DLC 4008

USER MANUAL

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Kernel Sistemi
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WARNING :

Kernel Sistemi s.r.l. reserve to themselves to change the contents of this manual in every moment, without prior notice to customers as a result of changes.

INDEX

1 HARDWARE CHARACTERISTICS

This chapter describes the hardware characteristics of “DLC_4008” :

1.1 Electric Characteristics

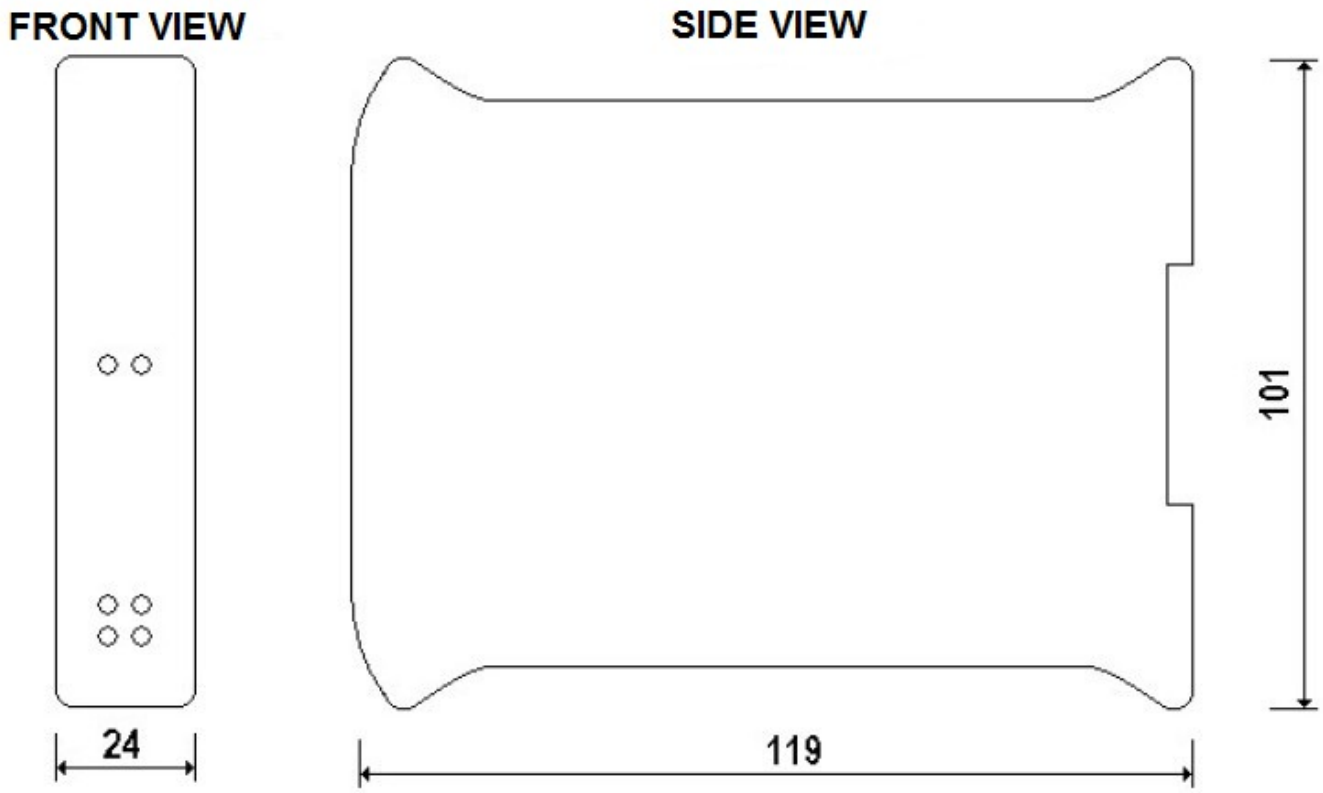
ELECTRIC CHARACTERISTICS	
Power supply voltage	**24** Vdc +/- 10 %
Maximum Permitted Power Supply	**27** Vdc
Current Consumption	Under **50** mA without loads [Power Supply = 24 Vdc]
Microprocessor	**Hitachi H8**
Digital Inputs	**x**
Analog Inputs	**4** analog inputs with 10 bits resolution [0 … 1023] ; for PT100, PT1000, thermocouple (J or K) otherwise voltage (0 … 10 V) or current (0 … 20 mA)
Digital Outputs	**8** static outputs 24 Vdc 500 mA
Analog Outputs	x
Serial Lines	**1** Serial Line : RS_422 / RS_485 Supports the communication protocols : KERNEL / KNP / EXPA and MODBUS RTU [19200 – N – 8 - 1]
Leds	**8** yellow leds, one for each digital output **2** red leds for communication signalling
Addressing	**4** Dip-switches (of which only **3** for the addressing from 1 to 7)

1.2 Mechanics Characteristics

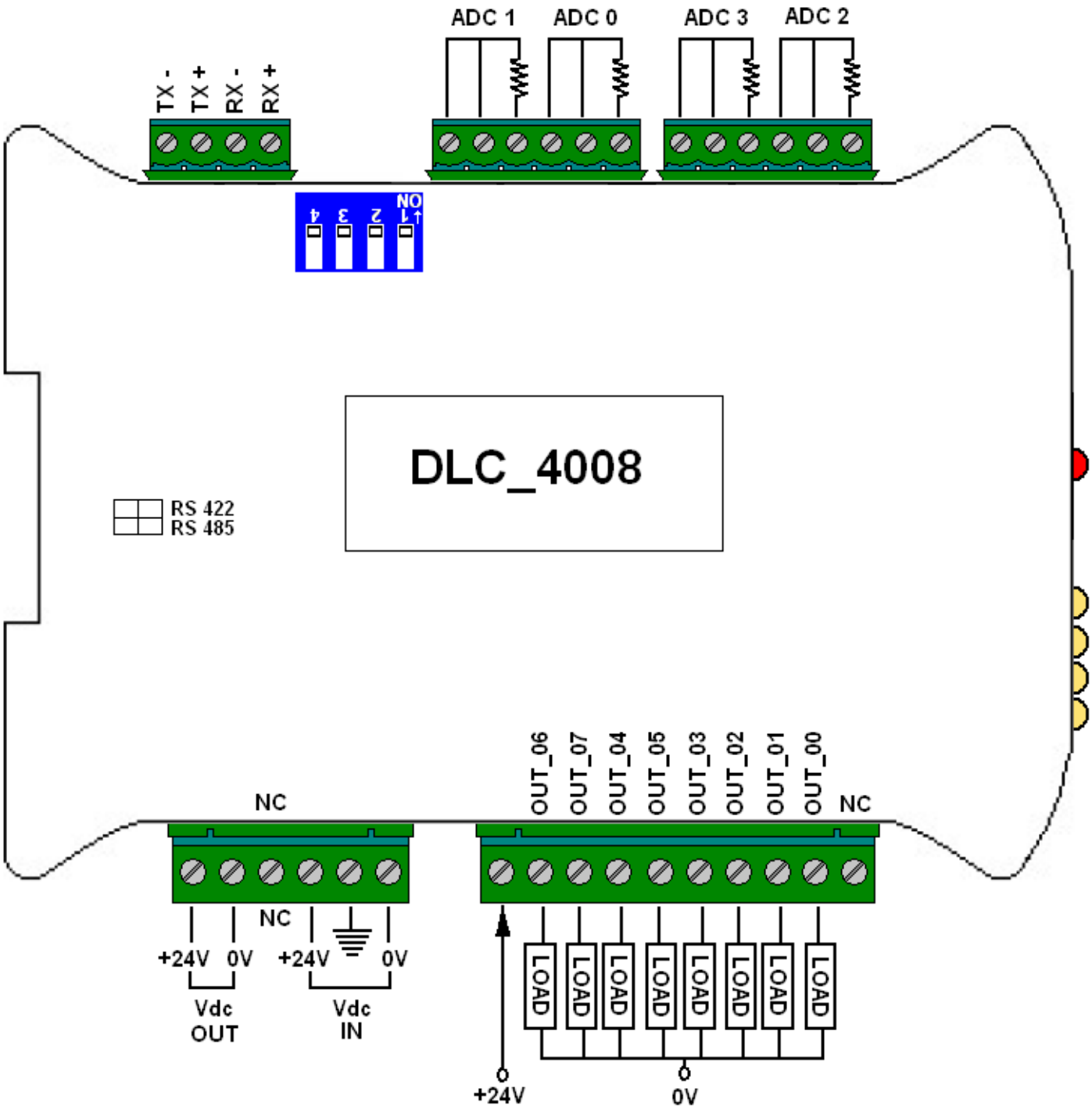
MECHANICS CHARACTERISTICS	
Temperature Range	From -10 ^C to +70^C
Humidity Range	From 10 % to 90 % (non-condensing)
Operating Atmosphere	Without corrosive gas
Noise Immunity	According to rules in force
Fixing System	On din rail
Weight	167 g
Keyboard	No Keyboard
Display	No Display

1.3 Dimensions

Front View 24x101 mm, Depth 119 mm



1.4 I/O Connections



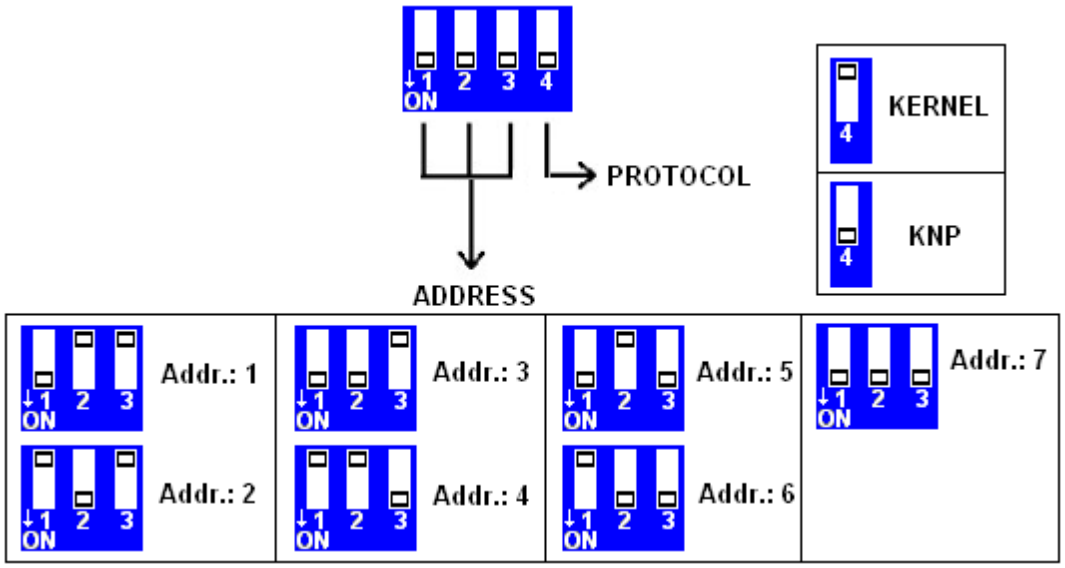
2 GENERAL NOTES

To have a complete idea about the DLC_4008 use, and about how work with this device, is necessary give some general notes. The DLC_4008 is an expansion module which can be connected to Kernel Sistemi devices (or even other devices) and its have four Analog inputs and 8 digital outputs 0/24 Vdc, at the order time is possible choose, Analog inputs for PT100 (with different reading ranges, for example: 0...300 °C, 0...600 °C or with a decimal point 0.0...100.0 °C or for temperatures under zero -20...+50 °C etc...), for current (0…20mA), voltage (0...10Vdc) or for thermocouple J or K. This modules allow, if they are properly programmed, to obtain different thermoregulation (4 for any modules connected to the network). This is possible because the DLC_4008 manage four different P.I.D regulation systems (Proportional, Integrative , Derivative) which are manageable through the internal memory map.

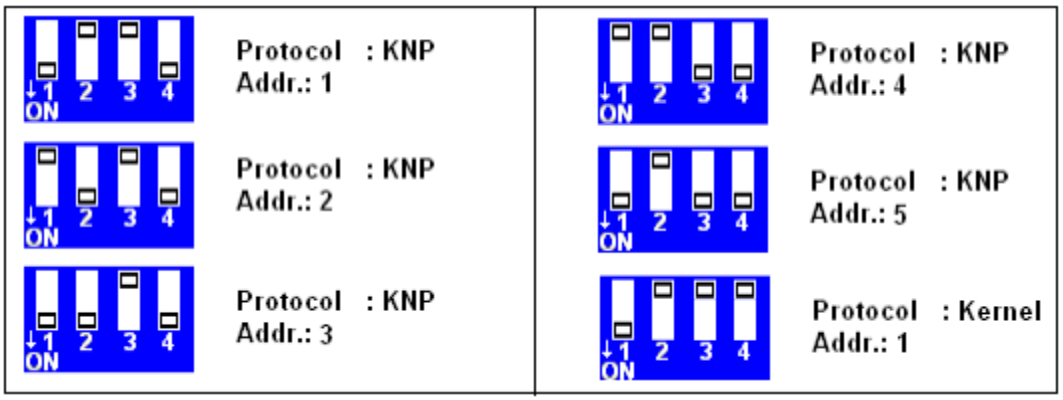
2.1 Addressing

You can give each DLC_4008 their own node address using the special dip-switch (see hardware features and the following figure) from 001 to 111 (1 to 7). Address 0 (000) is not usable because it is already used by a system resource. On older mounts you can find the dip-switch blacks, in the most recent edits are present the dip-switch blue, as in the following figure :

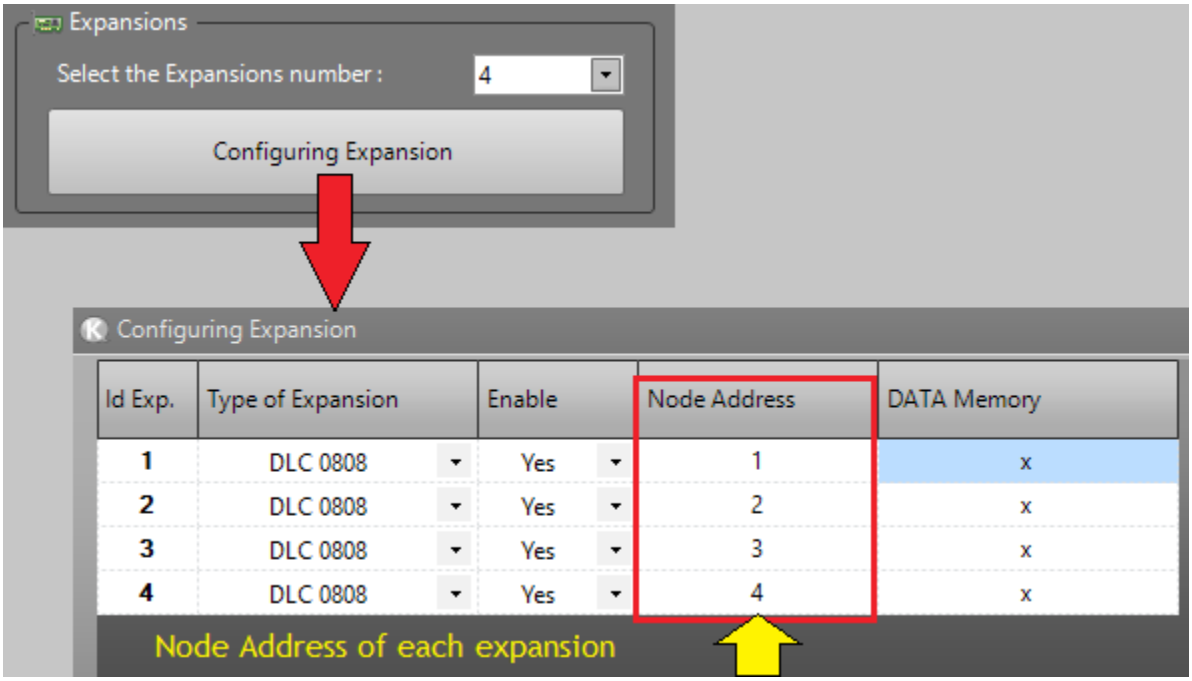
[**DLC_4008/KK**]



Examples :



If you select the KNP Protocol through the dip-switch number 1, the node address of each expansion will be shown automatically in the menu "Project Options" >> "Serial" >> "Configuration Expansion" Application Program Kernel PLC systems [see figure] :



2.2 Communication

Since the DLC_4008 has only one dip-switch dedicated to the choice of protocol, and protocols available are 3, it was chosen to create 3 different firmware for DLC_4008 (the one chosen is loaded at the time of shipment).
Note : If you don't indicate nothing in the order, will load the "KK" firmware; otherwise, if it serves the MODBUS Protocol (only on request) must be specified clearly in the order! Firmware versions :

```
DLC_4008/KK : 0 = Protocol KERNEL     / 1 = Protocol KNP     [STANDARD  ]
DLC_4008/MK : 0 = Protocol MODBUS RTU / 1 = Protocol KNP     [ON REQUEST]
DLC_4008/KM : 0 = Protocol MODBUS RTU / 1 = Protocol KERNEL [ON REQUEST]
```

Through the dip-switch (see figure above), the DLC_4008 sets its serial port on one of the above protocols with 19200 baud rate :

Protocol	Baud Rate	Parity	Bits	Stop
KERNEL SLAVE	19200	NO PARITY	8	1
KNP SLAVE	19200	NO PARITY	8	1
MODBUS RTU SLAVE [Only ON REQUEST]	19200	NO PARITY	8	1

With the **KNP** protocol is possible to network different types of Kernel Sistemi expansions.

At the software level there is nothing to set, only the correct number of expansions connected in the "Project Options" menu of the application program for the PLC (table "Serial"). You will need to set respectively :

- If the selected protocol on DLC_4008 is KERNEL SLAVE, on PLC you have to set :
  KERNEL 19200, N, 8, 1
- If the selected protocol on DLC_4008 is KNP SLAVE, on PLC you have to set :
  KNP MASTER 19200, N, 8, 1
- If the selected protocol on DLC_4008 is MODBUS RTU SLAVE, on PLC you have to set :
  MODBUS RTU MASTER 19200, N, 8, 1

You can also set its internal jumpers of communication (see hardware characteristics) in RS_485 position or RS_422 to select the type of serial communication. Since the factory setting the communication jumper is placed in RS_422.

2.3 Output Management

The **8** outputs available can be used as "normal" outputs in the project (with ID = 1 >> OUT.00 matches OUT.32 and so on), or, IF YOU ACTIVE THE PID REGULATION, can be DEDICATED to a specific function!

The outputs **from OUT.00 to OUT.03** correspond to the **ACTUATION** of the 4 Analog inputs (respectively ADC_0 to ADC_3) when is active the PID regulation of the respective channel! To enable this feature you must put equal to 1 the BIT 0 and the BIT 2 of DATA.132 for ADC_0, of DATA.133 for ADC_1 until DATA.135 for ADC_3!

The outputs **from OUT.04 to OUT.07** correspond to the **ALARM** of the 4 Analog inputs (respectively ADC_0 to ADC_3) when is active the PID regulation of the respective channel! To enable this feature you must put equal to 1 the BIT 0 of DATA.132 for ADC_0, of DATA.133 for ADC_1 until DATA.135 for ADC_3!

Out	Description
OUT.00	Dedicated to the **ACTUATION** of the ADC 0 ** ONLY IF the Bit 0 and the BIT 2 of DATA.132 are equal to 1 **
OUT.01	Dedicated to the **ACTUATION** of the ADC 1 ** ONLY IF the Bit 0 and the BIT 2 of DATA.133 are equal to 1 **
OUT.02	Dedicated to the **ACTUATION** of the ADC 2 ** ONLY IF the Bit 0 and the BIT 2 of DATA.134 are equal to 1 **
OUT.03	Dedicated to the **ACTUATION** of the ADC 3 ** ONLY IF the Bit 0 and the BIT 2 of DATA.135 are equal to 1 **
OUT.04	Dedicated to the **ALARM** of the ADC 0 ** ONLY IF the Bit 0 of DATA.132 is equal to 1 **
OUT.05	Dedicated to the **ALARM** of the ADC 1 ** ONLY IF the Bit 0 of DATA.133 is equal to 1 **
OUT.06	Dedicated to the **ALARM** of the ADC 2 ** ONLY IF the Bit 0 of DATA.134 is equal to 1 **
OUT.07	Dedicated to the **ALARM** of the ADC 3 ** ONLY IF the Bit 0 of DATA.135 is equal to 1 **

Operating Example :

In a project, if you set an expansion DLC_4008 with ID = 1, the following 8 operands will be added :

OUT	Operand to use within the Project (LogicPaint / Flash)
OUT.00	**OUT.32**
OUT.01	**OUT.33**
OUT.02	**OUT.34**
OUT.03	**OUT.35**
OUT.04	**OUT.36**
OUT.05	**OUT.37**
OUT.06	**OUT.38**
OUT.07	**OUT.39**

If you activate the PID regulation of ADC 0 [Bit 0 of DATA.132 = 1] and ADC 1 [Bit 0 of DATA.133 = 1], then the outputs **OUT.04 [OUT.36] and OUT.05 [OUT.37]** will no longer be used in the project, it will be used by DLC_4008 to report any **ALARMS** (that is, when the setting exceeds the set value)!

Also, if you enable the actuation of the PID on the outputs :

[ADC 0 > Bit 2 of DATA.132 = 1]
[ADC 1 >Bit 2 of DATA.133 = 1]

Then even the outputs **OUT.00 [OUT.32] and OUT.01 [OUT.33]** will no longer be used in the project!

Therefore, they will remain available only OUT.34, OUT.35, OUT.38 and OUT.39 as shown in the table below :

OUT	Operand to use within the Project (LogicPaint / Flash)
OUT.00	***DEDICATED***
OUT.01	***DEDICATED***
OUT.02	**OUT.34**
OUT.03	**OUT.35**
OUT.04	***DEDICATED***
OUT.05	***DEDICATED***
OUT.06	**OUT.38**
OUT.07	**OUT.39**

2.4 Memory

The DLC_4008 have 256 memory locations at 16 bits (word) called DATA. This locations are intended to contain program variables and they are named **from DATA.00 to DATA.256** (with KNP or KERNEL protocol). Some internal DLC_4008 data, are system data, it means that they have a fixed meaning, or rather the value write in the system word is considered as a specific parameter; the following table show the memory map of the fixed data memory. With the Modbus RTU protocol, the memory map is on the HOLDING REGISTERS and compared to this memory map, the Modbus memory map have an offset of **0**.
Any DATA in the following table is a 16bits word. Any DATA which isn't in this table is a “free” data.
figure 1.0

Operands	Description	
DATA.00 *(Modbus - 00)*	***NET ADDRESS*** **:** In this DATA MEMORY is written the node address given to the expansion using the dip-switch, only if the expansion is turned on with address = 0	
DATA.08 *(Modbus - 08)*	***OUTPUTS*** : The first 8 bits represent the status of the digital outputs	
DATA.14 *(Modbus - 14)*	***COLD BITS*** : Bits corresponding to the temperature in degrees of the cold junction. Only for Analog inputs for thermocouples	
DATA.15 *(Modbus - 15)*	***COLD*** : Temperature in degrees of cold junction. Only for Analog inputs for thermocouples	
DATA.16 *(Modbus - 16)*	***ADC 0 INSTANT VALUE*** Bits of the instant value read from Analog input 0	
DATA.17 *(Modbus - 17)*	***ADC 1 INSTANT VALUE*** Bits of the instant value read from Analog input 1	

<table>
<tr><th>Operands</th><th>Description</th><th></th></tr>
<tr><td>DATA.18
(Modbus - 18)</td><td>ADC 2 INSTANT VALUE
Bits of the instant value read from Analog input 2</td><td></td></tr>
<tr><td>DATA.19
(Modbus - 19)</td><td>ADC 3 INSTANT VALUE
Bits of the instant value read from Analog input 3</td><td></td></tr>
<tr><td>DATA.20
(Modbus - 20)</td><td>ADC 0 FILTERED
Bits of the average value read from Analog input 0</td><td></td></tr>
<tr><td>DATA.21
(Modbus - 21)</td><td>ADC 1 FILTERED
Bits of the average value read from Analog input 1</td><td></td></tr>
<tr><td>DATA.22
(Modbus - 22)</td><td>ADC 2 FILTERED
Bits of the average value read from Analog input 2</td><td></td></tr>
<tr><td>DATA.23
(Modbus - 23)</td><td>ADC 3 FILTERED
Bits of the average value read from Analog input 3</td><td></td></tr>
<tr><td>DATA.24
(Modbus - 24)</td><td>ADC 0 TEMPERATURE
Value of the temperature in degrees read from Analog input 0</td><td></td></tr>
<tr><td>DATA.25
(Modbus - 25)</td><td>ADC 1 TEMPERATURE
Value of the temperature in degrees read from Analog input 1</td><td></td></tr>
<tr><td>DATA.26
(Modbus - 26)</td><td>ADC 2 TEMPERATURE
Value of the temperature in degrees read from Analog input 2</td><td></td></tr>
<tr><td>DATA.27
(Modbus - 27)</td><td>ADC 3 TEMPERATURE
Value of the temperature in degrees read from Analog input 3</td><td></td></tr>
<tr><td>DATA.128
(Modbus - 128)</td><td>SENSOR :
Type of sensor used for the Analog inputs (PT100 = 1 or TMC = 0)</td><td></td></tr>
<tr><td>DATA.132
(Modbus - 132)</td><td>PID FLAGS ADC 0 : The first six bits of this DATA enable a function of PID regulator.
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>0</td><td><u>Enable :</u> This bit must be set to enable PID regulation on channel 0</td></tr>
<tr><td>1</td><td><u>Temperature :</u> This bit must be set to have the PID regulation on the temperature value, if this bit is zero the PID regulation is on the DATA.136 value</td></tr>
<tr><td>2</td><td><u>Enable Actuation :</u> This bit must be set to have the bit number 3 (out) associated with expansion's output 0</td></tr>
<tr><td>3</td><td><u>Out :</u> It's the PID regulation bit output. The expansion output 0 will be set as this bit state if the bit 2 (actuation) is equal to 1</td></tr>
<tr><td>4</td><td><u>Ready:</u> It is set to 1 by the DLC when the PID regulation is in progress</td></tr>
<tr><td>5</td><td><u>Alarm:</u> If this bit is 1, it signal the regulation level over the set value.</td></tr>
</table>
Ultimately the PID regulation has two operating systems :
1. with the DATA.132 = 111 [bin], the PID regulation is performed according to the temperature value read by ADC 0
2. with the DATA.132 = 101 [bin], the PID regulation is performed according to the value written inside the DATA.136</td><td></td></tr>
</table>

<table>
<tr><th>Operands</th><th>Description</th><th></th></tr>
<tr><td>DATA.133
(Modbus - 133)</td><td>
PID FLAGS ADC 1 : The first six bits of this DATA enable a function of PID regulator.
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>0</td><td><u>Enable :</u>
This bit must be set to enable PID regulation on channel 1</td></tr>
<tr><td>1</td><td><u>Temperature :</u> This bit must be set to have the PID regulation on the temperature value, if this bit is zero the PID regulation is on the DATA.144 value</td></tr>
<tr><td>2</td><td><u>Enable Actuation :</u> This bit must be set to have the bit number 3 (out) associated with expansion's output 1</td></tr>
<tr><td>3</td><td><u>Out :</u> It's the PID regulation bit output. The expansion output 1 will be set as this bit state if the bit 2 (actuation) is equal to 1</td></tr>
<tr><td>4</td><td><u>Ready:</u> It is set to 1 by the DLC when the PID regulation is in progress</td></tr>
<tr><td>5</td><td><u>Alarm:</u> If this bit is 1, it signal the regulation level over the set value.</td></tr>
</table>
Ultimately the PID regulation has two operating systems :

with the DATA.133 = 111 [bin], the PID regulation is performed according to the temperature value read by ADC 1
with the DATA.133 = 101 [bin], the PID regulation is performed according to the value written inside the DATA.144

</td><td>  </td></tr>
<tr><td>DATA.134
(Modbus - 134)</td><td>
PID FLAGS ADC 2 : The first six bits of this DATA enable a function of PID regulator.
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>0</td><td><u>Enable :</u>
This bit must be set to enable PID regulation on channel 2</td></tr>
<tr><td>1</td><td><u>Temperature :</u> This bit must be set to have the PID regulation on the temperature value, if this bit is zero the PID regulation is on the DATA.152 value</td></tr>
<tr><td>2</td><td><u>Enable Actuation :</u> This bit must be set to have the bit number 3 (out) associated with expansion's output 2</td></tr>
<tr><td>3</td><td><u>Out :</u> It's the PID regulation bit output. The expansion output 2 will be set as this bit state if the bit 2 (actuation) is equal to 1</td></tr>
<tr><td>4</td><td><u>Ready:</u> It is set to 1 by the DLC when the PID regulation is in progress</td></tr>
<tr><td>5</td><td><u>Alarm:</u> If this bit is 1, it signal the regulation level over the set value.</td></tr>
</table>
Ultimately the PID regulation has two operating systems :

with the DATA.134 = 111 [bin], the PID regulation is performed according to the temperature value read by ADC 2
with the DATA.134 = 101 [bin], the PID regulation is performed according to the value written inside the DATA.152

</td><td>  </td></tr>
<tr><td></td><td>
PID FLAGS ADC 3 : The first six bits of this DATA enable a function of PID regulator.
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>0</td><td><u>Enable :</u>
This bit must be set to enable PID regulation on channel 3</td></tr>
</table>
</td><td></td></tr>
</table>

<table>
<tr><th>Operands</th><th>Description</th><th></th></tr>
<tr><td>DATA.135
(Modbus - 135)</td><td>
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>1</td><td><u>Temperature :</u> This bit must be set to have the PID regulation on the temperature value, if this bit is zero the PID regulation is on the DATA.160 value</td></tr>
<tr><td>2</td><td><u>Enable Actuation :</u> This bit must be set to have the bit number 3 (out) associated with expansion's output 3</td></tr>
<tr><td>3</td><td><u>Out :</u> It's the PID regulation bit output. The expansion output 3 will be set as this bit state if the bit 2 (actuation) is equal to 1</td></tr>
<tr><td>4</td><td><u>Ready:</u> It is set to 1 by the DLC when the PID regulation is in progress</td></tr>
<tr><td>5</td><td><u>Alarm:</u> If this bit is 1, it signal the regulation level over the set value.</td></tr>
</table>
Ultimately the PID regulation has two operating systems :
1. with the DATA.135 = 111 [bin], the PID regulation is performed according to the temperature value read by ADC 3
2. with the DATA.135 = 101 [bin], the PID regulation is performed according to the value written inside the DATA.160
</td><td></td></tr>
<tr><td>DATA.136
(Modbus - 136)</td><td>PID VALUE : In the case where the bit 1 of DATA.132 is equal to 1, inside the DATA.136 is copied in automatic the DATA.24, that is, the value in degrees of the temperature read on ADC 0, and on this value is performed the PID regulation in according to the selected parameters.
In the case where the bit 1 of DATA.132 is equal to 0, then in this DATA it will be written the value on which to perform the PID regulation according to the selected parameters</td><td></td></tr>
<tr><td>DATA.137
(Modbus - 137)</td><td>SET POINT : Value to reach in the PID 0 regulation</td><td></td></tr>
<tr><td>DATA.138
(Modbus - 138)</td><td>CYCLE TIME : Cycle Time in msec of the PID 0 regulation</td><td></td></tr>
<tr><td>DATA.139
(Modbus - 139)</td><td>BAND : Regulation Band over and under the set point value of the PID 0</td><td></td></tr>
<tr><td>DATA.140
(Modbus - 140)</td><td>INTEGRAL VALUE : Integral value which works in the PID 0 regulation</td><td></td></tr>
<tr><td>DATA.141
(Modbus - 141)</td><td>DERIVATIVE VALUE : Derivative value which works in the PID 0 regulation</td><td></td></tr>
<tr><td>DATA.142
(Modbus - 142)</td><td>ALARM : Alarm threshold above which will be set bit 5 of DATA.132</td><td></td></tr>
<tr><td>DATA.143
(Modbus - 143)</td><td>ACTUATION : Value of the actuation for DAC Output (0...255) PID 0</td><td></td></tr>
<tr><td>DATA.144
(Modbus - 144)</td><td>PID VALUE : In the case where the bit 1 of DATA.133 is equal to 1, inside the DATA.144 is copied in automatic the DATA.25, that is, the value in degrees of the temperature read on ADC 1, and on this value is performed the PID regulation in according to the selected parameters.
In the case where the bit 1 of DATA.133 is equal to 0, then in this DATA it will be written the value on which to perform the PID regulation according to the selected parameters</td><td></td></tr>
</table>

Operands	Description	
DATA.145 *(Modbus - 145)*	***SET POINT :*** Value to reach in the PID 1 regulation	
DATA.146 *(Modbus - 146)*	***CYCLE TIME :*** Cycle Time in msec of the PID 1 regulation	
DATA.147 *(Modbus - 147)*	***BAND :*** Regulation Band over and under the set point value of the PID 1	
DATA.148 *(Modbus - 148)*	***INTEGRAL VALUE :*** Integral value which works in the PID 1 regulation	
DATA.149 *(Modbus - 149)*	***DERIVATIVE VALUE :*** Derivative value which works in the PID 1 regulation	
DATA.150 *(Modbus - 150)*	***ALARM :*** Alarm threshold above which will be set bit 5 of DATA.133	
DATA.151 *(Modbus - 151)*	***ACTUATION :*** Value of the actuation for DAC Output (0...255) PID 1	
DATA.152 *(Modbus - 152)*	***PID VALUE :*** In the case where the bit 1 of DATA.134 is equal to 1, inside the DATA.152 is copied in automatic the DATA.26, that is, the value in degrees of the temperature read on ADC 2, and on this value is performed the PID regulation in according to the selected parameters. In the case where the bit 1 of DATA.134 is equal to 0, then in this DATA it will be written the value on which to perform the PID regulation according to the selected parameters	
DATA.153 *(Modbus - 153)*	***SET POINT :*** Value to reach in the PID 2 regulation	
DATA.154 *(Modbus - 154)*	***CYCLE TIME :*** Cycle Time in msec of the PID 2 regulation	
DATA.155 *(Modbus - 155)*	***BAND :*** Regulation Band over and under the set point value of the PID 2	
DATA.156 *(Modbus - 156)*	***INTEGRAL VALUE :*** Integral value which works in the PID 2 regulation	
DATA.157 *(Modbus - 157)*	***DERIVATIVE VALUE :*** Derivative value which works in the PID 2 regulation	
DATA.158 *(Modbus - 158)*	***ALARM :*** Alarm threshold above which will be set bit 5 of DATA.134	
DATA.159 *(Modbus - 159)*	***ACTUATION :*** Value of the actuation for DAC Output (0...255) PID 2	
DATA.160 *(Modbus - 160)*	***PID VALUE :*** In the case where the bit 1 of DATA.135 is equal to 1, inside the DATA.160 is copied in automatic the DATA.27, that is, the value in degrees of the temperature read on ADC 3, and on this value is performed the PID regulation in according to the selected parameters. In the case where the bit 1 of DATA.135 is equal to 0, then in this DATA it will be written the value on which to perform the PID regulation according to the selected parameters	

Operands	Description	
DATA.161 *(Modbus - 161)*	***SET POINT :*** Value to reach in the PID 3 regulation	
DATA.162 *(Modbus - 162)*	***CYCLE TIME :*** Cycle Time in msec of the PID 3 regulation	
DATA.163 *(Modbus - 163)*	***BAND :*** Regulation Band over and under the set point value of the PID 3	
DATA.164 *(Modbus - 164)*	***INTEGRAL VALUE :*** Integral value which works in the PID 3 regulation	
DATA.165 *(Modbus - 165)*	***DERIVATIVE VALUE :*** Derivative value which works in the PID 3 regulation	
DATA.166 *(Modbus - 166)*	***ALARM :*** Alarm threshold above which will be set bit 5 of DATA.135	
DATA.167 *(Modbus - 167)*	***ACTUATION :*** Value of the actuation for DAC Output (0...255) PID 3	

Legend	
Comment	**Icon**
DATA saved in E²PROM	
Read Only DATA memory	

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