- 8 if P41=2		OC	
1002	**Number of program repetition** Availability: Always Range> 0 / 9999 32767 means endless repetitions Note: The write is possible only with program in “IDLE”	(“**rPt**”)	OC	OC
1004	**Target Set Point of 1st segment of Program 1** Availability: Always Range> rL / rH Decimal figure: 1 Note: The write is possible only with program in “IDLE”	(“**SP 1**”)	OC	OC

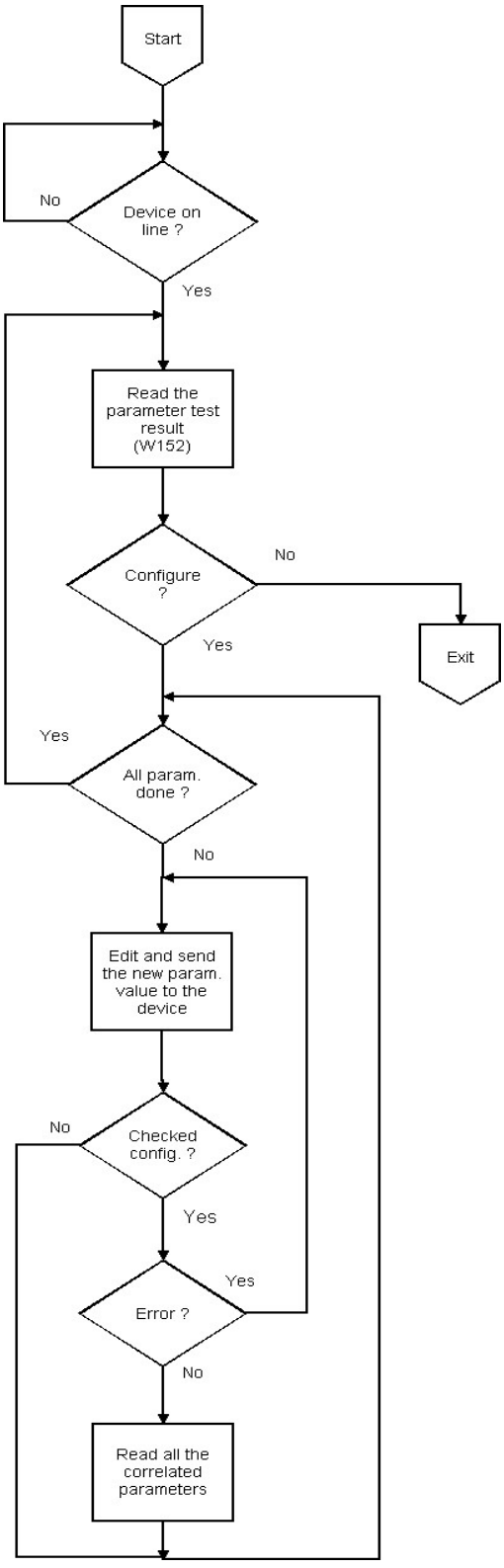
MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
1005	**Dwell/Ramp Eng Unit of 1st segment of Program 1** Availability: Always Range> 0 = Time (Dwell/Ramp) in mm.ss 1 = Time (Dwell/Ramp) in hh.mm 2 = Ramp in °C/°F per minute Note: The write is possible only with program in "IDLE" When the Eng.Unit is modified the value(following addres) will be checked and alligned if out of range	("**t 1**") or ("**rr 1**")	OC	OC
1006	**Dwell/Ramp Value of 1st segment of Program 1** Availability: Always Range> 1 / 5999 seconds or minutes (if Eng Unit = 0, 1) 1 / 30000 (if Eng Unit = 2) Decimal figure: 1 (Only if Eng Unit = 2) Note: The write is possible only with program in "IDLE"	("**t 1**") or ("**rr 1**")	OC	OC
1007	**Target Set Point of 2nd^{T} segment of Program 1** Availability: Always Range> rL / rH 32767 means end of program before of the last segment Decimal figure: 1 Note: The write is possible only with program in "IDLE"	("**SP 2**")	OC	OC
1008	**Dwell/Ramp Eng Unit of 2nd^{T} segment of Program 1** Availability: If segment exists For other information see 1005	("**t 2**") or ("**rr 2**")	OC	OC

MODBUS ADDRESS	DESCRIPTION	MNEM CODE	READ	WRITE
1009	**Dwell/Ramp Value of 2nd segment of Program 1** Availability: If segment exists For other information see 1006	("**t 2**") or ("**rr 2**")	O C	O C

With the same rules are available the other segments.
The address must be calculated as shown on the following table:

DESCRIPTION	ADDRESS	PROG 1	PROG 2	PROG 3	PROG 4
Initial Set Point	1000 + ((Prog - 1)*100)	1000	1100	1200	1300
Number of Segment available	1001 + ((Prog - 1)*100)	1001	1101	1201	1301
Number of program repetitions	1002 + ((Prog - 1)*100)	1002	1102	1202	1302
Target Set Point	1004 + ((Prog - 1)*100) + ((Seg –1)*3	1004,1007…..1097	1104,1107…..1149	1204,1207…..1225	1304,1307…..1325
Dwell / Ramp Eng Unit	1005 + ((Prog - 1)*100) + ((Seg –1)*3	1005,1008…..1098	1105,1108…..1150	1205,1208…..1226	1305,1308…..1326
Dwell / Ramp Eng Unit	1006 + ((Prog - 1)*100) + ((Seg –1)*3	1006,1009…..1099	1106,1109…..1151	1206,1209…..1227	1306,1309…..1327

Suggested setting flow chart



Modbus parameters address (Calibration mode)

MODBUS ADDRESS	DESCRIPTION	READ	WRITE
3001	**Input calibration or test selection** The content of this word determines the input calibration or test type. Range: 0 = TC low range (0 mV) 1 = TC high range (60 mV) 2 = RJ 3 = RTD low range (0 Ohm) 4 = RTD high range (375 Ohm)	L	L
3002	**Calibration start** The write operation into this word determines the start of the calibration selected by the word 3001. Range: If the contents of the word 3001 is 0, 1, 2, or 3, the value must be 1. If the contents of the word 3001 is 2, the content of this word must be the value of the temperature measured on the thermocouple terminals. This value must be between 0.0 and 50.0 °C and must be stored normalised from 0 and 500 bits. Note: When read returns 0	L	L
3003	**Input calibration verify** This word content the value measured on the input selected by the word 3001. This value is normalised with the calibration values stored for this input for a range from o to 30000 counts. If the selected input is the RJ this word contains the RJ temperature in 1/10 °C. The following values means a measure error. -30004 (8ACCh) = Under-range -30005 (8ACBh) = Over-range -30050 (8A9Eh) = Error on internal auto zero.	L	
3004	**Input calibration status** Range: 0 = no calibration done 1 = calibration in progress 2 = calibration done without error 3 = calibration done with error In writing mode only the value 0 is allowed and only if the current content of this word is 2 or 3	L	L

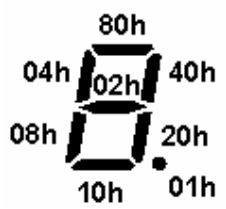
MODBUS ADDRESS	DESCRIPTION	READ	WRITE
3005	**Autozero value (in counts)** Note: The value 0 means an error in the auto zero measure.	L	
3006	**Tc Low range calibration value (in counts)**	L	
3007	**Tc High range calibration value (in counts)**	L	
3008	**RJ calibration value (in counts)**	L	
3009	**RTD low range calibration value (in counts)**	L	
3010	**RTD high range calibration value (in counts)**	L	
3011	**Not used** (Remain for compatibility with factory tool) In reading: Always 1 In writing: Any value	L	L
3012	**Direct writing on Analogue Output** Range: 0 to 3000 Note: When read returns 0	L	L
3013	**Current calibration check** Range: -200 to 10200 Note: When read returns 0	L	L
3014	**Voltage calibration check** Range: -200 to 10200 Note: When read returns 0	L	L
3015	**Current calibration low value** Range: 0 to 400	L	L
3016	**Current calibration high value** Range: 2600 to 3000	L	L
3017	**Voltage calibration low value** Range: 0 to 400	L	L
3018	**Voltage calibration high value** Range: 2600 to 3000	L	L

Modbus parameters address (Factory mode)

MODBUS ADDRESS	DESCRIPTION	READ	WRITE
4001	**Keyboard read status** This word return the status of all the key. If a key is pushed the corresponding bits is returned as true Key Bits: RUN = bit 0 -> 1h "▲" = bit 1 -> 2h "▼" = bit 2 -> 4h SET = bit 3 -> 8h The key bits are ored together	F	
4002	**Start test watch dog** Range 1 = Start of test		F
4003	**Watch dog time value (in msec.)** Limits 900 upto 2500 mS)	F	
4004	**Output 1 status** Range**:** 0 = relay off 1 = relay on	F	F
4005	**Output 2 status** Range**:** 0 = relay off 1 = relay on	F	F
4006	**Display digit 1 value**		F
4007	**Display digit 2 value**		F
4008	**Display digit 3 value**		F
4009	**Display digit 4 value**		F
4012	**Led value** Writing in this word it is possible to switch on or to switch off the front panel leds. For each led corresponds a bit in this word: Led bits: PROGRAM = bit 7 -> 80h LOW FLUID = bit 6 -> 40h LOW FLOW = bit 5 -> 20h OVER TEMP = bit 4 -> 10h PUMP SET = bit 3 -> 08h °F = bit 2 -> 04h HEAT = bit 1 -> 02h COOL = bit 0 -> 01h The led bits can be ored together		F

MODBUS ADDRESS	DESCRIPTION	READ	WRITE
4013	**Load default calibration values** Range**:** -23131 = Load data values N.B. The BURN_IN feature is enabled		F
4014	**EEprom reset** Range: 23130 = Write 0xFFFF in all locations		F
4015	**Output 3 status** Range**:** 0 = Relay off 1 = Relay on	F	F
4016	**Digital 1 input status** 0 = Contact open 1 = Contact closed	F	
4017	**BURNIN feature status** Reading 0 = Feature disabled 1 = Feature enabled Writing -1 = Feature enabled Every other value = Feature disabled	F	F
4018	**Digital 2 input status** 0 = Contact open 1 = Contact closed	F	
4019	**Digital 3 input status** 0 = Contact open 1 = Contact closed	F	
4020	**Display digit 5 value**		F
4021	**Display digit 6 value**		F
4022	**Display digit 7 value**		F
4023	**Display digit 8 value**		F
4026	**Buzzer status** Range**:** 0 = Buzzer off 1 = Buzzer on	F	F

The following figures show the correspondence between display led and word 4006/4009 4020/4023:



K2P

Dg1 Dg2 Dg3 Dg4

Dg5 Dg6 Dg7 Dg8

Special Modbus Address

There are a special addresses used only for program debug facility.
(The addresses are valid in any mode)

4100 up to 4999 for EEPROM location (0 up to 255)
EEPROM location = **MOD** ((Address – 4100) / 256)

5000 up to 5999 for INTERNAL RAM location (as a byte) (0 up to 255)
INTERNAL RAM location = **MOD** ((Address – 5000) / 256)

6000 up to 6999 for INTERNAL RAM location (as a word) (0 up to 255)
INTERNAL RAM location = **MOD** ((Address – 6000) / 256)
If consecutive addresses are read the ram address is incremented
Example:
Read two words starting from 6056 has as a result the reading of RAM locations 56,57 and 58,59

7000 up to 7999 for EXTERNAL RAM location (as a byte) (0 up to 255)
EXTERNAL RAM location = **MOD** ((Address – 7000) / 256)

8000 up to 8999 for EXTERNAL RAM location (as a word) (0 up to 255)
EXTERNAL RAM location = **MOD** ((Address – 8000) / 256)
If consecutive addresses are read the ram address is incremented
Example:
Read two words starting from 8128 has as a result the reading of
EXTERNAL RAM locations 128,129 and 130,131

N.B. MOD is the remainder of division

The write is not allowed