SmartMod+
Digital Input Module
HE389DIM610
16 Digital Inputs

1 Specifications

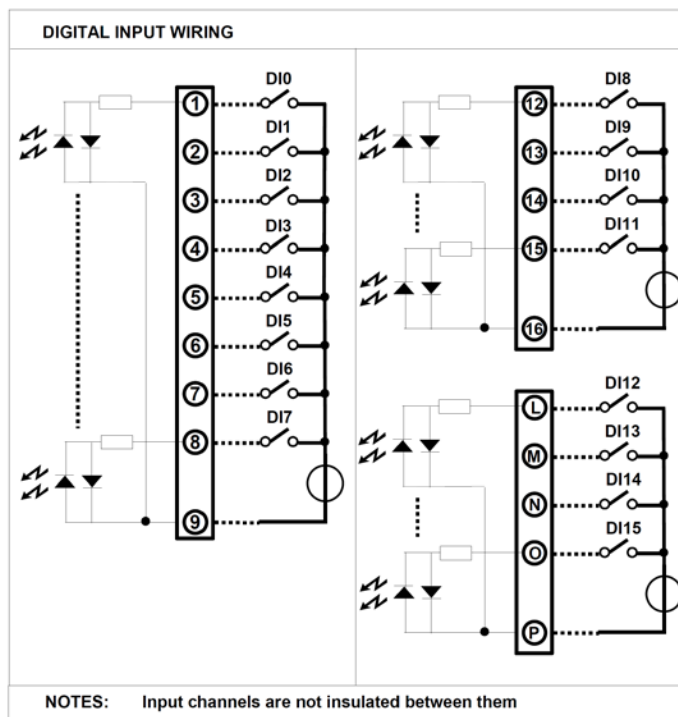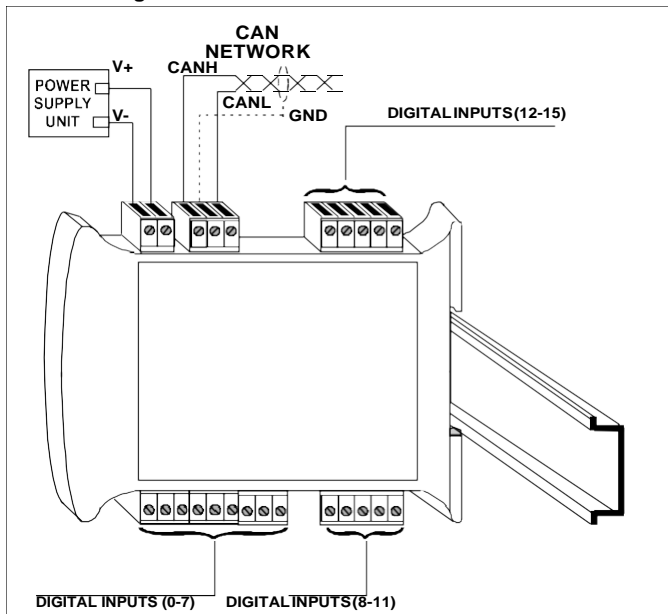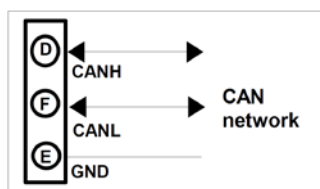| Input Channels	16	No. of counters	8 @ 300 Hz
Voltage Input (bipolar)	OFF state 0/3 V ON state 10/30 V	Min Pulse Width	1 ms
Input Impedance	4.7 KΩ	Storage Temp.	-40° to 85°C
Sample Time (per channel)	0.5/ 1 sec	Relative Humidity	0 to 90% Non-condensing
Operating Temp.	-10° to 60 °C	Mounting	DIN Rail standard EN-50022
External Power Supply Voltage	10-30Vdc	Weight	150g
Required Power (Steady State)	35mA @ 24Vdc 45mA @ 10Vdc	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		

2 Wiring – I/O

Mechanical Dimensions (mm)
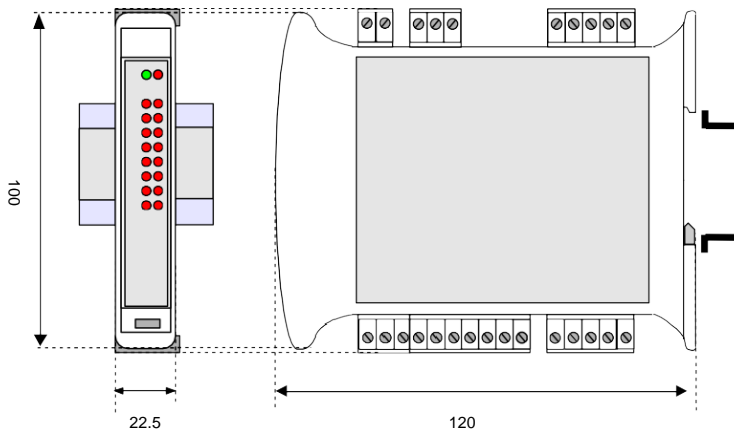
Note: Number of I/O terminal connections varies from model to model

CONNECTIONS

DIGITAL INPUT WIRING

NOTES: Input channels are not insulated between them
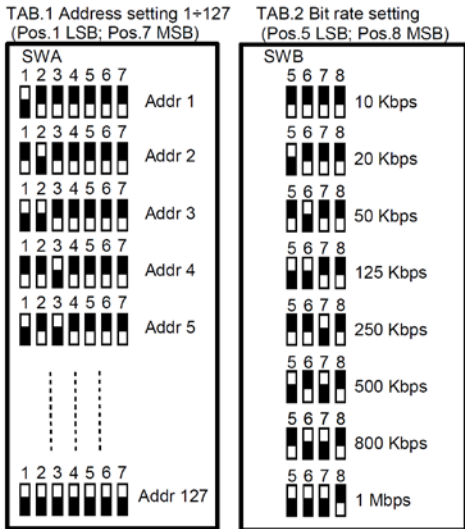
CAN NETWORK WIRING

POWER SUPPLY WIRING
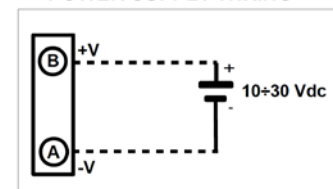
3   DIP Switches: Table of Configuration

SWA

SW [8] = INIT

SW [1-7] = CAN Node ID (1 ÷ 127)
SW [1] = Least Significant Bit
SW [7] = Most Significant Bit

SWB

SW [5-8] = CAN Bit rate

SW [5] = Least Significant Bit
SW [8] = Most Significant Bit
SW [1-4] = Not used
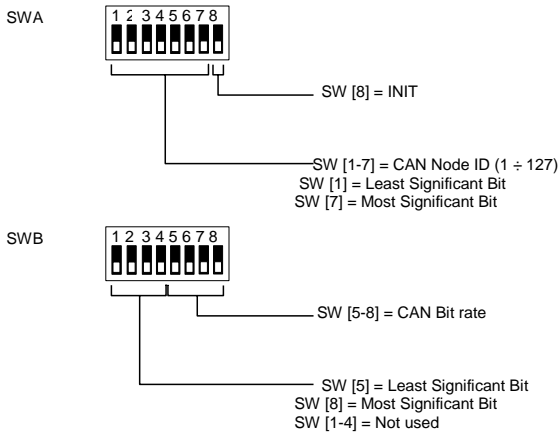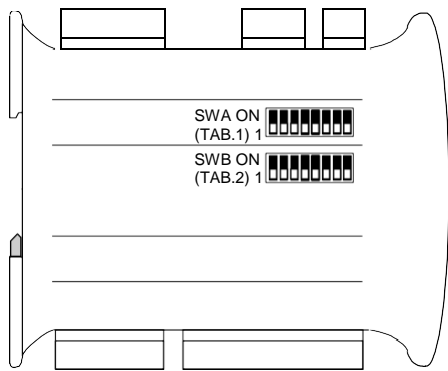
4   Communication Protocols

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 HE389DIM610 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
I *n*	Red	ON	State 1 Digital Inputs.
		OFF	State 0 Digital Inputs.

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 per the CANopen 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 in 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 in 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 Consumers. 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 the 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's are defined.

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 upon receiving a SYNC object when one or more parameters change. Value 1-240.

The TPDO is synchronous cyclic. It is transmitted upon 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) expresses the time between two SYNC objects and must have the same value or a bigger value than 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.
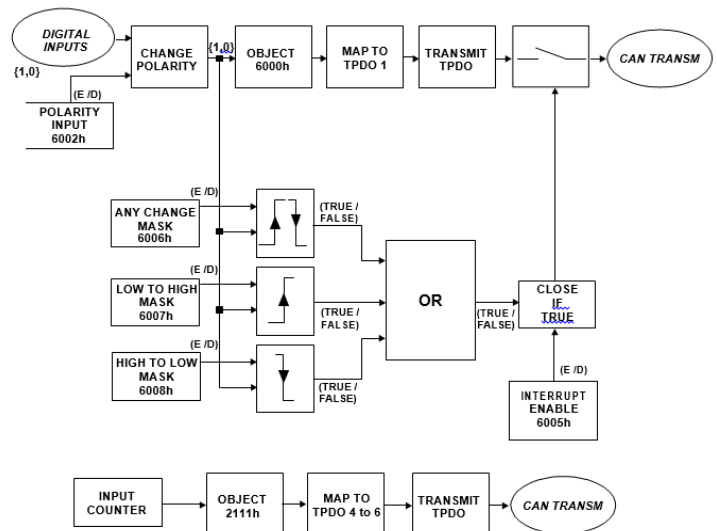The RPDO is asynchronous and it is processed by the node as soon as the PDO arrives.

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 digital inputs are processed and transferred to the object 6000h. The data associated with this object is moved to the 1st TPDO as a function of the mapping parameters set in the objects 1A00h. The communication parameters of TPDO are defined in the objects 1800h.

The system executes the Boolean operation OR between the values of the masks contained in the objects 6006h (any change mask), 6007h (low to high mask) and 6008h (high to low mask).
If the result of the operation OR is true, the transmission of the TPDO is performed only if the object 6005h has been enabled (value set as 1).
When the digital inputs change to the logic state 1, the associated counter mapped into the object 2111h is incremented. The data associated with this object is moved to the TPDOs as a function of the mapping parameters set in the objects from 1801h up to 1803h. The communication parameters of TPDOs are defined in the objects from 1A01h up to 1A03h.
To reset the value of the counter, write 0 in the Sub Index of the counter selected in the object 2111h.

Linking this object to the generation of a Heartbeat by the device or from another node, if the transmission (Producer) or reception (Consumer) of this object is missed the outputs will be set as defined in the object 6206h.

Example with object Consumer Heartbeat Time: Master unit: node ID 1
Device node ID 3
Producer Heartbeat time Master: 500 ms (01F4 hex.)
Consumer Heartbeat time device: Node 1, 1000 ms (000103E8 hex.)
Object 6206h = 0 (00 hex) – all the outputs in OFF.
If the Master unit does not send the Heartbeat on the line for 1000 ms, the outputs of the device will be set as defined in the object 6206h.

Example with object Producer Heartbeat Time: Master unit: node ID 1
Device node ID 3
Producer Heartbeat time Master: 500 ms (01F4 hex.)
Object 6206h = 0 (00 hex) – all the outputs in OFF.
If the CAN line of the device is interrupted the outputs of the device will be set as defined in the object 6206h.

12   HE389DIM610 Object Dictionary

Index	No. Sub-index	Name	Description	Object type	Default value	Access
0x1000	0	Device Type	Identifies the type of device (digital inputs & outputs) and its Device Profile (CiA 401)	Unsigned 32	0x00010191	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	HE389DIM610	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	0x0000	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	HE389DIM610 ID code	Unsigned 32	0x00000005	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
0x1800	5	**1st TPDO communication parameters**	List of the parameters of the 1st 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 + 0x180	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

Index	No. Sub-index	Name	Description	Object type	Default value	Access
0x1801	5	4th TPDO communication parameters	List of the parameters of the 4th 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
0x1802	5	5th TPDO communication parameters	List of the parameters of the 5th 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 + 0x380	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
0x1803	5	6th TPDO communication parameters	List of the parameters of the 6th 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 + 0x480	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 1ms)	Unsigned 16	0x0000	RW
0x1A00	2	1st TPDO mapping parameters	List of mapped parameters of the 1st TPDO	Array	------	----
	Sub Index 0	Number of mapped objects	Contains the number of sub-index supported	Unsigned 8	0x01	RO
	Sub Index 1	Mapped Object 1	Defines the 1st object mapped into TPDO	Unsigned 32	0x60000108	RW
0x1A01	3	4th TPDO mapping parameters	List of mapped parameters of the 4th TPDO	Array	------	----
	Sub Index 0	Number of mapped objects	Contains the number of sub-index supported	Unsigned 8	0x02	RO
	Sub Index 1	Mapped Object 1	Defines the 1st object mapped into TPDO	Unsigned 32	0x21110120	RW
	Sub Index 2	Mapped Object 2	Defines the 2nd object mapped into TPDO	Unsigned 32	0x21110220	RW

Index	No. Sub-index	Name	Description	Object type	Default value	Access
0x1A02	3	5th TPDO mapping parameters	List of mapped parameters of the 5th TPDO	Array	------	----
	Sub Index 0	Number of mapped objects	Contains the number of sub-index supported	Unsigned 8	0x02	RO
	Sub Index 1	Mapped Object 1	Defines the 1st object mapped into TPDO	Unsigned 32	0x21110320	RW
	Sub Index 2	Mapped Object 2	Defines the 2nd object mapped into TPDO	Unsigned 32	0x21110420	RW
0x1A03	3	6th TPDO mapping parameters	List of mapped parameters of the 6th TPDO	Array	------	----
	Sub Index 0	Number of mapped objects	Contains the number of sub-index supported	Unsigned 8	0x02	RO
	Sub Index 1	Mapped Object 1	Defines the 1st object mapped into TPDO	Unsigned 32	0x21110520	RW
	Sub Index 2	Mapped Object 2	Defines the 2nd object mapped into TPDO	Unsigned 32	0x21110620	RW
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). The values are programmable only from dip switch.					
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. The values are programmable only from dip switch.					
0x2111	9	Input Counter value	Contains the value of 8 input counter available	Array	------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x08	RO
	Sub Index 1	Input 1 counter	Contains the value of the counter associated to the digital input 1	Unsigned 32	0x00000000	RW
	Sub Index 2	Input 2 counter	Contains the value of the counter associated to the digital input 2	Unsigned 32	0x00000000	RW
	Sub Index 3	Input 3 counter	Contains the value of the counter associated to the digital input 3	Unsigned 32	0x00000000	RW
	Sub Index 4	Input 4 counter	Contains the value of the counter associated to the digital input 4	Unsigned 32	0x00000000	RW
	Sub Index 5	Input 5 counter	Contains the value of the counter associated to the digital input 5	Unsigned 32	0x00000000	RW
	Sub Index 6	Input 6 counter	Contains the value of the counter associated to the digital input 6	Unsigned 32	0x00000000	RW
	Sub Index 7	Input 7 counter	Contains the value of the counter associated to the digital input 7	Unsigned 32	0x00000000	RW
	Sub Index 8	Input 8 counter	Contains the value of the counter associated to the digital input 8	Unsigned 32	0x00000000	RW
0x6000	3	Read Digital Input	Contains the logic status of Digital Input Channels	Array	------------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x02	RO
	Sub Index 1	Digital Inputs 1 to 8	Digital input channel measure	Unsigned 8	0x00	RO
	Sub Index 2	Digital Inputs 9 to 16	Digital input channel measure	Unsigned 8	0x00	RO

Index	No. Sub-index	Name	Description	Object type	Default value	Access
0x6002	3	**Polarity Input 8 bit**	Contains the polarity settings For Digital Input Channels	Array	-------------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x02	RO
	Sub Index 1	Digital Inputs 1 to 8	Polarity settings digital inputs 1 to 8	Unsigned 8	0x00	RO
	Sub Index 2	Digital Inputs 9 to 16	Polarity settings digital inputs 9 to 16	Unsigned 8	0x00	RO
0x6005	0	**Global Interrupt Enable Digital**	Allows to enable / disable the global interrupt behaviour 0 = global interrupt disabled 255= global interrupt enabled	Unsigned 8	255	RW
0x6006	3	**Interrupt Mask Any Change 8 bit**	Contains the mask settings per input channel for Any change option	Array	-------------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x02	RO
	Sub Index 1	Digital Inputs 1 to 8	Settings digital inputs 1 to 8	Unsigned 8	0x00	RW
	Sub Index 2	Digital Inputs 9 to 16	Settings digital inputs 9 to 16	Unsigned 8	0x00	RW
0x6007	3	**Interrupt Mask Low-to-High 8 bit**	Contains the mask settings per input channel for Low to High option	Array	-------------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x02	RO
	Sub Index 1	Digital Inputs 1 to 8	Settings digital inputs 1 to 8	Unsigned 8	0x00	RW
	Sub Index 2	Digital Inputs 9 to 16	Settings digital inputs 1 to 8	Unsigned 8	0x00	RW
0x6008	3	**Interrupt Mask High-to-Low 8 bit**	Contains the mask settings per input channel for Low to High option	Array	-------------	----
	Sub Index 0	Max sub-index number	Contains the number of sub-index supported	Unsigned 8	0x02	RO
	Sub Index 1	Digital Inputs 1 to 8	Settings digital inputs 1 to 8	Unsigned 8	0x00	RW
	Sub Index 2	Digital Inputs 9 to 16	Settings digital inputs 9 to 16	Unsigned 8	0x00	RW

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