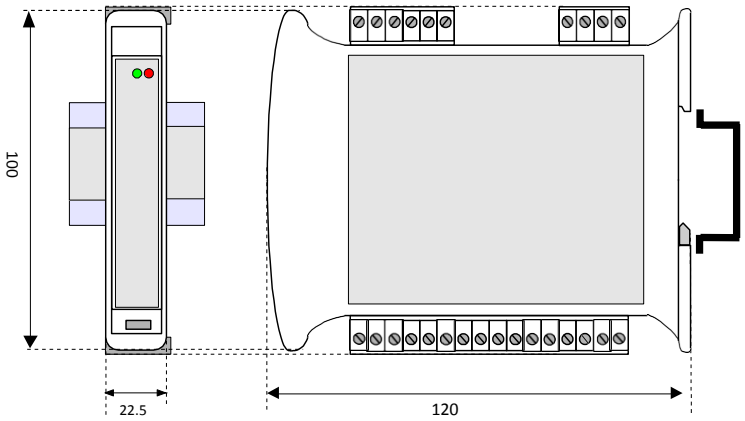
SmartMod+
Analogue Input Module
HE389THM100
4 mV/ Tc Analogue Input

1 Specifications

	Min	Max		
Input type			**Thermal Drift – Full Scale (1)**	±0.01 %/ °C
Voltage 50 mV 100 mV	 -50mV -100mV	 +50mV +100mV	**Thermal Drift CJC (1)**	±0.02°C / °C
			Sample Time (per channel)	40ms
Thermo-couple J K R S B E T N	 -200°C -200°C -50°C -50°C +400°C -200°C -200°C -200°C	 +1200°C +1370°C +1760°C +1760°C +1820°C +1000°C +400°C +1300°C	**Input Impedance**	>= 10 MΩ
			CJC Compensation	± 0.5 °C
			Storage Temp.	-40° to 85°C
			Operating Temp.	-10° to 60°C
			Relative Humidity	0 to 90% Non-condensing
Input Accuracy (1)	mV > ±0.05 %f.s. TC ±5µV		**Mounting**	DIN Rail standard EN-50022
Linearity (1)	TC ±0.2 % f.s		**Line Resistance**	< 0.8 µV/Ω
External Power Supply Voltage	10-30Vdc		**Weight**	150g
			Warm up time	3 min
Current Consump-tion	45mA @ 24VDC		**Communications**	CANopen Protocol
Reverse Polarity Protection	60 Vdc max		**Max. Data Transmission Baud Rate**	1 Mbps
Isolation	2000 VAC, 50Hz, 1 min		**Max. Distance**	1200m
CE Compliance	Immunity EN 61000-6-2 Emission EN61000-6-4			
(1)	Referred to Input Span (difference between max. and min. values)			

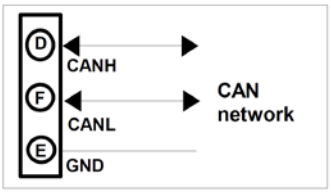
Mechanical Dimensions (mm)



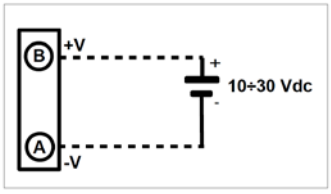
Note: Number of I/O terminal connections varies from model to model

2 Wiring – I/O

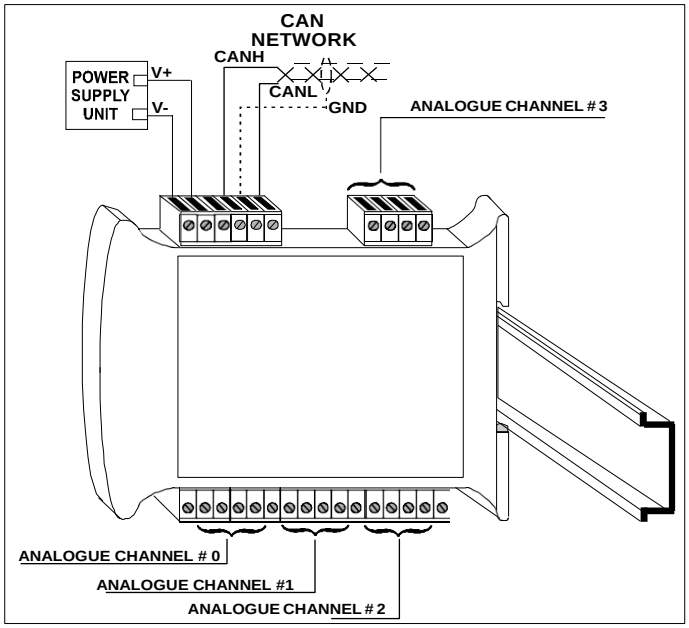
CAN NETWORK WIRING



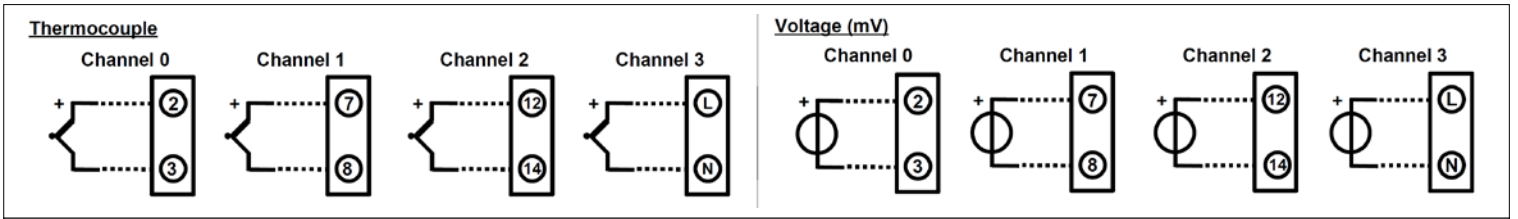
POWER SUPPLY WIRING



CONNECTIONS

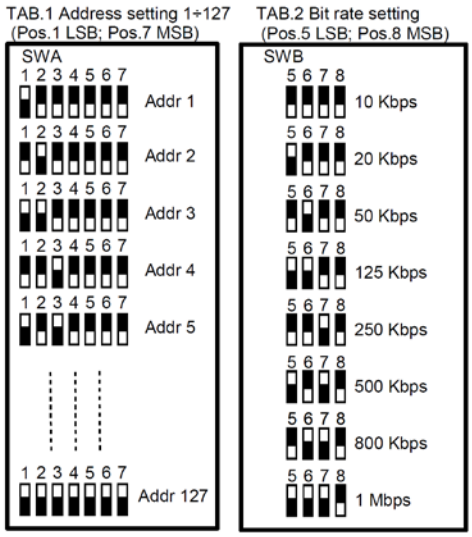


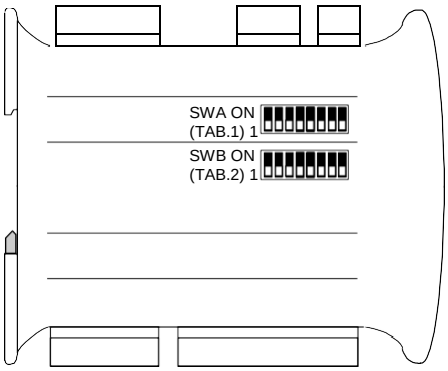
INPUT WIRING

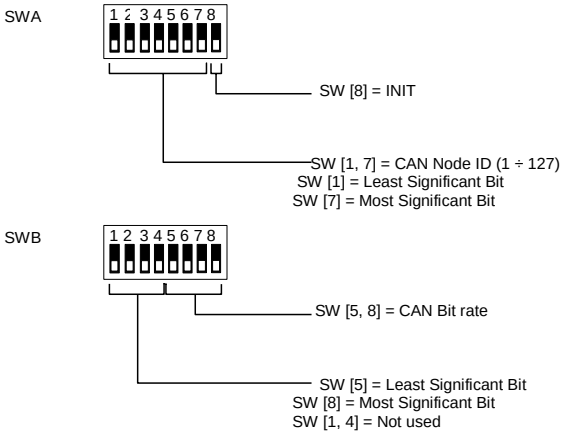


Terminals 3,8,14, and N = input negative reference
NOTE: The input channels are not insulated between them

3 DIP Switches: Table of Configuration







4 Communication Protocols

This module is designed to work with the ***CANopen Protocol***, one of the most used standard communication protocols, and allows the direct interface of HE389 series modules to Horner X-Series CAN Controllers in compliance with the CiA DS 301 and CiA DS 401 standards.

5 User Instructions

Before installing this module, please read the **Installation Instructions** section carefully. Connect the power supply, the data line and the I/O signals as shown in the **Wiring** section. Refer to the **LED Indicator** section to verify that the module is working correctly.
For easy maintenance or the substitution of the module, it is possible to “hot swap” the terminals.

6 Installation Instructions

Attach the HE389THM100 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
RUN	GREEN	ON	Device in Operational mode
		BLINKING	Device in Pre-Operational mode
		SLOW BLINKING	Device stopped
ERR	RED	OFF	No error
		ON	Bus off
		BLINKING	Invalid configuration

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

8 The Object Dictionary (OD)

The Object Dictionary is the part of the module profile, where the objects that influence the modules behavior are grouped (application objects, communication objects and state objects). The structure of the Object Dictionary is predefined as in Draft Standard CiA301.

How to read the Object Dictionary table present in this document.

Index	No. Sub Index	Name	Description	Object Type	Default Value	Access

Index: 16-bit number expressed in Hex format used to address the object inside the OD.
Sub-index: 8-bit number expressed in Hex format used to indicate and address the sub parts of an object.
Name: Defines the name of the object inside the OD.
Description: Text strings that describe what the function of the object is.
Object type: Indicates what the data type of the object is (Unsigned 32, Boolean, etc..).
Default value: Indicates what the default value for an object is.
Access: Indicates what the type of access designed for an object is.
RO: indicates an object that can only be read.
RW: indicates an object that can be read and written to.
---: indicates that the object is a complex object addressed by Sub-index.

9 Process Data Objects (PDO)

The real-time data-transfer is performed by means of the **Process Data Object** (PDO). The PDO is only transmitted from one Producer to one or more customers. The data field of a PDO can be between 1 and 8 bytes long.

There are two kinds of PDOs: the first is used for data transmission (TPDO) and the second for data reception (RPDO).

The PDOs are described by the communication and mapping parameters. The communication parameters define the communication capability of the PDO, the mapping parameters define the content of PDO.
Data type and mapping of the application objects into a PDO are determined by the default structure specified in the Object Dictionary.

The communication parameter is composed of:
- COB-ID;
- Transmission type;
- Inhibit time;
- Event timer.

COB-ID.
The COB-ID is the **Connection Object Identifier** and contains the unique CAN message Identifier of the object and additional configuration bits. For the PDOs the following 32-bit COB-ID are predicted.

TPDO1: NODE ID + 0x00000180
TPDO2: NODE ID + 0x00000280
TPDO3: NODE ID + 0x00000380
TPDO4: NODE ID + 0x00000480
RPDO1: NODE ID + 0x00000200
RPDO2: NODE ID + 0x00000300
RPDO3: NODE ID + 0x00000400
RPDO4: NODE ID + 0x00000500

The NODE ID is the CAN node ID of the device. The range value is from 0x01 (decimal 1) up to 0x7F (decimal 127). If the first byte is 8 the PDO is not used, if it is 0, the PDO is used.

Transmission Type.
To transmit the PDO the following transmission modes can be used:

- Synchronous Transmission
- Asynchronous Transmission

The value of the parameter Transmission Type defines how the PDO transmission is performed.

For TPDOs:

Value 0.
The TPDO is synchronous acyclic; it is transmitted after receiving a SYNC object when one or more parameters change. Value 1-240.

The TPDO is synchronous cyclic. It is transmitted after every nth SYNC object within the Synchronous Window Length (object 0x1007). The value n is the value of the Transmission Type.

NOTE: The Communication Cycle Period object (0x1006) express the time between two SYNC and must have the same value or a bigger value of the Synchronous Window Length.

Value 255.
The TPDO is asynchronous and it is transmitted as a function of the parameter Event Timer.

For RPDOs:

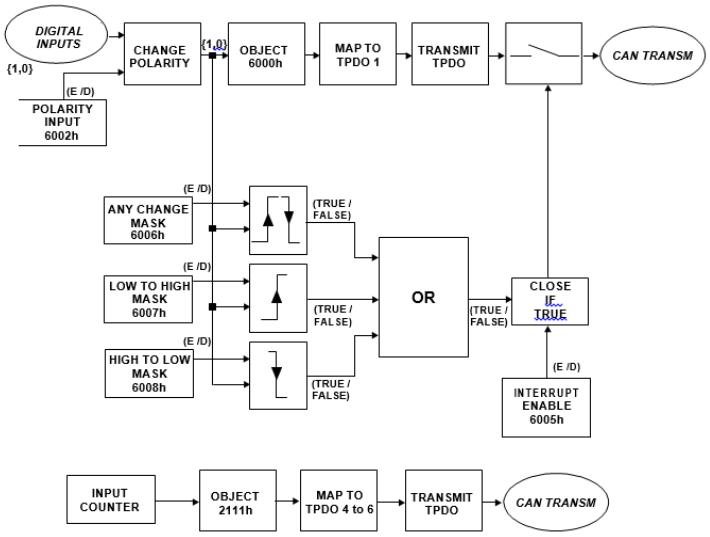
Value 0-240.
The RPDO is synchronous and the actual value of the transmission type is not relevant because the RPDO is processed on reception of the next SYNC object.

Value 255.
The RPDO is asynchronous and it is processed by the node as soon as the PDO arrives.

Inhibit Time.
This is the time when the PDO is not transmitted. The PDO is transmitted only when the time expires.

Event Timer.
The PDO is transmitted on a fixed time base

10 Functional Diagram for Digital Inputs Transmission



11 Interrupt Triggering TPDO Transmission

The analogue signals are processed and transferred to the object 6401h. The data associated with this object is moved to the TPDO as a function of the mapping parameters set in the object 1A01h. The communication parameters of TPDO are defined in the object 1801h.

At the same time the analogue value is checked with the values contained in the objects 6424h (upper limit), 6425h (lower limit) and 6426h (delta).
The system executes the Boolean operation XOR between the object 6424h (true if the input value is greater or equal to the pre-set values of the object) and the object 6425h (true if the input value is lower than the pre-set values of the object) and successively executes the Boolean operation AND between the result of the XOR and the object 6426h (true if the input value rises or falls above or below the delta value with respect to the last communicated value).
If the result of the operation AND is true, the transmission of the TPDO is performed only if the object 6423h has been enabled (value set as 255).

12 HE389THM100 Object Dictionary

Index	No. Sub-index	Name	Description	Object type	Default value	Access
0x1000	**0**	**Device Type**	Identifies the type of device (analogue input) and its Device Profile (CiA 401)	Unsigned 32	0x00040191	RO
0x1001	**0**	**Error register**	Register used to monitor eventual internal errors	Unsigned 8	0x00	RO
0x1002	**0**	**Manufacturer status register**	Status register	Unsigned 32	0x00000000	RO
0x1003	**2**	**Predefined error field**	Contains the list of the recent errors	Array	------	----
	Sub Index 0	Number of errors	Contains the number of errors occurred	Unsigned 8	0x00	RW
	Sub Index 1	Standard error field 1	Stores the recent errors occurred	Unsigned 32	0x00000000	RO
0x1005	**0**	**SYNC COB-ID**	Defines the COB-ID of the Synchronism Object consumed	Unsigned 32	0x00000080	RW
0x1006	**0**	**Communication cycle period**	Defines the SYNC interval and it is expressed as µs	Unsigned 32	0x00000000	RW
0x1007	**0**	**Synchronous window length**	Defines the time window expressed as µs to transmit the synchronous PDO after the SYNC object	Unsigned 32	0x00000000	RW
0x1008	**0**	**Manufacturer device name**	Contains the device's name	Visible String	HE389THM100	RO
0x1009	**0**	**Manufacturer hardware Version**	Indicates the hardware version of the device	Visible String	"1.00"	RO
0x100A	**0**	**Manufacturer software Version**	Indicates the version of the device's firmware	Visible String	"2.10"	RO
0x1010	**2**	**Store parameters**	Supports the saving of the parameters	Array	------	----
	Sub Index 0	Max sub-index number	Contains the number of sub index supported	Unsigned 8	0x01	RO
	Sub Index 1	Save all parameters	Saves all the parameters	Unsigned 32	0x00000000	RW
	Write the value **65766173 Hex, 1702257011 Decimal** (ASCII “save”) in sub-index to save data.					
0x1011	**2**	**Restore default**	Restore the default values of the parameters	Array	------	----
	Sub Index 0	Max sub-index number	Contains the number of sub index supported	Unsigned 8	0x01	RO
	Sub Index 1	Restore all parameters	Restores all the parameters	Unsigned 32	0x00000000	RW
	Write the value **64616F6C Hex, 1684107116 Decimal** (ASCII “load”) in sub-index to restore data. Type of reset caused at the restore of default: -restore of sub index 1 : Node reset					

Index	No. Sub-index	Name	Description	Object type	Default value	Access
0x1014	**0**	**COB-ID Emergency Object (EMCY)**	Defines the COB-ID of the Emergency Object	Unsigned 32	Node ID + 0x80	RW
0x1015	**0**	**Inhibit time (EMCY)**	Defines the inhibit time for the Emergency Object (multiple of 100 µs)	Unsigned 32	0x00000000	RW
0x1016	2	Consumer heartbeat time	Defines the heartbeat cycle time (multiple of 1 ms)	Array	------	----
	Sub Index 0	Max sub-index number	Contains the number of sub index supported	Unsigned 8	0x01	RO
	Sub Index 1	Consumer heartbeat time	Heartbeat time	Unsigned 32	0x00000000	RW
0x1017	0	Producer heartbeat time	Defines the heartbeat cycle time (multiple of 1 ms)	Unsigned 16	0x00000000	RW
0x1018	**5**	**Identity**	Contains the general information about the device	Record	------	----
	Sub Index 0	Max sub-index number	Contains the number of sub index supported	Unsigned 8	0x04	RO
	Sub Index 1	Vendor ID	Horner APG Unique code	Unsigned 32	0x00000044	RO
	Sub Index 2	Product code	HE389THM100 ID code	Unsigned 32	0x00000004	RO
	Sub Index 3	Revision number	Revision number	Unsigned 32	0x00000000	RO
	Sub Index 4	Serial number	Serial number code	Unsigned 32	0x00000000	RO
0x1029	**2**	**Error behaviour**	Defines the behaviour of the device in case of error encountered	Array	------	----
	Sub Index 0	Max sub-index number	Contains the number of error classes	Unsigned 8	0x01	RO
	Sub Index 1	Communication error	Defines the device condition for a communication error	Unsigned 8	0x00	RW
0x1200	**3**	**Server SDO parameters**	Describes the SDO communication channel for the node	Array	------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x02	RO
	Sub Index 1	COB ID Client to Server (Receive SDO)	Defines the COB ID in case of receiving SDO	Unsigned 32	Node ID + 0x600	RO
	Sub Index 2	COB ID Server to Client (Transmit SDO)	Defines the COB ID in case of transmitting SDO	Unsigned 32	Node ID + 0x580	RO
0x1801	**5**	**2nd TDO communication parameters**	List of the parameters of the 2nd TPDO	Record	------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x04	RO
	Sub Index 1	COB ID	Defines the COB ID of the PDO	Unsigned 32	Node ID + 0x280	RW
	Sub Index 2	Transmission type	Defines the transmission type for the TPDO	Unsigned 8	0xFF	RW
	Sub Index 3	Inhibit timer	Defines the delay to transmit the next PDO (multiple of 100 µs)	Unsigned 16	0x0000	RW
	Sub Index 5	Event timer	Transmits the PDO when the timer is expired (multiple of 1 ms)	Unsigned 16	0x0000	RW
0x1A01	**5**	**2nd TPDO mapping parameters**	List of mapping parameters of the 2nd TPDO	Array	------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x04	RW
	Sub Index 1	Mapped Object 1	Defines the 1st object mapped into TPDO	Unsigned 32	0x64010110	RW
	Sub Index 2	Mapped Object 2	Defines the 2nd object mapped into TPDO	Unsigned 32	0x64010210	RW
	Sub Index 3	Mapped Object 3	Defines the 3rd object mapped into TPDO	Unsigned 32	0x64010310	RW
	Sub Index 4	Mapped Object 4	Defines the 4th object mapped into TPDO	Unsigned 32	0x64010410	RW

Index	No. Sub-index	Name	Description	Object type	Default value	Access
0x2101	0	Can Node ID	Defines which is the default CAN node number of the device	Unsigned 8	0x7F	RO
	Values available: from Dec.1 (0x01) up to Dec 127 (0x7F).					
0x2102	0	Can bit rate	Defines which is the default bit rate value	Unsigned 8	0x03	RO

Decimal and Hex value to select the Bit rate parameter.

Bit rate	Value (Dec)	Value (Hex)
10 Kbps	0	0x00
20 Kbps	1	0x01
50 Kbps	2	0x02
125 Kbps	3	0x03
250 Kbps	4	0x04
500 Kbps	5	0x05
800 Kbps	6	0x06
1 Mbps	7	0x07

5	Sensor type selection	ains the programming of the Analog Input Channels	Array	----------	----
Sub Index 0	Max sub-index number	e number of sub-index supported	Unsigned 8	0x04	RO
Sub Index 1	CH1 sensor type	Programming of Input Channel 1	Unsigned 8	0x01	RW
Sub Index 2	CH2 sensor type	Programming of Input Channel 2	Unsigned 8	0x01	RW
Sub Index 3	CH3 sensor type	Programming of Input Channel 3	Unsigned 8	0x01	RW
Sub Index 4	CH4 sensor type	Programming of Input Channel 4	Unsigned 8	0x01	RW

Decimal and Hex values to select the type of the input sensor.

Input type	Value (Dec)	Value (Hex)
Input not used	0	0x00
+/- 100 mV	1	0x01
Thermocouple J	24	0x18
Thermocouple K	25	0x19
Thermocouple T	26	0x1A
Thermocouple E	27	0x1B
Thermocouple R	28	0x1C
Thermocouple S	29	0x1D
Thermocouple B	30	0x1E
Thermocouple N	31	0x1F

Index	No. Sub-index	Name	Description	Object type	Default value	Access
0x6401	5	**16 bit Input Channel Measure**	Contains the measures of the Analog Input Channels	Array	------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x04	RO
	Sub Index 1	CH1 measure	Shows the measure of the Input Channel 1	Integer 16	------	RO
	Sub Index 2	CH2 measure	Shows the measure of the Input Channel 2	Integer 16	------	RO
	Sub Index 3	CH3 measure	Shows the measure of the Input Channel 3	Integer 16	------	RO
	Sub Index 4	CH4 measure	Shows the measure of the Input Channel 4	Integer 16	------	RO
0x6423	0	**16 bits Analogue Global Interrupt Enable**	Enables / Disable globally the interrupt behaviour	Unsigned 8	0	RW
	Value 0: object disable (no analogue input activates the interrupt). Value 255: object enabled (one or more analogue inputs can activate the interrupt).					
0x6424	5	**16 bits Analogue Interrupt Upper limits**	Contains the upper limits for the analogue input channels	Array	------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x04	RO
	Sub Index 1	CH1 Interrupt Upper limit	Upper limit of the Channel 1	Integer 16	0x0000	RW
	Sub Index 2	CH2 Interrupt Upper limit	Upper limit of the Channel 2	Integer 16	0x0000	RW
	Sub Index 3	CH3 Interrupt Upper limit	Upper limit of the Channel 3	Integer 16	0x0000	RW
	Sub Index 4	CH4 Interrupt Upper limit	Upper limit of the Channel 4	Integer 16	0x0000	RW
	This object works only if the Object 0x6423 has been enabled. The interrupt is triggered when the input value rise above or is equal to the settled value.					
0x6425	5	**16 bits Analogue Interrupt Lower limits**	Contains the lower limits for the analogue input channels	Array	------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x04	RO
	Sub Index 1	CH1 Interrupt Lower limit	Lower limit of the Channel 1	Integer 16	0x0000	RW
	Sub Index 2	CH2 Interrupt Lower limit	Lower limit of the Channel 2	Integer 16	0x0000	RW
	Sub Index 3	CH3 Interrupt Lower limit	Lower limit of the Channel 3	Integer 16	0x0000	RW
	Sub Index 4	CH4 Interrupt Lower limit	Lower limit of the Channel 4	Integer 16	0x0000	RW
	This object works only if the Object 0x6423 has been enabled. The interrupt is triggered when the input value falls below the settled value.					
0x6426	5	**16 bits Analogue Interrupt Delta**	Contains the delta values for the analogue input channels	Array	------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x04	RO
	Sub Index 1	CH1 Delta limit	Delta value for the Channel 1	Integer 16	0x000A	RW
	Sub Index 2	CH2 Delta limit	Delta value for the Channel 2	Integer 16	0x000A	RW
	Sub Index 3	CH3 Delta limit	Delta value for the Channel 3	Integer 16	0x000A	RW
	Sub Index 4	CH4 Delta limit	Delta value for the Channel 4	Integer 16	0x000A	RW
	This object works only if the Object 0x6423 has been enabled. The interrupt is triggered when the input rises or falls above or below the last communicated value.					

13 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.

14 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