

# DATA ACQUISITION AND CONTROL MODULES

The logo consists of the letters 'DM' in a white, bold, sans-serif font, centered within a solid green square.

## USER'S MANUAL

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## 0. Safety and Warranty

This manual should be available to the staff responsible for the installation and to the users of Data Acquisition and Control Modules (DM).

The installation and operation of the Data Acquisition and Control Modules (DM) doesn't usually involve personal safety risks, however the operation of substation equipment requests special cares and all applicable standards, safety procedures, safe working practices and good judgement must be used by personnel when installing, operating and maintaining such equipment.

### **WARNING:**

To guarantee user's safety, equipment protection and proper operation, the following cares should be followed during installation and maintenance of the Data Acquisition and Control Modules:

1. Read this manual carefully prior to the installation, operation and maintenance of the DM. Errors in the installation or in the settings of the DM may cause unsafe operation, involving risks of equipment damage or improper trip of substation equipment.
2. Personnel trained and familiar with control devices and command circuits of substation equipment should carry out the installation, settings and operation of the DM.
3. Pay special attention to the settings of the DM (see item 2), which will ensure safe operation of the equipment when properly effected. Also to the type and size of cables used on installation (see item 3) and to the start up procedures (see item 4).

### **WARRANTY AND LIMITATION OF LIABILITY:**

*The Data Acquisition and Control Modules (DM) will be guaranteed by Treotech for the period of 2 (two) years, exclusively against eventual production faults or quality vices that turns it inappropriate for regular use. The warranty will start from acquisition date and will obey the special discriminated conditions and recommendations in this manual. The warranty does not embrace damages suffered by the equipment caused by accidents, mistreatments, incorrect handling, installation or application, inadequate tests or breaking of the warranty seal. Warranty repairs should be made by Treotech technical attendance or by its nominated ones.*

*No warranties expressed or implied beyond those set out above are provided by Treotech. Treotech does not provide any implied warranty of merchantability and fitness for a particular application.*

*The seller shall not be liable for any property damages whatsoever or for any loss or damage arising out of, connected with, or resulting from this contract, or from the performance or breach thereof, or from all services possibly furnished together with the equipment.*

*In no event shall the seller be liable for special, incidental, exemplary, or consequential damages, including but not limited to, loss of profits or revenue, loss of use of the equipment or any associated equipment, cost of capital, cost of purchased power, cost of substitute equipment, facilities or services, downtime costs, or claims or damages of customers or employees of the Buyer for such damages, regardless of whether said claim or damages is based on contract, warranty, tort including negligence, or otherwise.*

*Under no circumstance shall the Seller be liable for any personal injury whatsoever.*



## 1. INTRODUCTION

The **Data Acquisition and Control Modules (DM)** are used to provide an interface between Digital Data Acquisition Systems (Host System) and analog or electromechanical devices that need to be supervised or controlled. As these devices normally don't have a serial communication port, the Data Acquisition DM's receive all the information (analog or discrete) and make them available to the Host System through their serial communication ports. On the other hand, the Control DM's receive commands sent by the Host System through their serial communication ports and open or close the output contacts, allowing the command of analog or electromechanical devices. There are three different types of DM, each of them available with 8, 16 or 24 inputs or outputs:

- **DM1** – *Data Acquisition Module with Digital Inputs* for status supervision of dry contacts;
- **DM2** - *Data Acquisition Module with Analog Inputs* for measurement of analog signals;
- **DM3** – *Control Module with Digital Outputs*, equipped with output dry contacts for switching of loads up to 250Vdc or 250Vac.

### Features:

- ✓ Continuous remote monitoring of dry contacts status (e.g. alarm, trip or signaling contacts);
- ✓ Continuous remote measurement of analog signals (e.g. temperature transducers, gas monitors, level gauges, etc.);
- ✓ Remote actuation of output dry contacts (turn-on/turn-off motors, lamps, alarm devices, etc).
- ✓ Communication through Serial Interface RS485 with Modbus RTU protocol;
- ✓ Interconnection of the DM's RS485 interfaces with the host system through a single twisted-pair cable. Optionally, optic fibers can be applied using electrical-optical converters (RS485 to optic fiber converter);
- ✓ Up to 31 DM's can be interconnected in the same RS485 network;
- ✓ Maximum length of RS485 communication cable 1300 meters, measured from one end to another;

Optionally, the Voltage Converter for the auxiliary power supply of the DM's can be furnished by Treotech. The Treotech Voltage Converter has been developed specifically for this application, with wide range input voltage (85 to 265Vdc/Vac, 50/60Hz) and two output voltages (5V and 12V), as required by the DM's. A single Voltage Converter can supply several DM's, according to the type and number of inputs/outputs (see Technical Characteristics).



## 2. ADJUSTS

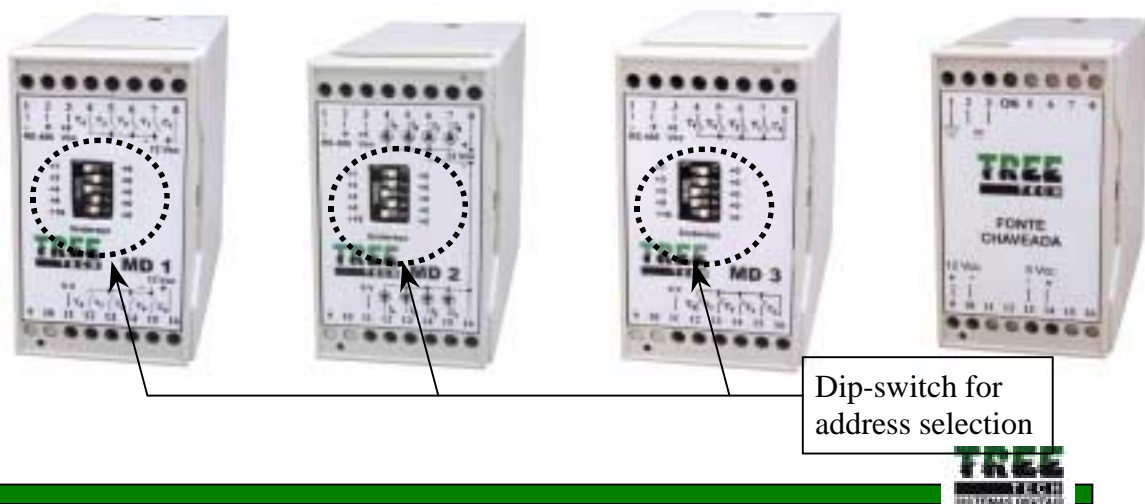
Each DM must have an unique address in the communication network, which can be adjusted at the 5-pole dip-switch selector located at the front panel of the equipment, as shown on figure 1. The desired address can be adjusted according to table 1.

- Range of Adjust: 0 to 31.

**TABLE 1 – ADDRESS MAP**

| Address | Dip Switch Position |   |   |   |   | Address | Dip Switch Position |   |   |   |   | LEGEND                      |
|---------|---------------------|---|---|---|---|---------|---------------------|---|---|---|---|-----------------------------|
|         | 5                   | 4 | 3 | 2 | 1 |         | 5                   | 4 | 3 | 2 | 1 |                             |
| 0       | ■                   | ■ | ■ | ■ | ■ | 16      | □                   | ■ | ■ | ■ | ■ | <b>ON</b> ■<br><b>OFF</b> □ |
| 1       | ■                   | ■ | ■ | ■ | □ | 17      | □                   | ■ | ■ | ■ | □ |                             |
| 2       | ■                   | ■ | ■ | □ | ■ | 18      | □                   | ■ | ■ | □ | ■ |                             |
| 3       | ■                   | ■ | ■ | ■ | □ | 19      | □                   | ■ | ■ | ■ | □ |                             |
| 4       | ■                   | ■ | □ | ■ | ■ | 20      | □                   | ■ | □ | ■ | ■ |                             |
| 5       | ■                   | ■ | ■ | ■ | □ | 21      | □                   | ■ | ■ | ■ | □ |                             |
| 6       | ■                   | ■ | ■ | □ | ■ | 22      | □                   | ■ | □ | ■ | ■ |                             |
| 7       | ■                   | ■ | ■ | ■ | □ | 23      | □                   | ■ | ■ | ■ | □ |                             |
| 8       | ■                   | □ | ■ | ■ | ■ | 24      | □                   | □ | ■ | ■ | ■ |                             |
| 9       | ■                   | ■ | ■ | ■ | □ | 25      | □                   | ■ | ■ | ■ | □ |                             |
| 10      | ■                   | ■ | ■ | □ | ■ | 26      | □                   | ■ | □ | ■ | ■ |                             |
| 11      | ■                   | ■ | ■ | ■ | □ | 27      | □                   | ■ | ■ | ■ | □ |                             |
| 12      | ■                   | ■ | ■ | ■ | ■ | 28      | □                   | ■ | ■ | ■ | ■ |                             |
| 13      | ■                   | ■ | ■ | □ | ■ | 29      | □                   | ■ | ■ | ■ | □ |                             |
| 14      | ■                   | ■ | ■ | ■ | ■ | 30      | □                   | ■ | ■ | ■ | ■ |                             |
| 15      | ■                   | ■ | ■ | ■ | □ | 31      | □                   | □ | ■ | ■ | ■ |                             |

**FIGURE 1 – DM's AND VOLTAGE CONVERTER FRONTAL PANELS**



### 3. INSTALLATION

The best place to install the DM units is inside the control cabinet of the equipment to be monitored or controlled, so that the minimum of connection cables is used and the information is transmitted with only a twisted-pair cable. The DM is adequate for fixation on standard 35mm mounting rail.

All connections must be in accordance with figure 2 (Connection Diagrams).

Serial communication among the DM and the host system (the master of the Modbus communication protocol) is made through the RS 485 port, which presents low susceptibility to electromagnetic interference, allowing operation at a maximum end-to-end distance of the communication net of 1.3 km. Port interconnections must be made through twisted pair and one-end grounded shielded cables.

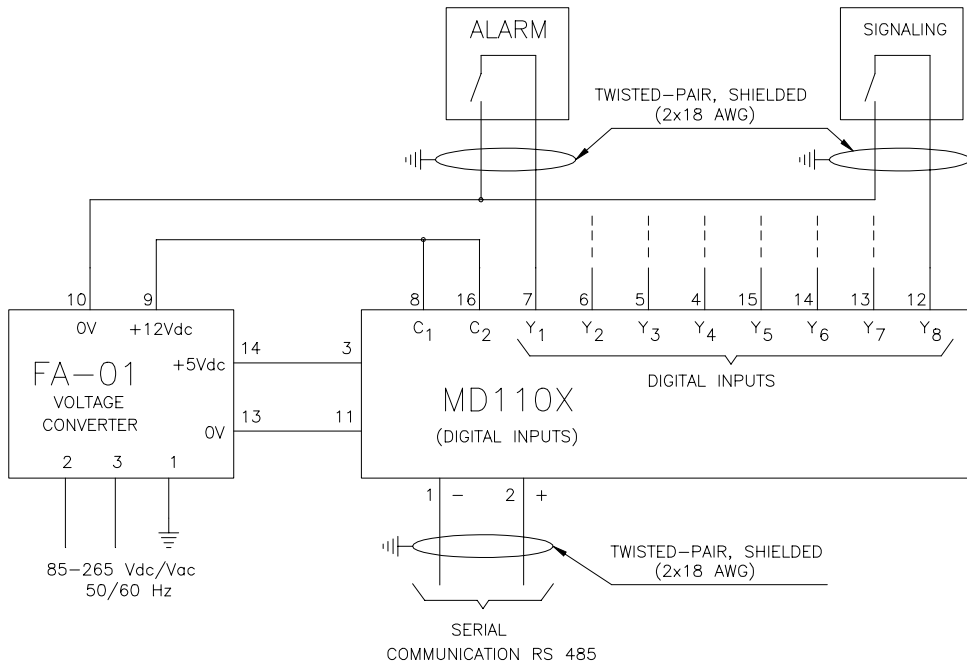
### 4. START UP

- Set the network address of each DM, as well as other devices that may be on the same communication network, as described in item 2. Each address number must be assigned to a single device.
- Turn on the DM units energizing the voltage converter FA with 85 to 265 Vdc/Vac power supply.
- Check the communication of each DM unit by addressing it in the host system or in a diagnosis software.
- In case of DM's for analog or digital inputs, verify if the information send through the serial communication is in accordance with the input variable in the DM.
- In case of DM's for digital output, verify if the corresponding output contact closes and opens when the host system or the diagnosis software sends a command.

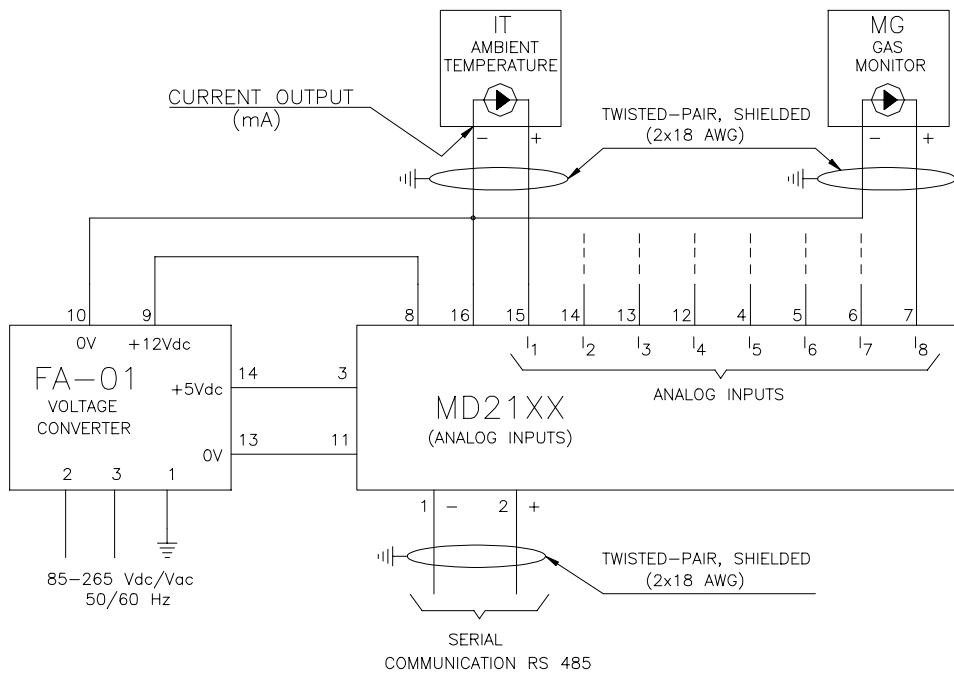


**FIGURE 2 – CONNECTION DIAGRAM**

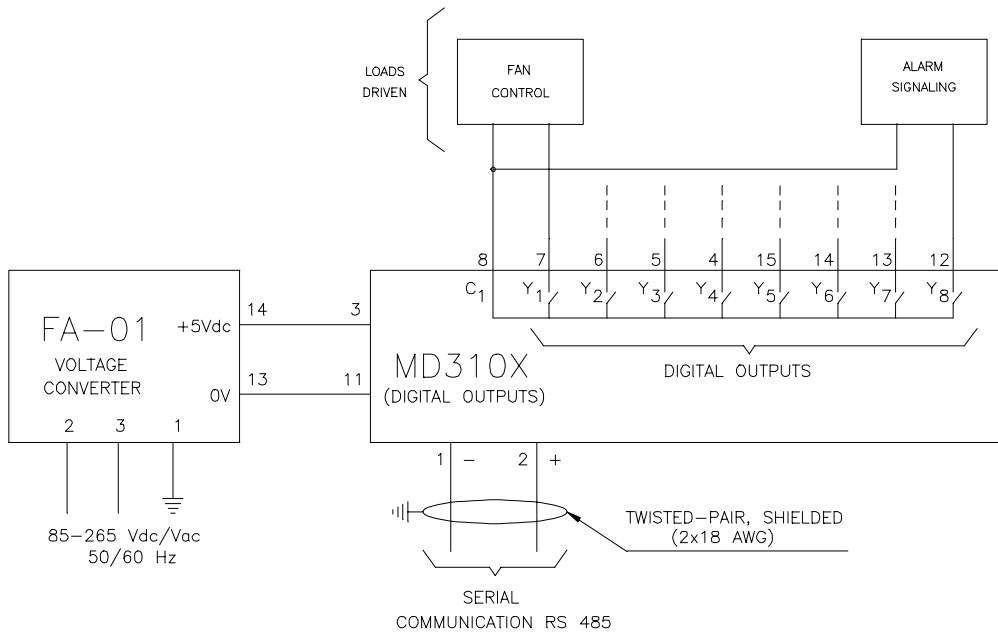
**a) DM with 8 digital inputs (type DM110X)**



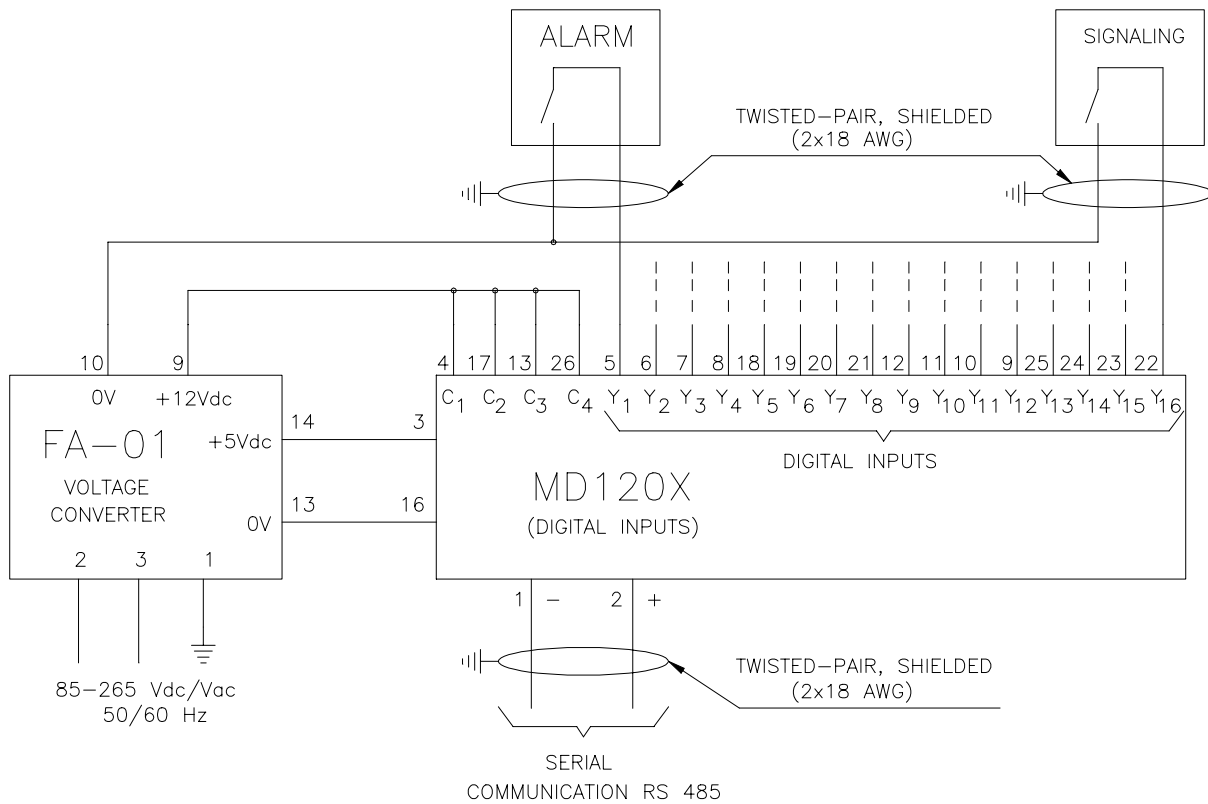
**b) DM with 8 analog inputs (type DM21XX)**



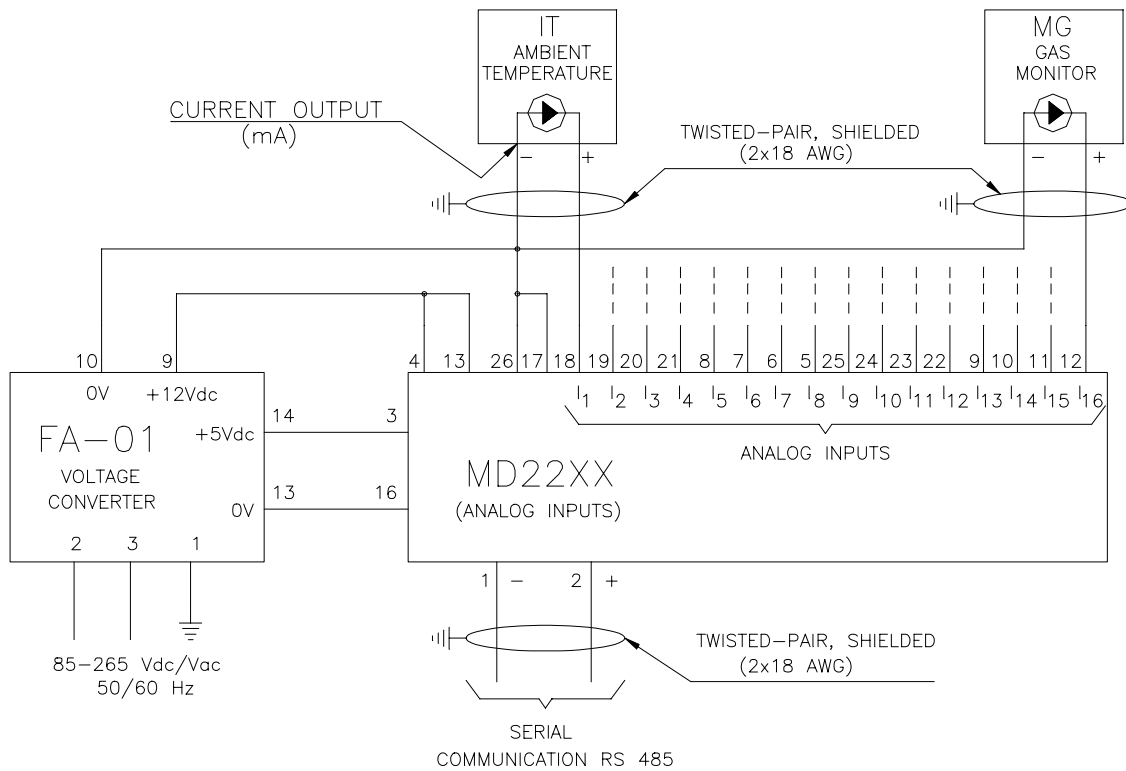
**c) DM with 8 digital outputs (type DM310X)**



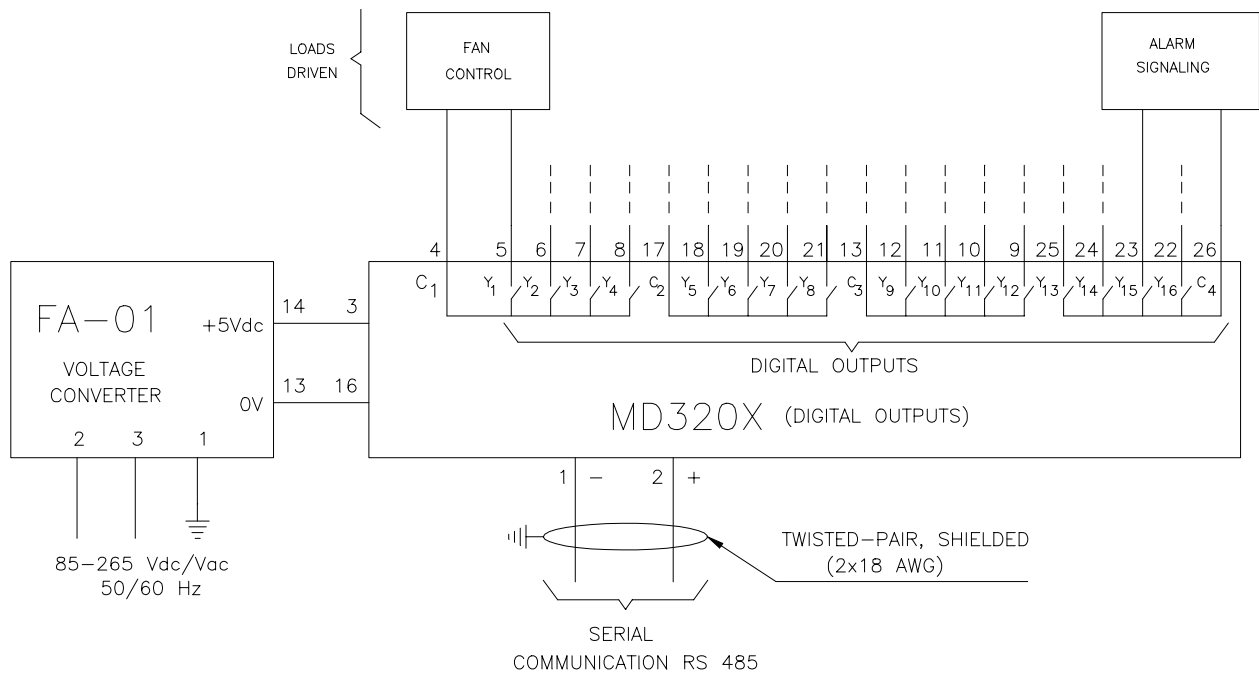
**d) DM with 16 digital inputs (type DM120X)**



**e) DM with 16 analog inputs (type DM22XX)**

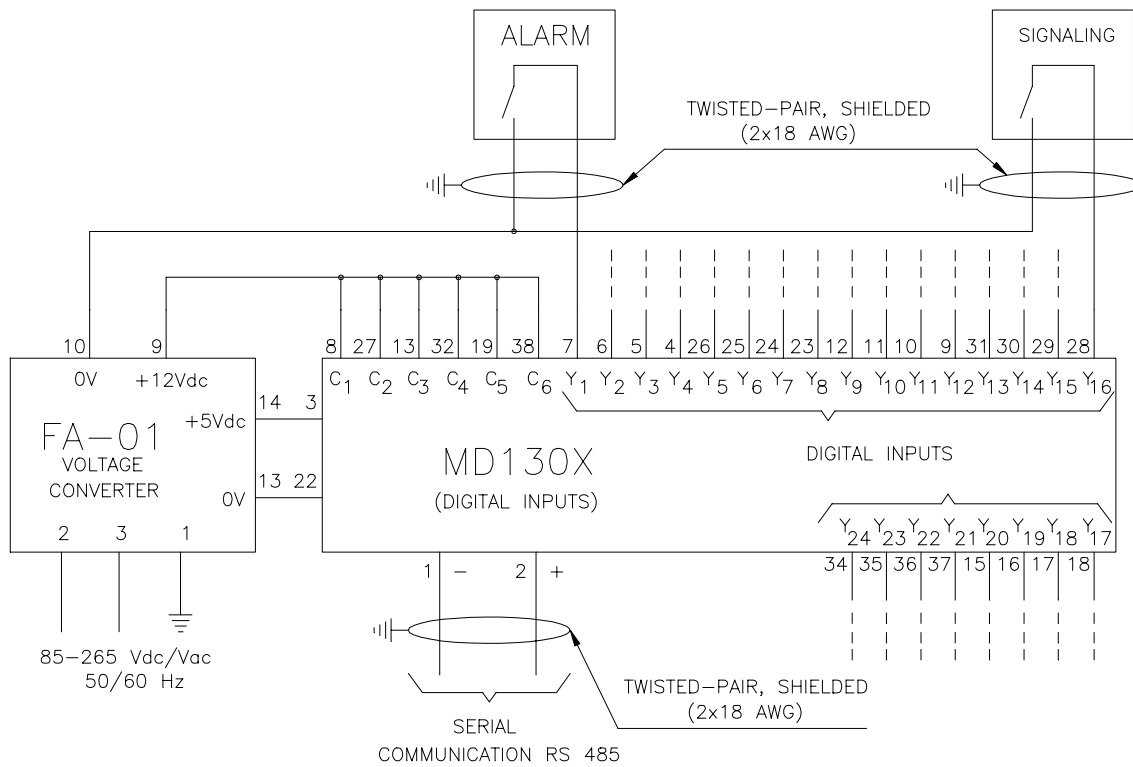


**f) DM with 16 digital outputs (type DM320X)**

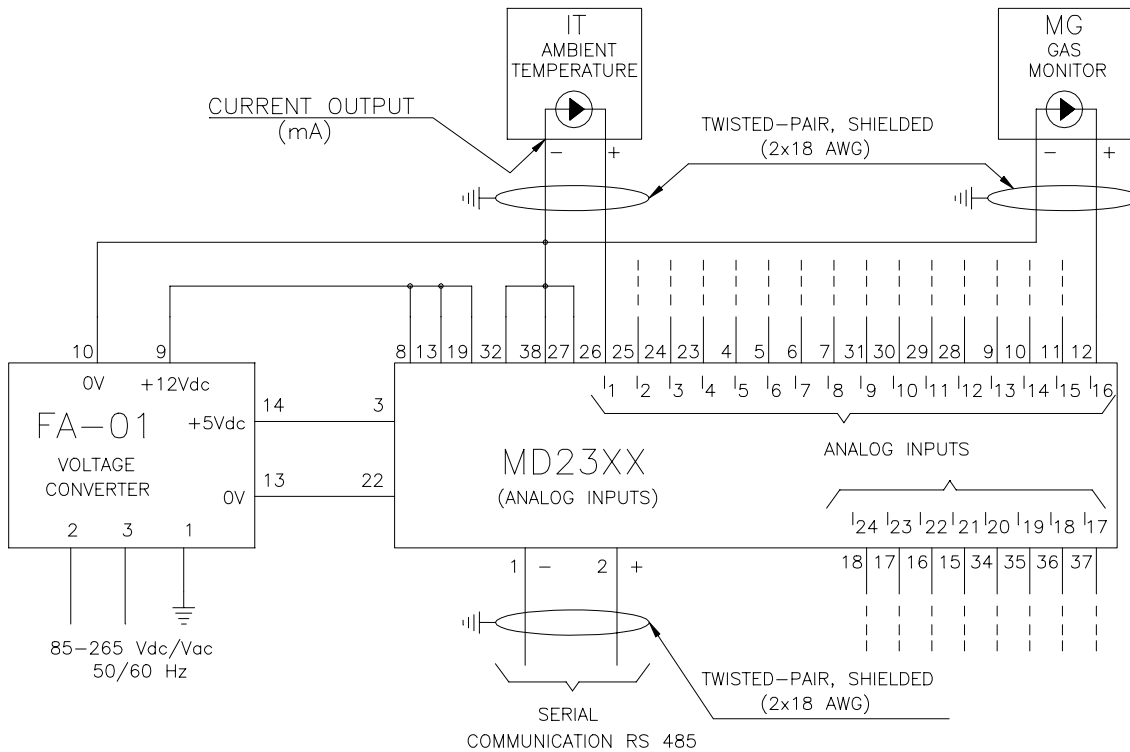




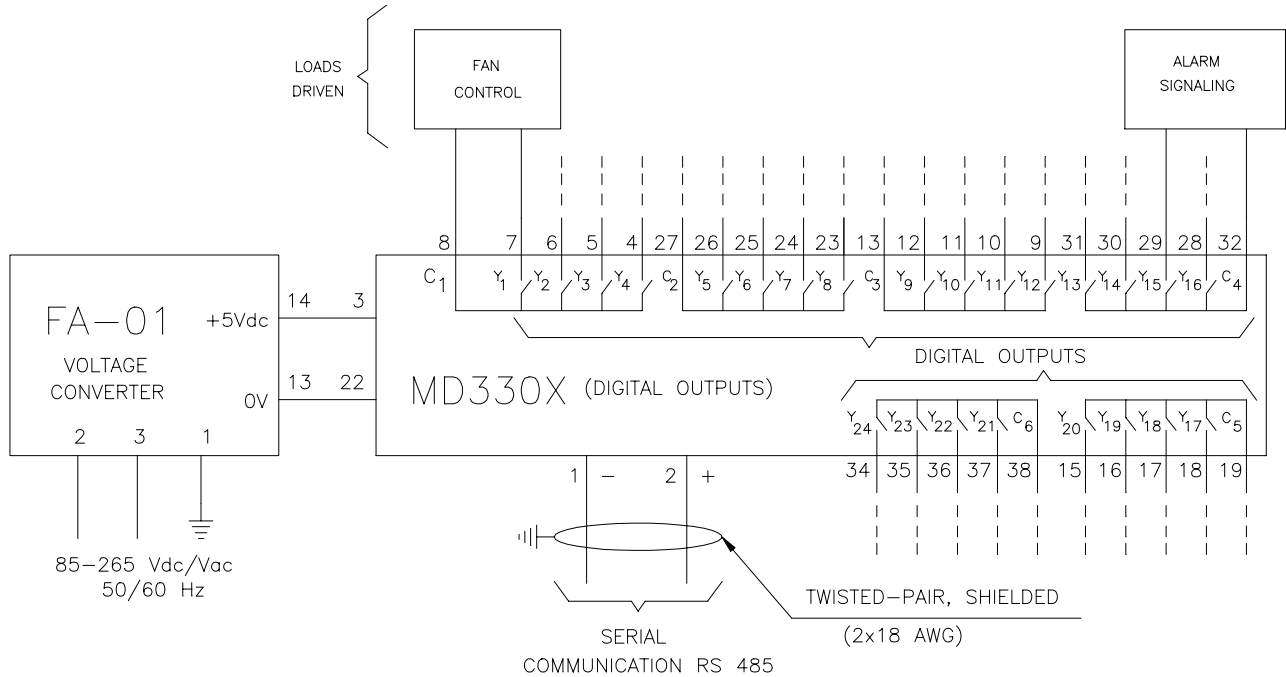
**g) DM with 24 digital inputs (type DM130X)**



**h) DM with 24 analog inputs (type DM23XX)**



**i) DM with 24 digital outputs (type DM330X)**



**5. TECHNICAL CHARACTERISTICS**

**5.1 Digital Input Module**

|  |                             |
|--|-----------------------------|
| <b>Supply Voltage (digital circuit):</b> | 5 Vdc $\pm$ 5%              |
| <b>Consumption in 5V:</b>                | < 0.5 W per 8 input block   |
| <b>Operation Temperature:</b>            | -10 to +70 °C               |
| <b>Serial Communication:</b>             | RS 485, Modbus RTU Protocol |
| <b>Protection Degree:</b>                | IP 40                       |
| <b>Fixing:</b>                           | Mounting on 35mm rail       |
| <b>Type of Input:</b>                    | Potential-free contacts     |
| <b>Number of Inputs:</b>                 | 8, 16 or 24                 |
| <b>Input contacts wetting:</b>           | 12 Vdc $\pm$ 20%            |
| <b>Consumption of inputs in 12V:</b>     | < 0.15 W per contact        |



## 5.2 Analog Input Module

|  |  |
|--|--|
| <b>Supply Voltage (digital circuit):</b> | 5 Vdc $\pm$ 5%   |
| <b>Consumption in 5V:</b>                | < 0.5 W per 8 input block  |
| <b>Supply Voltage (analog circuit):</b>  | 12 Vcc $\pm$ 20%   |
| <b>Consumption in 12V:</b>               | < 0.15 W per 8 input block   |
| <b>Operation Temperature:</b>            | -10 to +70 °C  |
| <b>Serial Communication:</b>             | RS 485, Modbus RTU Protocol  |
| <b>Protection Degree:</b>                | IP 40  |
| <b>Fixing:</b>                           | Mounting on 35mm rail  |
| <b>Type of Input:</b>                    | Analog, mA current   |
| <b>Measurement Resolution:</b>           | 10 bits  |
| <b>Maximum error:</b>                    | 0,5% of end of scale   |
| <b>Number of Inputs:</b>                 | 8, 16 or 24  |
| <b>Input Options and Load:</b>           | 0 ... 1 mA - 1000 $\Omega$<br>0 ... 5 mA - 200 $\Omega$<br>0 ... 10 mA - 100 $\Omega$<br>0 ... 20 mA - 50 $\Omega$ |

## 5.3 Digital Output Module

|  |   |
|--|---|
| <b>Supply Voltage (digital circuit):</b> | 5 Vdc $\pm$ 5%  |
| <b>Consumption in 5V:</b>                | < 2 W per 8 input block   |
| <b>Operation Temperature:</b>            | -10 to +70 °C   |
| <b>Serial Communication:</b>             | RS 485, Modbus RTU Protocol   |
| <b>Protection Degree:</b>                | IP 40   |
| <b>Fixing:</b>                           | Mounting on 35mm rail   |
| <b>Number of Outputs:</b>                | 8, 16 or 24   |
| <b>Type of Output:</b>                   | Normally Open Potential-free Contacts   |
| <b>Maximum Switching Power:</b>          | 70 W / 250 VA   |
| <b>Maximum Switching Voltage:</b>        | 250 Vdc/Vac   |
| <b>Maximum Conduction Current</b>        | 1.0 A for each individual contact<br>1.0 A total for each block of 4 outputs with the same common connection terminal |

## 5.4 Voltage Converter FA-01 – Optional

|                                     |                           |
|-------------------------------------|---------------------------|
| <b>Supply Voltage:</b>              | 85 to 265 Vdc/Vac 50/60Hz |
| <b>Consumption:</b>                 | < 15 W                    |
| <b>Operation Temperature:</b>       | -10 to +70 °C             |
| <b>Protection Degree:</b>           | IP 40                     |
| <b>Fixing:</b>                      | Mounting on 35mm rail     |
| <b>Output Voltages:</b>             | 5Vdc and 12Vdc            |
| <b>Maximum power of 5V output:</b>  | 7,5 W                     |
| <b>Maximum power of 12V output:</b> | 4,5 W                     |



## 6. TYPE TESTS

### Surge and Transients (IEC 60255-6)

|  |          |
|--|----------|
| 1 <sup>st</sup> half cycle peak value: | 2.5 kV   |
| Frequency:                             | 1.1 MHz  |
| Application time:                      | 2 s      |
| Surges per second:                     | 400      |
| Decay to 50% of peak value:            | 5 cycles |

### Impulse (IEC 60255-5)

|                   |  |
|-------------------|--|
| Waveform:         | 1.2/50 $\mu$ s   |
| Amplitude:        | 5 kV   |
| Number of pulses: | 3 negative e 3 positive with 5 second interval between pulses. |
| Energy:           | 0.5J   |

### Applied Voltage (IEC 60255-5)

|  |   |
|--|---|
| Power frequency rated withstand voltage: | 2.0 kVrms, 60 Hz, for 1 minute between circuits and mass. |
|--|---|

### Electromagnetic Compatibility (IEC 61000-4-3)

|                  |               |
|------------------|---------------|
| Severity Level:  | 3             |
| Frequency:       | 20 to 2000MHz |
| Field Intensity: | 10 V/m        |

### Climatic Test (IEC 60068-2-14)

|                    |              |
|--------------------|--------------|
| Temperature range: | -10 to +70°C |
| Test time:         | 6 hours      |

### Electrostatic Discharge (IEC 61000-4-2)

|                 |                             |
|-----------------|-----------------------------|
| Mode "air":     | 10 discharges level 3 (8kV) |
| Mode "contact": | 10 discharges level 3 (8kV) |

### Fast Electrical Transients (IEC 61000-4-4)

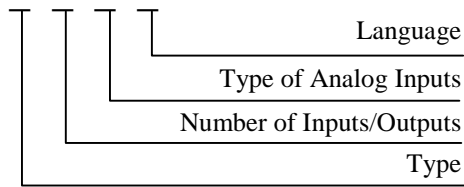
|                                       |     |
|---------------------------------------|-----|
| Severity Level:                       | 4   |
| Test on auxiliary power supply input: | 4kV |
| Test on inputs/outputs:               | 2kV |



## 7. ORDER SPECIFICATION

### 7.1 Data Acquisition and Control Modules

**DM -**



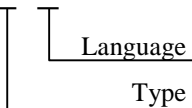
**Example: DM – 1102**

Data Acquisition Module with 8 digital inputs, labels in English

| <b>Where:</b> | <b>Type</b>       | <b>Number of Inputs/Outputs</b> | <b>Type of Analog Inputs</b> | <b>Language:</b> |
|---------------|-------------------|---------------------------------|------------------------------|------------------|
|               | 1 Digital Inputs  | 1 8                             | 0 Not Applicable             | 1 Portuguese     |
|               | 2 Analog Inputs   | 2 16                            | 1 0 ... 1 mA                 | 2 English        |
|               | 3 Digital Outputs | 3 24                            | 2 0 ... 5 mA                 | 3 Spanish        |
|               |                   |                                 | 3 0 ... 10 mA                |                  |
|               |                   |                                 | 4 0 ... 20 mA                |                  |

### 7.2 Voltage Converter (Optional)

**FA -**



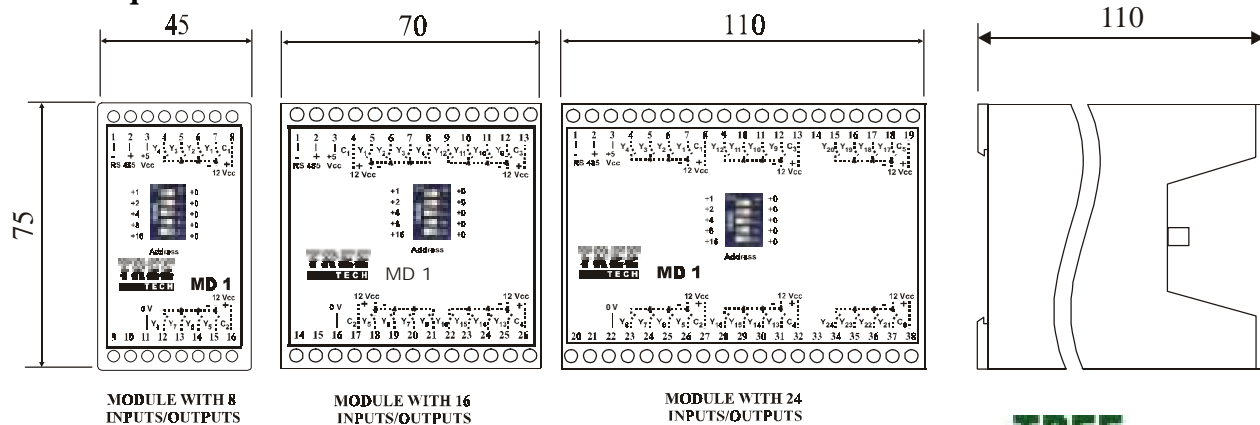
**Example: FA – 012**

Voltage Converter with 5Vdc and 12 Vdc Outputs, labels in English

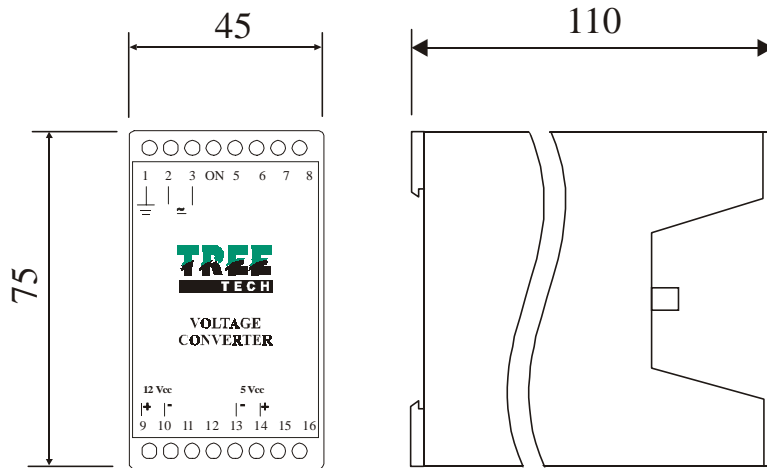
| <b>Where:</b> | <b>Type</b>                             | <b>Language:</b>                       |
|---------------|---|--|
|               | 01 – Output Voltages<br>5Vdc and 12 Vdc | 1 Portuguese<br>2 English<br>3 Spanish |

## FIGURA 3 – DIMENSIONS

### a) Data Acquisition and Control Modules



## b) Voltage Converter (Optional)



## 8. SERIAL COMMUNICATION

### 8.1 General Information

|                       |   |
|-----------------------|---|
| Protocol:             | Modbus  |
| Mode:                 | RTU (binary)  |
| Baud Rate:            | 9600 bits per second (other baud rates under request)                             |
| Data Bits:            | 8   |
| Stop bits:            | 2   |
| Parity:               | None  |
| Implemented Commands: | 03 (Read hold registers, in block or individually)<br>06 (Preset single register) |



## 8.2 Digital Input module DM1 – Register Map

### a) Read only addresses

| <u>Register</u> | <u>Description</u>         | <u>Minimum</u> | <u>Maximum</u> | <u>Unit</u><br>1)    |
|-----------------|----------------------------|----------------|----------------|----------------------|
| 0               | Configuration              | 8              | 24             |                      |
| 1               | Input block 1 (Y8...Y1)    | 2)             |                |                      |
| 2               | Input block 2 (Y16...Y9)   | 2)             |                |                      |
| 3               | Input block 3 (Y24...Y17)  | 2)             |                |                      |
| 4               | Active period of input Y1  | 0              | 65534          | cycles <sup>3)</sup> |
| 5               | Active period of input Y2  | 0              | 65534          | cycles <sup>3)</sup> |
| 6               | Active period of input Y3  | 0              | 65534          | cycles <sup>3)</sup> |
| 7               | Active period of input Y4  | 0              | 65534          | cycles <sup>3)</sup> |
| 8               | Active period of input Y5  | 0              | 65534          | cycles <sup>3)</sup> |
| 9               | Active period of input Y6  | 0              | 65534          | cycles <sup>3)</sup> |
| 10              | Active period of input Y7  | 0              | 65534          | cycles <sup>3)</sup> |
| 11              | Active period of input Y8  | 0              | 65534          | cycles <sup>3)</sup> |
| 12              | Active period of input Y9  | 0              | 65534          | cycles <sup>3)</sup> |
| 13              | Active period of input Y10 | 0              | 65534          | cycles <sup>3)</sup> |
| 14              | Active period of input Y11 | 0              | 65534          | cycles <sup>3)</sup> |
| 15              | Active period of input Y12 | 0              | 65534          | cycles <sup>3)</sup> |
| 16              | Active period of input Y13 | 0              | 65534          | cycles <sup>3)</sup> |
| 17              | Active period of input Y14 | 0              | 65534          | cycles <sup>3)</sup> |
| 18              | Active period of input Y15 | 0              | 65534          | cycles <sup>3)</sup> |
| 19              | Active period of input Y16 | 0              | 65534          | cycles <sup>3)</sup> |
| 20              | Active period of input Y17 | 0              | 65534          | cycles <sup>3)</sup> |
| 21              | Active period of input Y18 | 0              | 65534          | cycles <sup>3)</sup> |
| 22              | Active period of input Y19 | 0              | 65534          | cycles <sup>3)</sup> |
| 23              | Active period of input Y20 | 0              | 65534          | cycles <sup>3)</sup> |
| 24              | Active period of input Y21 | 0              | 65534          | cycles <sup>3)</sup> |
| 25              | Active period of input Y22 | 0              | 65534          | cycles <sup>3)</sup> |
| 26              | Active period of input Y23 | 0              | 65534          | cycles <sup>3)</sup> |
| 27              | Active period of input Y24 | 0              | 65534          | cycles <sup>3)</sup> |

### b) Read and write address

| <u>Register</u> | <u>Description</u> | <u>Minimum</u> | <u>Maximum</u> | <u>Unit</u><br>4) |
|-----------------|--------------------|----------------|----------------|-------------------|
| 28              | Cycle Extension    | 10             | 65535          | ms                |

#### Remarks:

- 1) Indicates how many inputs are installed in the DM1 module (8, 16 or 24).
- 2) State of inputs, in binary mode. 1=contact closed; 0=contact open.
- 3) Number of cycles the input is active (contact closed). See remark 4 for the definition of "cycle". This number keeps changing while the input is active.
- 4) Cycle extension. Determines the time extension of one cycle. This information is used in registers 4 to 27 for counting the time any input remains active (contact closed). Default value: 1000; this variable returns to default at DM1 reset.



### 8.3 Digital Output module DM3 – Register Map

#### a) Read only addresses

| <u>Register</u> | <u>Description</u> | <u>Minimum</u> | <u>Maximum</u> | <u>Unit</u>   |
|-----------------|--------------------|----------------|----------------|---------------|
| 0               | Configuration      | 8              | 24             | <sup>1)</sup> |

#### b) Read and write address

| <u>Register</u> | <u>Description</u>         | <u>Minimum</u> | <u>Maximum</u> | <u>Unit</u> |
|-----------------|----------------------------|----------------|----------------|-------------|
| 1               | Output block 1 (Y8...Y1)   | <sup>2)</sup>  |                |             |
| 2               | Output block 2 (Y16...Y9)  | <sup>2)</sup>  |                |             |
| 3               | Output block 3 (Y24...Y17) | <sup>2)</sup>  |                |             |

#### Remarks:

- 1) Indicates how many inputs are installed in the DM3 module (8, 16 or 24).
- 2) State of outputs, in binary mode. 1=contact closed; 0=contact open.





## 8.4 Analog Input module DM2 – Register Map

### a) Read only addresses

| <u>Register</u> | <u>Description</u> | <u>Minimum</u> | <u>Maximum</u> | <u>Unit</u> |
|-----------------|--------------------|----------------|----------------|-------------|
| 0               | Configuration      | 8              | 24             | 1)          |
| 1               | Analog Input I1    | 0              | 4095           | 2)          |
| 2               | Analog Input I2    | 0              | 4095           | 2)          |
| 3               | Analog Input I3    | 0              | 4095           | 2)          |
| 4               | Analog Input I4    | 0              | 4095           | 2)          |
| 5               | Analog Input I5    | 0              | 4095           | 2)          |
| 6               | Analog Input I6    | 0              | 4095           | 2)          |
| 7               | Analog Input I7    | 0              | 4095           | 2)          |
| 8               | Analog Input I8    | 0              | 4095           | 2)          |
| 9               | Analog Input I9    | 0              | 4095           | 2)          |
| 10              | Analog Input I10   | 0              | 4095           | 2)          |
| 11              | Analog Input I11   | 0              | 4095           | 2)          |
| 12              | Analog Input I12   | 0              | 4095           | 2)          |
| 13              | Analog Input I13   | 0              | 4095           | 2)          |
| 14              | Analog Input I14   | 0              | 4095           | 2)          |
| 15              | Analog Input I15   | 0              | 4095           | 2)          |
| 16              | Analog Input I16   | 0              | 4095           | 2)          |
| 17              | Analog Input I17   | 0              | 4095           | 2)          |
| 18              | Analog Input I18   | 0              | 4095           | 2)          |
| 19              | Analog Input I19   | 0              | 4095           | 2)          |
| 20              | Analog Input I20   | 0              | 4095           | 2)          |
| 21              | Analog Input I21   | 0              | 4095           | 2)          |
| 22              | Analog Input I22   | 0              | 4095           | 2)          |
| 23              | Analog Input I23   | 0              | 4095           | 2)          |
| 24              | Analog Input I24   | 0              | 4095           | 2)          |

### Remarks:

- 1) Binary data. Indicates how many analog inputs are installed in the DM2 module (8, 16 or 24).
- 2) Value proportional to the current measured.  
 Version 0...1mA - 0 = 0mA; 4095 = 1.2mA  
 Version 0...5mA - 0 = 0mA; 4095 = 6mA  
 Version 0...10mA - 0 = 0mA; 4095 = 12mA  
 Version 0...20mA - 0 = 0mA; 4095 = 24mA

