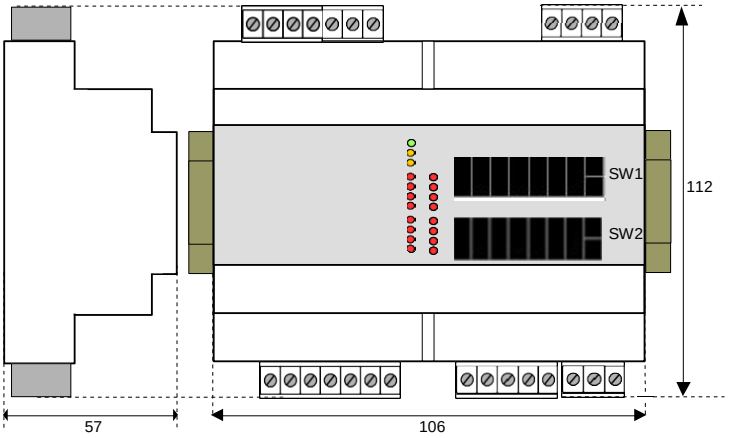
SmartMod+
Digital Input Module
HE379DIM616
16 Digital Inputs

1 Specifications

Input Channels	16	**Reverse Polarity Protection**	60 Vdc max
Voltage input (Bipolar)	OFF: 0/3V ON: 10/30V	**Isolation**	1500 Vac, 50Hz, 1 min
Impedance	4.7KΩ	**Storage Temp.**	-40° to 85° C
Sample Time (per channel)	5 ms	**Operating Temp.**	-10° to 60° C
No. of Counters	8	**Relative Humidity**	0 to 90% Non-condensing
Counter Register Size	16 bit	**Mounting**	DIN Rail standard EN-50022
Counter Frequency	Up to 100 Hz	**Weight**	200g
Minimum Pulse Width	1 ms	**Communications**	Modbus/RTU RS-485 half duplex
External Power Supply Voltage	10-30Vdc	**Max. Data Transmission Baud Rate**	115.2 Kbps
Current Consumption (Operative)	40mA @ 24Vdc 85mA @ 10Vdc	**Max. Distance**	1200m
CE Compliance	Immunity EN 61000-6-2 Emission EN 61000-6-4		

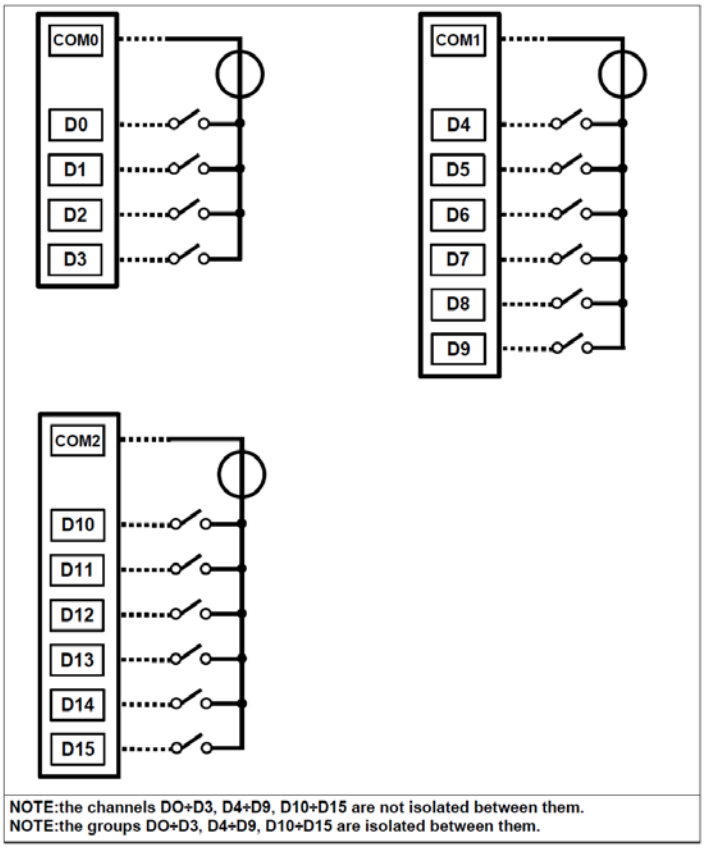
Mechanical Dimensions (mm)



Note: Number of I/O terminal connections varies from model to model

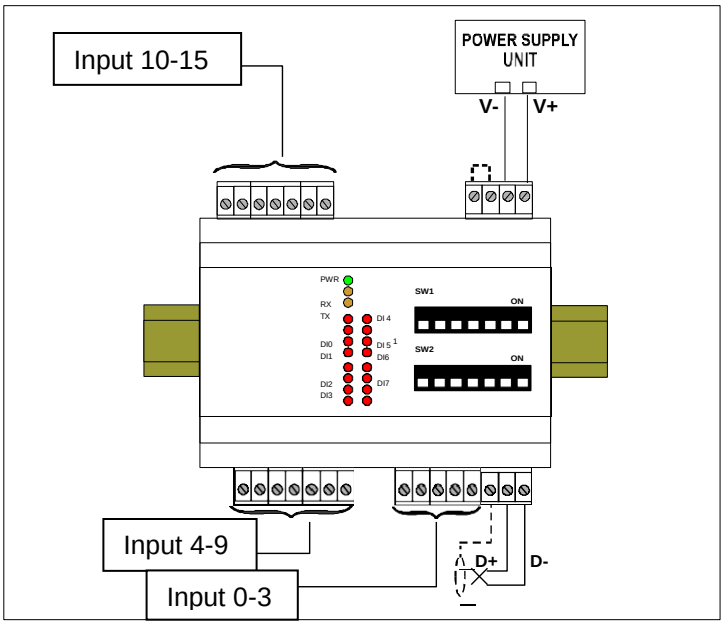
CONNECTIONS

Digital Inputs

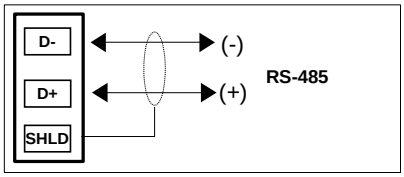


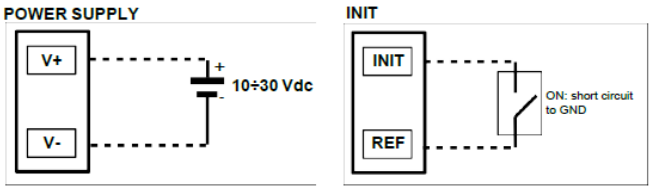
NOTE:the channels DO+D3, D4+D9, D10+D15 are not isolated between them.
NOTE:the groups DO+D3, D4+D9, D10+D15 are isolated between them.

2 Wiring – I/O



Serial Line RS485

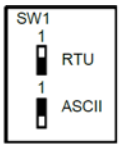




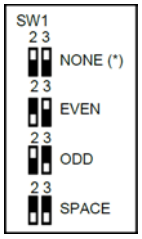
3 DIP Switches: Table of Configuration

Warning: Set all the dip-switches to the OFF position to access the module in EEPROM mode (the module will follow all the communication parameters set by the software) or INIT.
Power-cycle the module to apply the settings of the dip-switches.

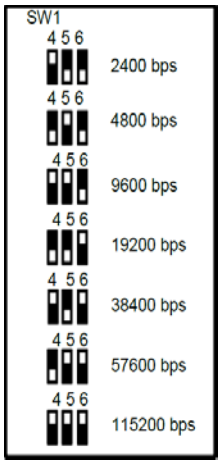
Tab 1: Mode Settings (Pos.1)



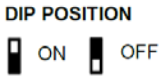
TAB.2. Parity settings (Pos.2 LSB; Pos.3 MSB)



TAB.3 Baud rate settings (Pos.4 LSB; Pos.6 MSB)



Note (*)
-in **Modbus RTU** mode the setting is **NONE, number of bits = 8**
-in **Modbus ASCII** mode the setting is **MARK, number of bits = 7**



4 Communication Protocols

This module is designed to work with the MODBUS RTU/MODBUS ASCII protocol, the standard protocol in fieldbus, and allows the direct interface of HE379 series modules to all Horner X-Series controllers.

5 User Instructions

Before installing this module, please read the **Installation Instructions** section carefully. It is possible to configure the module using the dip-switches located on the front of the module using the INIT mode. Connect the terminal INIT to the terminal REF and, at power-on, the module will be automatically set to the configuration set-up. Connect the power supply, serial bus and analogue inputs as shown in the **Wiring** section. The LEDs state depends on the working condition of the module, see the **LED Indicator** section to verify the modules working state. To perform configuration and calibration operations, read the instructions below.

To simplify handling or replacing the module, it is possible to remove the wired terminals when the module is powered on.

6 Installation Instructions

Attach the HE379DIM616 to DIN rails in the vertical position. For optimum operation follow these instructions:

When the modules are installed side by side and - If the panel temperature exceeds 45°C and power supply voltage is 10 VDC - **it may be necessary to separate them by >5 mm:**

Make sure that there is sufficient air flow around the module, avoid placing near cable routing or other objects that can obstruct the ventilation slits. Additionally, avoid mounting modules above appliances that generate heat. Ideally, they should be placed in the lower part of the panel. Install the module in a location without vibration.

It is also recommended to avoid routing conductors near power signal cables (motors, induction ovens, inverters etc...) and to use shielded cables for connecting signals.

7 LED Indicator

LED	COLOUR	STATE	DESCRIPTION
POWER	Green	ON	Device Powered
		OFF	Device Not Powered
		BLINK	1 sec. - Watch-Dog alarm condition occurred
RX	Orange	BLINK	Receiving Data
		OFF	Not receiving data
TX	Orange	BLINK	Transmitting Data
		OFF	Not Transmitting data
DI	Red	ON	Digital Input ON state
		OFF	Digital Input OFF state

The LED's are located on the front of the model.

8 User Guide- MODBUS Protocol

All of the data shared by modules communicating via Modbus RTU / Modbus ASCII protocol are mapped in tables at defined addresses. Each data point can be one of two types:
- "REGISTER", 2 bytes (word of 16 bits) that can be associated with analogue input or output, variables, set-point, etc...
- "COIL", 1 single bit that can be associated with digital input or output or to a logic state.

A register can contain the image (mirror) of more coils; for example, each of the 16 digital inputs of a module can be read or written as a single bit by addressing the coil related to each input. Alternatively, the 16 bits can be read or written as a single word addressing the associated register where each bit corresponds to a coil.
In the Modbus protocol, registers and coils are divided as per the following groups of addresses:
0xxxx and 1xxxx = Coils (bit)
3xxxx and 4xxxx = Registers (word)
When read and write functions are performed, use the tables indicated below to address the registers and coils.

9 Supported Modbus Functions Codes

Function	Description
01(**)	Read Coil Status (0xxxx)
02(**)	Read Inputs Status (1xxxx)
03	Read Holding Registers (4xxxx)
04	Read Inputs Registers (3xxxx)
05	Force Single Coil
06	Pre-set Single Register
15 (0F)	Force Multiple Coil
16 (10)	Pre-set Multiple Registers

10 Coil Table

COILS TABLE

(*)Coil (Hex)	(*)Coil (Dec)	Description	Access
0x0001	00001	Watchdog Enable	R/W
0x0002	00002	Watchdog Event	R/W
0x0003	00003	Power Up Event	R/W
0x0004	00004	Auto Reset Counter #0	R/W
0x0005	00005	Auto Reset Counter #1	R/W
0x0006	00006	Auto Reset Counter #2	R/W
0x0007	00007	Auto Reset Counter #3	R/W
0x0008	00008	Auto Reset Counter #4	R/W
0x0009	00009	Enable Counter #0	R/W
0x000A	00010	Enable Counter #1	R/W
0x000B	00011	Enable Counter #2	R/W
0x000C	00012	Enable Counter #3	R/W
0x000D	00013	Enable Counter #4	R/W
0x000E	00014	Enable Counter #5	R/W
0x000F	00015	Enable Counter #6	R/W
0x0010	00016	Enable Counter #7	R/W
0x0011	00017	Input #0	RO
0x0012	00018	Input #1	RO
0x0013	00019	Input #2	RO
0x0014	00020	Input #3	RO
0x0015	00021	Input #4	RO
0x0016	00022	Input #5	RO
0x0017	00023	Input #6	RO
0x0018	00024	Input #7	RO
0x0019	00025	Input #8	RO
0x001A	00026	Input #9	RO
0x001B	00027	Input #10	RO
0x001C	00028	Input #11	RO
0x001D	00029	Input #12	RO
0x001E	00030	Input #13	RO
0x001F	00031	Input #14	RO
0x0020	00032	Input #15	RO
0x0021	00033	Rise Latch #0	R/W
0x0022	00034	Rise Latch #1	R/W
0x0023	00035	Rise Latch #2	R/W
0x0024	00036	Rise Latch #3	R/W
0x0025	00037	Rise Latch #4	R/W
0x0026	00038	Rise Latch #5	R/W
0x0027	00039	Rise Latch #6	R/W
0x0028	00040	Rise Latch #7	R/W
0x0029	00041	Rise Latch #8	R/W
0x002A	00042	Rise Latch #9	R/W
0x002B	00043	Rise Latch #10	R/W
0x002C	00044	Rise Latch #11	R/W
0x002D	00045	Rise Latch #12	R/W
0x002E	00046	Rise Latch #13	R/W
0x002F	00047	Rise Latch #14	R/W
0x0030	00048	Rise Latch #15	R/W
0x0031	00049	Fall Latch #0	R/W
0x0032	00050	Fall Latch #1	R/W
0x0033	00051	Fall Latch #2	R/W
0x0034	00052	Fall Latch #3	R/W
0x0035	00053	Fall Latch #4	R/W
0x0036	00054	Fall Latch #5	R/W
0x0037	00055	Fall Latch #6	R/W
0x0038	00056	Fall Latch #7	R/W
0x0039	00057	Fall Latch #8	R/W
0x003A	00058	Fall Latch #9	R/W
0x003B	00059	Fall Latch #10	R/W
0x003C	00060	Fall Latch #11	R/W
0x003D	00061	Fall Latch #12	R/W
0x003E	00062	Fall Latch #13	R/W
0x003F	00063	Fall Latch #14	R/W
0x0040	00064	Fall Latch #15	R/W

NOTES:

(*) Subtract 1 from the address position number of the register and/or coil. Registers and coils marked as RO in the column 'Access' are Read only registers. Registers and coils marked as R/W in the column 'Access' are Read and Write registers. For HE379 series modules, the group of data 0xxxx is the mirror of the group 1xxxx, the group of data 3xxxx is the mirror of the group 4xxxx, therefore the first register can be addressed as either 30001 (with function code 04) or 40001 (with function code 03).

(**) The functions 01, 02 and 15 support a maximum number of 32 consecutive coils for reading and writing.

11 Register Table

REGISTER TABLE

Register Position (*)	Description	Access
40001	Test	R/W
40002	Firmware [0]	RO
40003	Firmware [1]	RO
40004	Name [0]	R/W
40005	Name [1]	R/W
40006	Communication	R/W
40007	Address	R/W
40008	Delay RX/TX	R/W
40009	Watchdog Timer	R/W
40010	System Flags	R/W
40011	Digital Inputs	RO
40012	Rise Latch	R/W
40013	Fall Latch	R/W
40014	Sync. Value	R/W
40015	Counter #0	R/W
40016	Counter #1	R/W
40017	Counter #2	R/W
40018	Counter #3	R/W
40019	Counter #4	R/W
40020	Counter #5	R/W
40021	Counter #6	R/W
40022	Counter #7	R/W

12 Description Modbus Registers

40001: TEST

This register is used for the following function:
-Synchronized Sampling (refer to section “Procedures”)

40002 / 40003: FIRMWARE

Field of 2 read only registers; contains the firmware identifier provided by the manufacturer.

40004 / 40005: NAME

Field of 2 read/write registers (4 bytes or 4 ASCII characters) available for the user, it can contain the name of the module or an abbreviation that identifies its function inside the plant. Each one of the 4 bytes can be written by values from 0 to 255, ASCII characters included.
The default value of this field contains the identifier of the module expressed in ASCII characters.
-Default value: “7200” (ASCII).

40006: COMMUNICATION

If the user wants to set the communication parameters, it is necessary to set the bits of this register referring to the table below in order to configure baud-rate, parity and mode. The configuration of the parameters is not necessary if it is done by the dip switches.
-Default of manufacturer: 38400 bps, mode RTU, parity NONE

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
MODBUS ASCII	0
MODBUS RTU	1

Parity RTU	Parity ASCII	P1	P0
None	Mark	0	0
Even	Even	0	1
Odd	Odd	1	0
Space	Space	1	1

Baud Rate	B2	B1	B0
2400	0	0	1
4800	0	1	0
9600	0	1	1
19200	1	0	0
38400	1	0	1
57600	1	1	0
115200	1	1	1

No. bit	N
7 bit	0
8 bit	1

NOTE:

-the number of bits is ignored, in ASCII mode is fixed to 7; in RTU mode is fixed to 8.

40007: ADDRESS
Contains the MODBUS address of the module, the values allowed are from 1 to 247 decimal. Each node connected to the same line must have a unique address. The address 255 is used for broadcast function.
-Default value: 01

40008: DELAY RX/TX
Indicates the value of the delay time between the reception of a query and the transmission of the response, expressed as milliseconds.
-Default value: 01(1 ms)

40009: WATCHDOG TIMER
Contains the value of Watchdog timer, expressed in intervals of 0.5 seconds. If the Watchdog is enabled and the module doesn't receive a command for the time set in this register, the Watchdog Alarm will be activated (refer to section “Procedures”).
-Default value: 10 (5 sec.)

40010: SYSTEM FLAGS
Contains the enable bits and system events of the module. The following parameters are configurable:

WATCHDOG ENABLE
Enables the Watchdog alarm. If the alarm is enabled and the module doesn't receive commands for a time higher than the one specified in register 40009, the Watchdog Alarm will be activated (refer to section “Procedures”).
0 = Watchdog disabled.
1 = Watchdog enabled.

WATCHDOG EVENT
Indicates the state of the Watchdog Alarm. If the alarm is enabled and the module doesn't receive commands for a time higher than the one specified in register 40009, this bit is forced to 1. To erase the alarm set this bit to 0. If the bit is forced to 1 by a command of the Master unit, a Watchdog event will be simulated and consequently an alarm condition will be created.
0 = Normal condition
1 = Alarm condition

POWER-UP EVENT
This bit is forced to 1 each time the module is powered-on in order to indicate that the module has been switched-off or a reset has occurred. By setting this bit to 0 and checking its state it is possible to monitor if a reset of the module has occurred.
0 = reset not occurred
1 = reset occurred

It is possible to use this register to read and write all the bits without implementing the specific read and write functions of the coils (01-02-05-15).

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

40011: DIGITAL INPUTS
This register shows the state of the digital inputs (0 = OFF, 1 = ON).
It is possible to use this register to read and write all the bits without implementing the specific read functions of the coils (01-02).

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	02	01	00
Descr.	Input															
Channel	#7	#6	#5	#4	#3	#2	#1	#0	#15	#14	#13	#12	#11	#10	#9	#8
Coil	24	23	22	21	20	19	18	17	32	31	30	29	28	27	26	25

40012: RISE LATCH
Contains the value of the rise latch (event of change from logic state 0 to logic state 1) of the digital inputs.
The latch event signals the single change of state and is not updated by the system; in the case of a latch event it is necessary to monitor this parameter for more than one variation, it is necessary to reset the bit writing its value to 0.
Each bit corresponds to a digital input, see the table below:
- Default value: 0

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	02	01	00
Descr.	Input															
Channel	#7	#6	#5	#4	#3	#2	#1	#0	#15	#14	#13	#12	#11	#10	#9	#8
Coil	40	39	38	37	36	35	34	33	48	47	46	45	44	43	42	41

40013: FALL LATCH
Contains the value of the fall latch (event of change from logic state 1 to logic state 0) of the digital inputs.
The latch event signals the single change of state and is not updated by the system; in the case of a latch event it is necessary to monitor this parameter for more than one variation, it is necessary to reset the bit writing its value to 0.
Each bit corresponds to a digital input, see the table below:
- Default value: 0

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	02	01	00
Descr.	Input															
Channel	#7	#6	#5	#4	#3	#2	#1	#0	#15	#14	#13	#12	#11	#10	#9	#8
Coil	56	55	54	53	52	51	50	49	64	63	62	61	60	59	58	57

40014: SYNC VALUE
When the module receives the command of Synchronism, the value of the register 40011 are saved into this register.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	02	01	00
Input	#7	#6	#5	#4	#3	#2	#1	#0	#15	#14	#13	#12	#11	#10	#9	#8

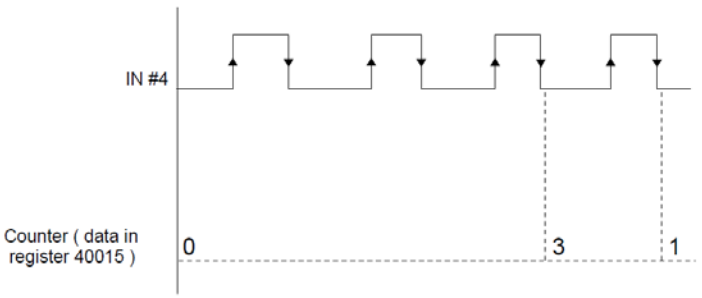
The function of Synchronism is a broadcast command sent to all the modules on the RS-485 network. When the modules receive this command, all the input values measured at reception are saved into the proper registers.
To send the command, write the value 10 into the register “Test” (40001), to the address '255'.

NOTE: the values of synchronism are not saved in EEPROM. After each power-on the values in the registers are reset.

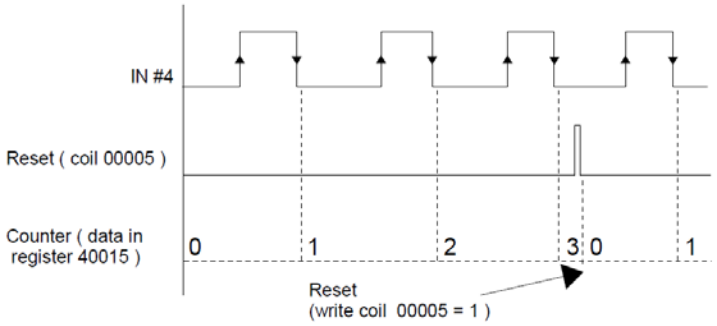
Register	Type
40015:	COUNTER #0
40016:	COUNTER #1
40017:	COUNTER #2
40018:	COUNTER #3
40019:	COUNTER #4
40020:	COUNTER #5
40021:	COUNTER #6
40022:	COUNTER #7

Contains the pulse counts detected on the associated digital input, starting from the last reset of the counter. The format of the number is an unsigned 16 bit integer (0 - 65535).
When a pulse on the input occurs (rising edge followed by a falling edge), the value of the register associated with that digital input is increased by 1. If the “Automatic Reset” is enabled, the value is automatically reset to 0 each time the registers are read.
If the “Automatic Reset” is not enabled, the value of these registers can only be reset by writing 0 to them. NOTE: when the device is powered-on the value of these registers is set to 0.

Working with Automatic Reset enabled, Counter (data in register 40015)



Working with Automatic Reset NOT enabled



13 Coils Dedicated to Digital Counters

00004 - 00008: ENABLE OF THE AUTOMATIC RESET FOR COUNTER #0 - #4
Enables the automatic reset of a counter: if this parameter is enabled, each time that the register associated with the counter is read, its value is reset immediately after the data has been transmitted; if this parameter is not enabled the counter can only be reset by writing the value 0 to the associated register.
0 = Manual Reset
1 = Automatic Reset (default)

00009 - 00016: COUNTER ENABLED #0 - #7
Write 1 to these coils to activate the digital counter associated with each input channel. Write 0 these coils to stop the counting operation.

13 Procedures

USE OF "INIT" FUNCTION
USE OF "INIT" FUNCTION
The "INIT" function allows the module to be set in the default configuration, independently of the register configuration. To use this function the dip-switches must all be in the OFF position.

The INIT forces: mode RTU, parity NONE, baud rate 9600, number of bits = 8, address 1

-Only connect the module to be configured to the RS485 port.
-Switch-off the module.
-Connect the terminal INIT to the terminal REF.
-Power-on the module.
-Check that the green "PWR" LED on the front of the module is on. If not, check the power supply connection (terminals V+ and V-).
-Set the controller communications port with the following values:
Mode = Modbus RTU
Baud-rate = 9600 bps
Parity = None
No. bits = 8
Stop bits = 1
-the module will respond to the address 01.
-Write the desired settings to the following Module registers:
-40006: "Communication" to set the baud-rate.
-40007: "Address" to set the address of the module.
-Switch-off the module.
-Disconnect the terminal INIT from the terminal REF.
-Power-on the module with all the dip-switches in the OFF position.
-Set the controllers communication port with the baud-rate configured in the register 40006.
-The module will respond to the address configured in the register 40007.

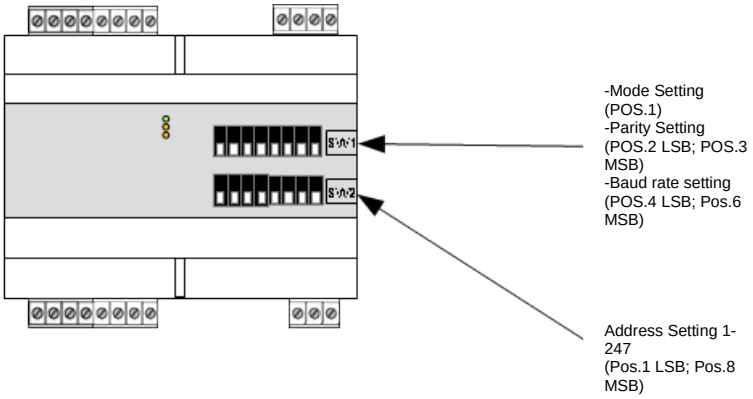
NOTE:
The default configuration values are the following:
-Address: 01
-Baud-rate: 38400 bps
-Protocol: RTU
-Parity: None

WATCHDOG
HE379 series modules have a Watchdog timer that, if enabled, activates an alarm each time that the communication exceeds the configured time.
In the alarm condition, the green PWR LED on the front starts to blink once per second and this forces the coil "Watchdog Event" to 1. To exit the alarm condition, reset the "Watchdog Event" coil. The LED will stop blinking.

SYNCHRONISM
The function of Synchronism is a broadcast command sent to all the modules on the RS-485 network. When the modules receive this command, all the input values measured on receipt are saved to the appropriate registers.
To send the command, write the value 10 into the register "Test" (40001), to the address '255'.

NOTE: the values of synchronism are not saved in EEPROM. After each power-on the values in the registers are reset.

CONFIGURATION BY DIP SWITCHES
Note: Set all the dip-switches to the OFF position to access the module in EEPROM mode (the module will follow the configuration parameters set by the registers) and INIT mode.
To program the module using the dip-switches, the module must be reset.



Note (*)
-in **Modbus RTU** mode the setting is **NONE, number of bits = 8**
-in **Modbus ASCII** mode the setting is **MARK, number of bits = 7**
-For the table of configuration refer to **TAB 4. Address Selection** (below).

DIP POSITION

14 Installation / safety

Warning: Remove power from the OCS controller, CAN port, and any peripheral equipment connected to this local system before adding or replacing this or any module.

- All applicable codes and standards should be followed in the installation of this product.
- Shielded, twisted-pair wiring should be used for best performance.
- Shields may be terminated at the module terminal strip.
- In severe applications, shields should be tied directly to the ground block within the panel.
- Use the following wire type or equivalent: Belden 8441.

For detailed installation and a handy checklist that covers panel box layout requirements and minimum clearances, refer to the hardware manual of the controller you are using.

When found on the product, the following symbols specify:


Warning: Electrical Shock Hazard.


Warning: Consult user documentation.

15 Technical support

Technical Support at the following locations:

North America:
Tel: 317 916-4274
Fax: 317 639-4279
Web: www.hornerautomation.com
Email: techsppt@heapg.com

Europe:
Tel: +353-21-4321266
Fax: +353-21-4321826
Web: http://www.horner-apg.com
Email: tech.support@horner-apg.com

TAB.4 Address Selection 1 - 247 (Pos.1 LSB; Pos.8 MSB)