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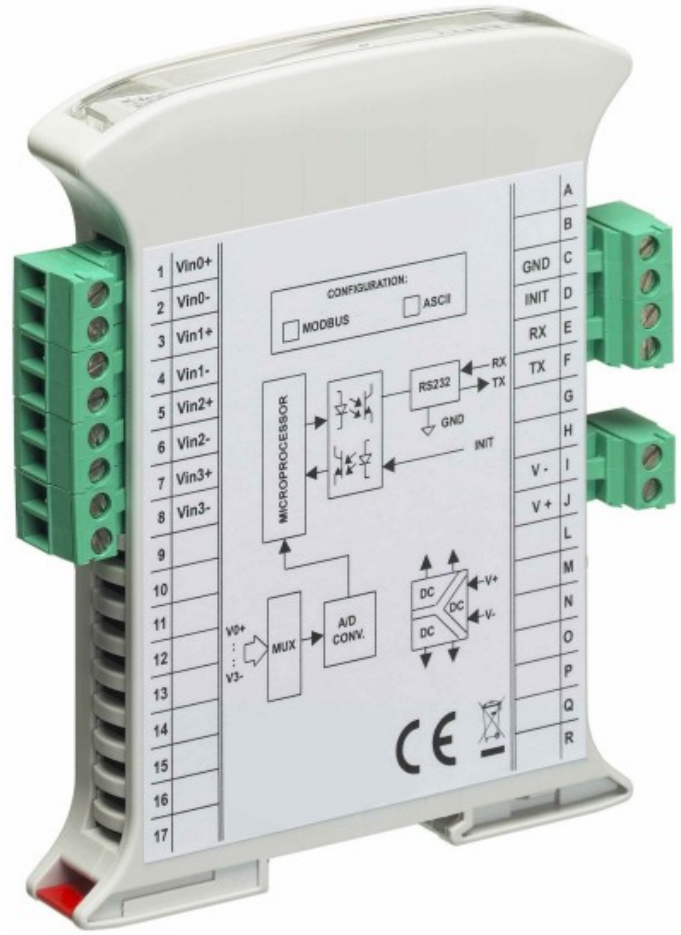
EMOD 3015/V



• Field-Bus remote data acquisition
• Modbus Slave device on RS-485
• Modbus RTU/ Modbus ASCII protocol
• 4 channels input up to ± 10V
• Remotely Configurable
• Watch-Dog Alarm
• 2000 Vac 3-ways Galvanic Isolation
• High Accuracy
• UL / CE mark
• DIN rail mounting in compliance with EN-50022

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Indice

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1.0 General Description

The EMOD 3015V device is able to acquire on input up to 4 analog voltage signals. Data values are transmitted with MODBUS RTU/ASCII protocol on the RS-485 network (RS-232 interface is available).

It is possible to connect up to ± 10V voltage signals.

By means of a 16 bit converter, the device guarantee a high accuracy and a stable measure versus time and temperature. To ensure the plant safety, two Watch-Dog timer alarms are provided.

The 2000 Vac isolation between input, power supply and serial line removes eventual ground-loop effects, allowing the use of the device even in the heavy environmental conditions.

The EMOD 3015V is in compliance with the Directive 2004/108/EC on the electromagnetic compatibility.

The device is housed in a rough self-extinguishing plastic container which, thanks to its thin profile of 17.5mm only, allows a high density mounting on EN-50022 standard DIN rail.

1.1 Communication protocols

The EMOD3015V is designed to work with the MODBUS RTU/ASCII protocol: standard protocol in field-bus; allows to directly interface EMOD3000 series devices to the larger part of PLCs and SCADA applications available on the market. For the protocol instructions, see the relative User Guide.

1.2 User instructions

Before to install the device, please read the “Installation Instruction” section.

If the module configuration is unknown, it can be hardly to establish a communication with them; connecting the INIT terminal to the GND terminal (ground), at the next power-up the device will be auto-configured in the default settings (see Operating User Guide). Connect power supply, serial bus and analog inputs as shown in the “Wiring” section.

The “PWR” LED state depending to the working condition of the device: see the "Light Signalling" section to verify the device working state. To perform configuration and calibration operations, read the instructions in the Operating User Guide.

To simplify handling or replacing of the device, it is possible to remove the wired terminals even with the device powered.

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2.0 Technical Specifications

Typical @ 25 °C and in the nominal conditions

Input type	Min	Max
Voltage 10 V	-10 V	+10 V

Input Calibration (1)	
	± 10 mV
Linearity (1)	
Volt	± 0.1% f.s.
Input Impedance	
Volt	> 100 KΩ
Thermal drift (1)	
Full Scale	± 0.005 % / °C
Sample time	0.5 ÷ 1 sec.
Data Transmission	
Baud Rate	38.4 Kbps
Max distance	1.2 Km

(1) Referred to input Span (difference between max. and min. values)

Power Supply	
Supply Voltage	10 .. 30 Vdc
Current consumption	30 mA @ 24 Vdc
Polarity inversion protection	60 Vdc max
Isolation	
Input – RS485	2000 Vac 50 Hz, 1 min.
Supply – Input	2000 Vac 50 Hz, 1 min.
Supply – RS485	2000 Vac 50 Hz, 1 min.
Temperature & Humidity	
Operating temperature	-10°C .. +60°C
Storage temperature	-40°C .. +85°C
Humidity (non condensing)	0 .. 90 %
Housing	
Material	Self-extinguishing plastic
Mounting	EN-50022 DIN rail
Weight	~ 150 g.
EMC (for industrial environments)	
Immunity	EN 61000-6-2
Emission	EN 61000-6-4

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2.1 Installation Instructions

The EMOD 3015-V is suitable for fitting to DIN rails in the vertical position.

For optimum operation and long life follow these instructions:

When the devices are installed side by side it may be necessary to separate them by at least 5 mm in the following case:

- If panel temperature exceeds 45°C and at least one of the overload conditions exist.

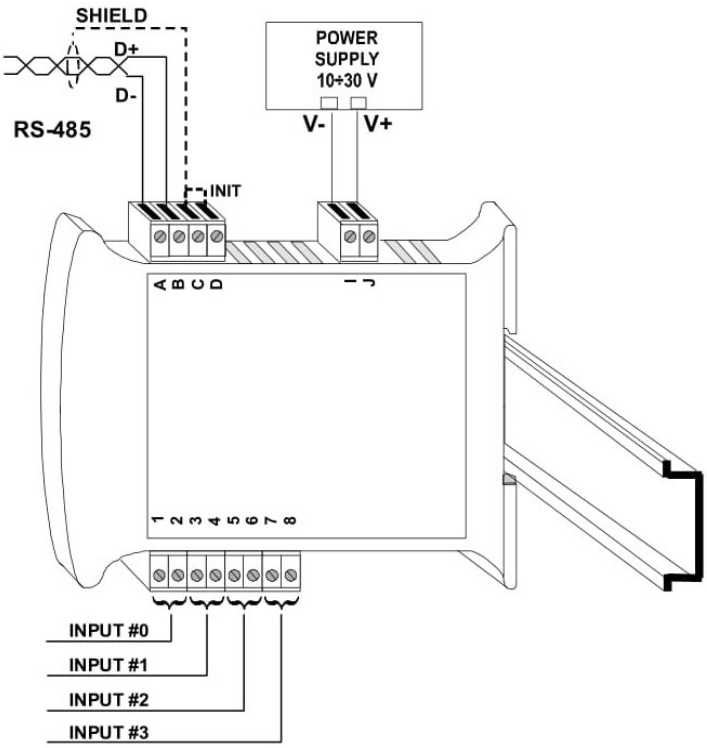
Make sure that sufficient air flow is provided for the device avoiding to place raceways or other objects which could obstruct the ventilation slits.

Moreover it is suggested to avoid that devices are mounted above appliances generating heat; their ideal place should be in the lower part of the panel.

Install the device in a place without vibrations.

Moreover it is suggested to avoid routing conductors near power signal cables (motors, induction ovens, inverters etc...) and to use shielded cable for connecting signals.

2.2 Cabling



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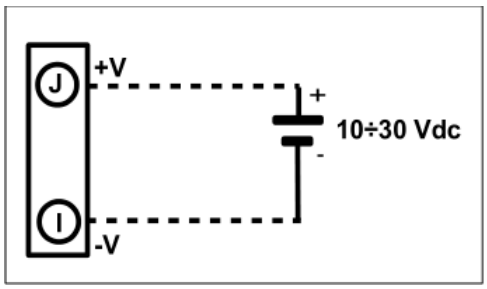
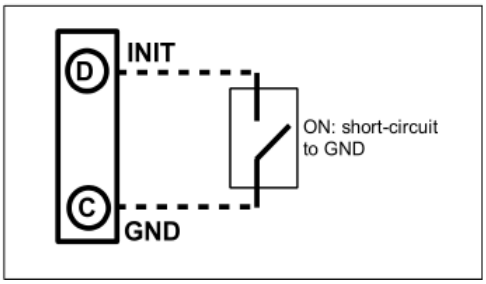
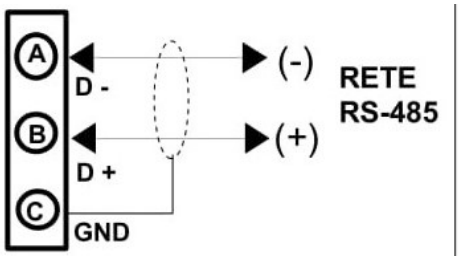
2.3 Wiring

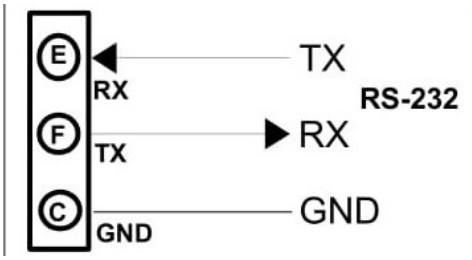
2.3.1 Power supply and INIT





2.3.2 Serial (RS232/485)





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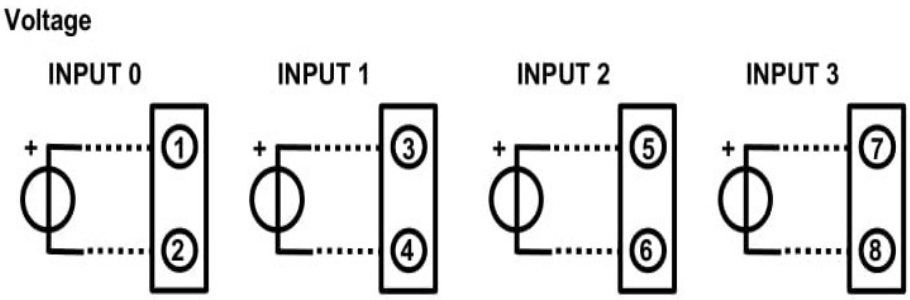
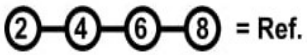
2.3.3 Analog input



NOTE: input channels are not isolated between them.



= Ref.

2.4 Light signalling

LED	COLOUR	STATE	DESCRIPTION
PWR	GREEN	ON	Device powered
		OFF	Device non powered / Wrong RS-485 cabling
		FAST BLINK	Communication in progress (blink frequency depends to Baud-rate)
		1 second BLINK	Watch-Dog Alarm condition

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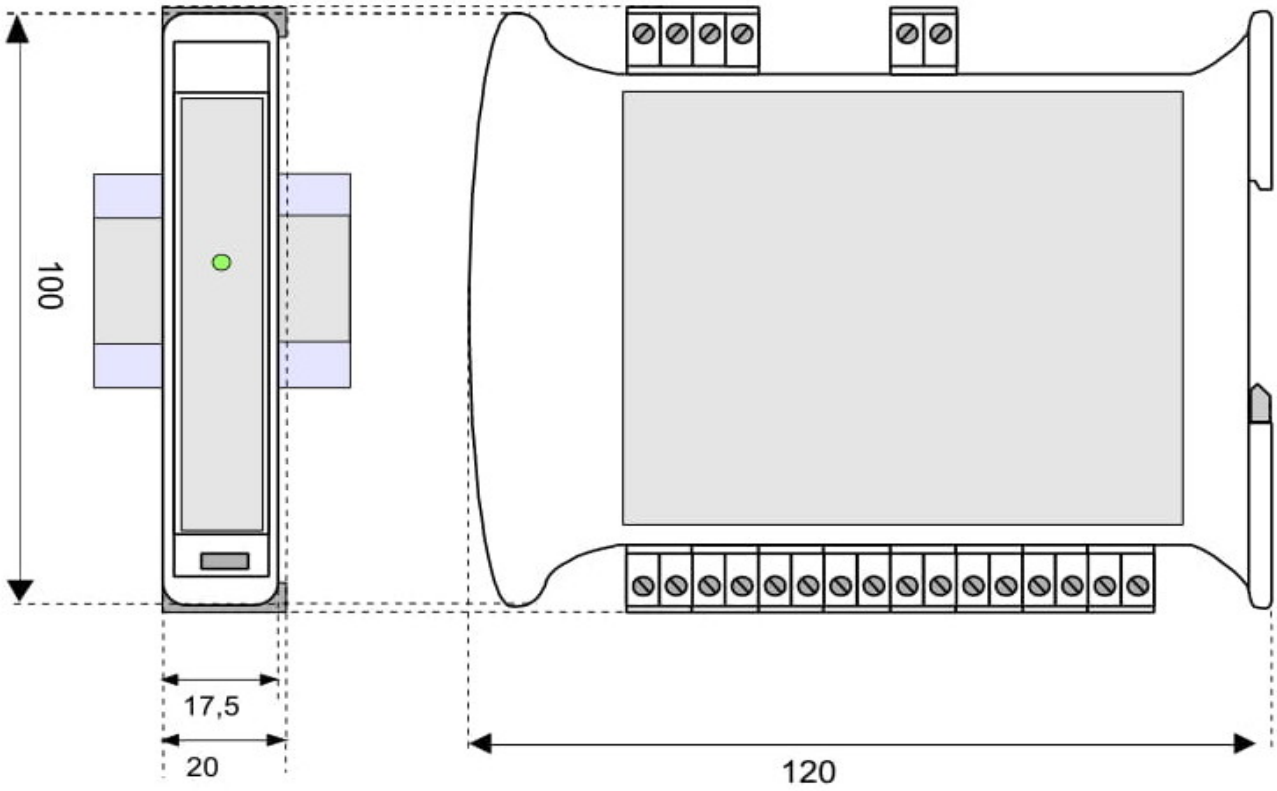
2.5 Mechanical dimension (mm)



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3.0 General description Modbus

All the data variables shared by a Modbus module are shown in tables, where each data is linked to one address.

Each data can be of two types:

- “COIL”, composed by a single bit, can be associated to digital input (switch), digital outputs (relays), logic states (alarms).
- “REGISTER”, composed by 2 bytes (16 bits), can be associated to analog input or outputs, variables, set-point, etc...

A register can also include the image of more coils, for example the 16 digital inputs of a device can be read and write as bit, one by one, addressing the relative coil , or they can be read or write as a single 16-bit port addressing the associated register, where for example the last significant bit will respond to the first coil.

In the Modbus protocol, coils and registers are divided in banks:

0xxxx and 1xxxx = Coils (bits)

3xxxx and 4xxxx = Registers (words)

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3.1 Registers table

Register	Description	Access	E²P
40000	Test	R/W	
40001	Firmware Version	R	
40002		R	
40003	Device Name	R/W	*
40004		R/W	*
40005	Communication	R/W	*
40006	Address	R/W	*
40007	RX/TX Delay	R/W	*
40008	Watchdog Timer	R/W	*
40009	Coils	R/W	
40010	-- (reserved)	R/W	*
40011	Channel Enable	R/W	*
40012	-- (reserved)	R/W	*
40013	-- (reserved)	R	
40014	Input # 0	R	
40015	Input # 1	R	
40016	Input # 2	R	
40017	Input # 3	R	
40018	-- (reserved)	R	
40019	-- (reserved)	R	
40020	-- (reserved)	R	
40021	-- (reserved)	R	
40022	Sync. value input # 0	R	
40023	Sync. value input # 1	R	
40024	Sync. value input # 2	R	
40025	Sync. value input # 3	R	
40026	-- (reserved)	R	
40027	-- (reserved)	R	
40028	-- (reserved)	R	
40029	-- (reserved)	R	

NOTE:
The registers marked with ' * ' in the ' E2P ' column are saved in EEPROM each time they are written, to be automatically reloaded to each power-on of the device.

3.2 Coils table

Coil	Description	Access	E²P
00008	Watchdog Enable	R/W	
00009	Watchdog Event	R/W	
00010	Power Up Event	R/W	

3.3 Implemented modbus functions

Function	Description
01	Read multiple coils (0xxxx bank)
02	Read multiple coils (1xxxx bank)
03	Read multiple registers (4xxxx bank)
04	Read multiple registers (3xxxx bank)
05	Write single coil
06	Write single register
15	Write multiple coils
16	Write multiple registers
08	Diagnostic

NOTE:
For EMOD3000 series devices, the bank 0xxxx is a mirror of bank 1xxxx, as the 3xxxx bank is a mirror of bank 4xxxx, as for i.e. the first register can be read indifferently as 30001 (with the function 04) or 40000 (with the function 03)

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4.0 Register description Modbus

40000 : TEST

This register is used to perform the following functions:

- Analog inputs calibration (see the “Procedures” section).
- Synchronized sampling (see the “Procedures” section).

40001 / 40002 : FIRMWARE VERSION

Read-only 2-register field, that hold the manufacturer firmware identifier.

- Manufacturer default: 3310 (hex)

40003 / 40004 : DEVICE NAME

2-registers field (4 byte or 4 ASCII characters) user free, that can hold the device name or a function identifier.

Each byte can be written with each value from 0 to 255, than ASCII characters too.

- Manufacturer default: “3015” (ASCII).

40005 : COMMUNICATION

Set the bits of this register as shown in the following table, to set the baud-rate, the bit number, the parity type and the protocol type.

- Manufacturer default:38400 bps, RTU mode

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Desc	-	-	-	-	-	-	-	-	-	M	P1	P0	N	B2	B1	B0

Mode	M
ASCII	0
RTU	1

Parity	P1	P0
Mark	0	0
Even	0	1
Odd	1	0
Space	1	1

N°bit	N
7 bit	0
8 bit	1

BaudRate	B2	B1	B0
1200	0	0	0
2400	0	0	1
4800	0	1	0
9600	0	1	1
19200	1	0	0
38400	1	0	1
---	1	1	0
---	1	1	1

NOTE:

- the bit number is ignored, as for in ASCII mode it is fixed to 7 and in RTU mode it is fixed to 8.
- In RTU mode the parity is ignored (parity *NONE*)

40006 : ADDRESS

Specify the net address of the device; there are allowed the address from 1 to 255.

Each device connected to the same net must have a unique address.

The address 255 is used for broadcast functions (i.e. synchronized sampling)

- Manufacturer default: 01

40007 : RX/TX delay

Specify the value of the delay between the reception of a command and the response transmission, indicated in milliseconds.

- Manufacturer default: 1 (1 ms.)

40008 : WATCHDOG TIMER

Specify the value of the WatchDog Timer (see the “Procedures” section), indicated in steps of 0.5 seconds.

- Manufacturer default: 10 (5 sec.)

40009 : COILS

This register is a mirror of the coils table: each bit of this register corresponds to a coil, as shown in the following table.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Coil	-	-	-	-	-	-	-	-	-	-	-	-	-	11	10	09

40010 : (reserved)

This register must have the default value:

- EMOD 3015-V = 04
- EMOD 3015-I = 06

40011 : CHANNEL ENABLE

It is suggested to disable the channels not used. Write the relative bit on this register to enable (1) or disable (0) the channel.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Channel	-	-	-	-	-	-	-	-	-	-	-	-	#3	#2	#1	#0

40014 : INPUT VALUE # 0

40015 : INPUT VALUE # 1

40016 : INPUT VALUE # 2

40017 : INPUT VALUE # 3

These registers contain the measure value for each input channel, converted in engineering units: the values are expressed in Ohm for resistance input, % for potentiometer input and °C for RTD inputs.

The format is a 16bit signed integer; the decimal number depends from the input type, as shown in the table.

Type	Decimals
± 10 V	3
± 20 mA	3

40022 : SYNCHRONISM INPUT VALUE # 0

40023 : SYNCHRONISM INPUT VALUE # 1

40024 : SYNCHRONISM INPUT VALUE # 2

40025 : SYNCHRONISM INPUT VALUE # 3

When the device receive the Sync command (see the “Procedures” section), the actual input values in the 40014÷40017 registers are saved in these registers, channel by channel, to be read in a following time.

5.0 Coils description

00008 : WATCHDOG ALARM ENABLE

Enable the WatchDog alarm. If the alarm is enabled and the device does not receive any command for a time longer than the time specified in the 40008 register, the WatchDog alarm Event coil is forced to 1 (see the “Procedures” section).

- 0 = Watchdog alarm disabled
- 1 = Watchdog alarm enabled

00009 : WATCHDOG ALARM EVENT

This coil indicates the condition of WatchDog Alarm. If the alarm is enabled and the device does not receive any command for a time longer than the time specified in the 40008 register, this coil is forced to 1. To return from the alarm condition, set this coil to 0.

- 0 = Normal Condition
- 1 = Alarm Condition

00010 : POWER-UP EVENT

This coil is forced to 1 at each power-on of the device; this state indicates that the device has been switched off.

It is possible to know if a reset of the device is happened clearing this coil and monitoring its state.

- 0 = reset not happened
- 1 = reset happened

6.0 Procedures

6.1 “Init” functions

If the exact configuration of a module is unknown, it can result impossible to establish a communication with it.

The “INIT” function gives a solution to this throuble:

- Connect to the RS485 net only the device to configure.
- Turn off the device.
- Connect the INIT pin (D) to the GND pin (C)
- Turn on the device.
- Ensures that the “PWR” green LED on the front of the enclosure is lighted.

If not, control the voltage supply connections (I and J pins) and RS485 net connections (A and B pins).

If the supply connection is right, and the led still unlighted, it can be necessary to invert the RS485 pins connection.

Set the communication port to these values:

- baud-rate = 9600 bps
- parity = None
- n° bits = 8
- stop bits = 1

The device now communicates at the address 01 with the RTU protocol.

Read or program the desired settings on the registers:

- 40005 : “Communication” for the baud-rate setting
- 40006 : “Address” for the net address of the device

Turn off the device.

Disconnect the INIT pin from the GND pin.

Turn on the device.

Set the communication port at the baud-rate programmed in the 40005 register.

The device now communicates with the addressprogrammed in the 40006 register.

NOTE: The default manufacturer programmation is the following:

- Address: 01;
- Baud-rate = 38400 bps
- Protocol: RTU

6.2 Watchdog

The modules has been provided of a Host Watchdog timer which, when it is enabled, makes to start the alarm each time the communication between the module and the host is inactive for a period time greater then the programmed one.

When the alarm goes on, the values of the outputs are automatically converted to the values set as ‘safety value’, that corresponding to the state in which the outputs must be putted, and therefore the actuators are putted, to avoid damages to the system in case of failure.

Moreover, under the alarm condition the green LED on the front of the enclosure is blinking and the “Watchdog Event” coil is forced to 1.

To return from the alarm condition, reset the coil “Watchdog Event” coil: the LED stop blinking and it is possible to set the outputs. There is also a Module Watchdog timer that monitor the internal CPU work and is active when the CPU don't function correctly for any reason, and resets the module.

After the reset, all outputs will assume their initial default value (“power up value”), that may be different to the output value after the reset.

6.3 Synchronism

The Synchronism function is performed by a command sent to all devices connected on the net. When the devices receive the Sync command, all input states are saved in the relative register, to be read after time. Doing this, it is possible to read the value of all inputs at the Sync command time.

To send the synchronism command, write the value 10 in the “Test” register (40000) at the address 255.

NOTE: The sync values are not saved in EPROM.

6.4 Calibration

The procedure of calibration is performed in factory on all the modules during the testing phase. However it can be convenient to make another calibration of the module according to the requirements of the user. To make this, it is necessary to use precision instruments and to correctly perform all the necessary steps, because any error reduces the accuracy and the good operation of the device.

To re-calibrate the device, follow this procedure:

1. Turn on the device in INIT condition
2. Connect a calibrator to the channel #0.
3. Program the input type to be calibrated
4. Set the calibrator at 0V or 0mA
5. Write on the “Test” register (40000) the value 20.
6. Set the calibrator to the full-scale value (10V or 20mA)
7. Write on the “Test” register (40000) the value 30.
8. Repeat point 3 to 7 for each input type to be calibrated.