SmartRail I/O – CANopen Base
HE599COS100

1   INTRODUCTION

SmartRail I/O is a real-time, modular I/O system – expanding the application of the OCS family of all-in-one controllers. The SmartRail I/O CANopen Base (COS100) utilizes CANopen communications for the I/O connection with the OCS. The highly efficient, and highly reliable nature of CANopen allows a significant amount of I/O to be added while maintaining fast I/O updates.

Any modern OCS Controller with a CAN port can utilize COS100 Base units. Each COS100 base can support up to 8 SmartRail I/O modules – addressed with up to 256 digital I/O and 32 analog I/O per base. The maximum number of bases supported by an OCS controller is currently 16.

The COS100 network wiring is typically a daisy-chain architecture, although trunkline-dropline architectures are also supported. Entire bases of I/O may be hot-swapped to/from the CANopen network, but individual I/O modules may not be hot-swapped on the base. SmartRail I/O is not complex to configure – it utilizes Cscape (9.4 or later) in an easy, straightforward process.

Note: The SmartRail CANopen base is NOT supported by Classic OCS Controllers such as miniOCS, OCS100 and OCS200.

2   SPECIFICATIONS

General Specifications	
Required Power (Steady State)	400mA @ 24 VDC, max **CLASS 2 POWER SUPPLY ONLY**
Primary Power Range	11 – 28 VDC
Output Power	1500mA @ 5 VDC
Terminal Type	M3 Screw Type, Removable
Optional Terminals	HE200ACC500 (spring-clamp double plug) HE200ACC512 (m12 adapter)
Terminal Torque Rating	0.6 Nm (5.2 in-lb)
Accepted Wire Size	14-26AWG (copper)
Wire Stripping Length	7mm
Relative Humidity	5 to 95% Non-condensing
Operating Temp.	-5℃ to +50℃
Storage Temp.	-40℃ to +75℃
Dimensions (H x W x D)	90 x 45 x 60 mm [3.54 x 1.77 x 2.36 in]
Weight	114g (4oz)
Vibration & Shock	Per IEC1131-2
Noise Immunity	Per IEC1131-2, IEC61000-4-2, IEC61000-4-3, IEC61000-4-4
CE	Yes
UL & C-UL	Class I, Div 2 Groups A, B, C & D
Communications Specifications	
Data Transmission	CANopen
Flow Control	CAN bitwise arbitration
Connector	5-pin Removable Terminal Block
Architecture	Daisy-chain or Trunkline-Dropline
Node ID config	Digital Rotary Switches (2)
Legal Node Ids	1 to 79 decimal
Inactivity Timeout	Configurable from Cscape
Cscape version	9.4 or later
OCS Firmware version	12.98 or later
I/O Specifications	
Compatible I/O	SmartRail I/O
Bases Supported (per system)	16
Modules Supported (per base)	8
Digital I/O, max (per base)	256 (Inputs + Outputs)
Analog I/O, max (per base)	32 (Inputs + Outputs)
I/O Limitations (per system)	2048 Digital In, 2048 Digital Out, 512 Analog In, 512 Analog Out
Power Supplied for I/O modules	1500mA @ 5V DC maximum

I/O Module 5V Power Usage (1500mA total available)			
8 DC In DIM510 30mA	16 DC In DIM610 40mA	32 DC In DIM710 50mA	8 DC Out DQM506 40mA
16 DC Out DQM606 60mA	32 DC Out DQM706 120mA	8 Relay Out DQM502 230mA	16 Relay Out DQM602 420mA
8DC + 8 Out DIQ512 250mA	4 Analog In ADC170 50mA	4 RTD In RTD100 100mA	4 T-couple In THM100 100mA
4 Anlg. Out (mA) DAC106 120mA	4 Analog Out (V) DAC101 70mA	2 Analog In + 2 Analog Out MIX116 100mA	

3   INSTALLATION

3.1   Physical Installation

The COS100 is compact (45mm W x 90mm H x 60mm D), and mounts on DIN-rail. Each I/O module installed adds width in increments of 20mm (for DC & analog I/O) or 27mm (for relay I/O).

Modules can be added either before or after the CNX100 base has been installed on the DIN-rail.

HE599COS100, with 8 I/O modules installed.

I/O modules are physically added with the following procedure:

1.   Remove the cover (if present) for the expansion connector from the COS100 base, and for all but the rightmost I/O module.
2.   Make sure that the locks on the top and bottom of the CNX100 base are all the way to the front in the "Open" position.
3.   Align the first I/O module to the right of the COS100 base using the alignment features in the plastic case.
4.   Upon mounting the module securely, slide the locks on the top and bottom of the base all the way to the back in the "Close" position.
5.   Repeat steps 2-4 above until all modules are mounted.
6.   Hang the COS100 base and all the affixed I/O modules on the DIN-rail, and secure them underneath by sliding the DIN-rail latches to the "up" position.

3.2   Wiring

The SmartRail COS100 Base should be powered *independently* from the power supplied to the SmartRail I/O modules themselves. This offers optimum noise immunity, and helps maintain galvanic isolation between the CAN Network and I/O Power. The recommended approach is to power the CAN network from one power supply, and I/O devices from at least one separate power supply. The SmartRail bases are powered from the CAN Network.

The COS100 SmartRail base provides two locations to land power wiring – a 5-pin removable network connector, and a 3-pin fixed power connector. While either can be used to power the COS100, it is recommend to use only the 5-pin removable connector. Leave the 3-pin fixed connector disconnected.

For network wiring, the recommended approach is to daisy-chain each node, with a continuous connection for shield. Do not connect shield to any node, but connect it directly to earth ground at one location only – usually at the DC supply powering the network. The network DC supply should have its V- terminal connected directly to earth ground.

If multiple DC supplies are used to power the network, the V+ from any one supply should be connected only to nodes it is powering – disconnected from other sections powered by other supplies. The V- connection should be continuous across the entire network, although V- should connect to earth at one point only.

At each end of the network, a 121 ohm, ¼ watt, 1% resistor should be used for termination – installed between the CAN_H and CAN_L terminals. Only appropriate Thin (for <100m) or Thick (<500m) cabling should be used (assuming 125 KBaud). This cable is available from a variety of sources, including Horner APG which offers both Thin (HE200CBL100) and Thick (HE200CBL500) varieties.

3.3   Software Configuration

Each SmartRail COS100 Base is configured from Cscape, under "Hardware Configuration". Cscape 9.4 or later is required, and OCS firmware version 12.98 or later is required. The following is the general configuration procedure.

1. In Cscape, select "Hardware Configuration".
2. Ensure that the OCS controller to be used in the application has been selected.
3. Select the "CAN1 CANopen I/O" Tab.
4. Click the "Add" Button
5. Select "HE599COS100" in the SmartRail tab
6. Click the "OK" button. The following dialog will open:
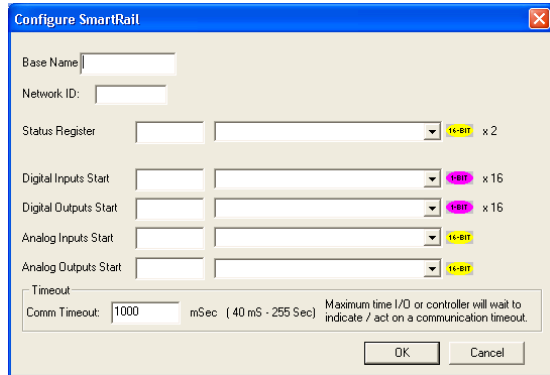
Base Name – any descriptive text (up to 15 characters)
Network ID – unique CAN ID (1-79 decimal)
Status Register – Location where two consecutive words are reported
Digital Inputs / Digital Outputs / Analog Inputs / Analog Outputs Start – starting locations for each type of I/O for that base.
Comm Timeout – Maximum amount of time the COS100 or OCS will wait to act on a communications timeout (40 to 255000 milliseconds)

7. Having entered the required information (above), click "OK". At this point, the following Hardware Configuration dialog will appear:
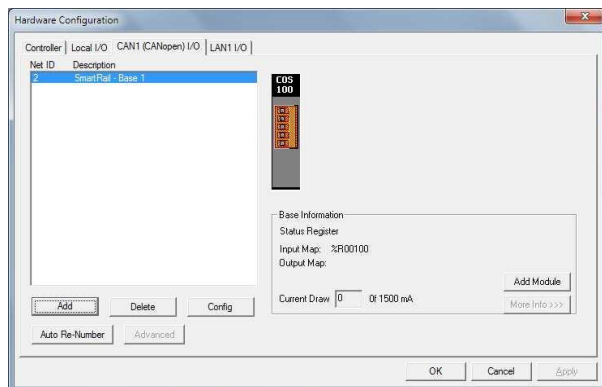
8. Now up to 8 modules can be added via the "Add Module" button. As I/O modules are added the Input Map, Output Map, and Current Draw are updated, showing the accumulated I/O Module Information. More details regarding each module can be viewed via the "More Info" button.
9. Right clicking on an I/O module will allow detailed configuration to be performed, as follows:
   a. Digital Input modules can be configured to update on a change of state (typical) or periodically (rare). Input filtering can also be adjusted from the default of 1mS.
   b. Digital Output modules can optionally be configured to hold last state (in groups of 8) in Stop/Idle mode.
   c. Analog Input modules can be configured with an update rate of 10mS to 255 seconds. Analog Inputs also have configurable data type and range which varies by module type.
   d. Analog Output modules have configurable type and range, and also can have Stop/Idle behavior adjusted to Hold Last State, or go to Minimum (default), Medium or Maximum value.
10. Press "OK" to complete the process.

3.4   Troubleshooting

The two primary tools for troubleshooting the SmartRail I/O are the LED indicators and the COS100 Base Status Registers – assigned during Cscape configuration.

3.4.1   LED Indicators

During normal operation, the RUN, MS & NS LEDs will be solid green, and the I/O LED will not be illuminated.

LED	State	Meaning
RUN (Power)	Off	Base Unit is powered down
	Solid Green	Base Unit is powered up
I/O (I/O System)	Solid Red	I/O interface power-on-self-test failed
	Blinking Red	I/O Module error detected (IOE_n status bit On)
	Off	I/O Modules are running normally
MS (Main System)	Solid Red	Power-on-self-test failed
	Blinking Red	Configuration mismatch error (CME_n status bit On)
	Blinking Green	Waiting to be configured (NO_CFG status bit On)
	Solid Green	Base Unit is running normally
NS (Network System)	Solid Red	Network Ack or Duplicate ID test failed
	Blinking Red	Network ID test failed
	Blinking Green	Network Life Timeout expired (LIFE_ERR status bit On)
	Solid Green	Network is running normally

3.4.2   Status Registers

First 16-bit Status Word								
Bits								
16	11-15	10	9	5-8	4	3	2	1
SEND	0	PUP_ERR	LIFE_ERR	0	BAD_FW	NOT_SR	NO_CFG	Offline

- SEND_NOW – can be asserted by the application to force the OCS to immediately update all digital and analog outputs. This is an advanced feature not normally used.
- PUP_ERR – indicates the base had powered down and is now powered up again. This is a "sticky bit", which should be cleared by the OCS application.
- LIFE_ERR – indicates the controlling OCS had stopped communicating with the base and has now resumed that communication. This will happen if the OCS is power-cycled, placed in STOP mode or has its application updated. While the OCS is down, the base sets all of its outputs to their default states. This is a "sticky bit", which should be cleared by the OCS application.
- BAD_FW – always 0 for SmartRail
- NOT_SR – always 0 for SmartRail (indicates a SmartStix or SmartBlock device)
- NO_CFG – indicates the base is waiting to be configured
- Offline – indicates no device was found with the configured Network ID.

Second 16-bit Status Word								
Bits								
8	7	6	5	4	3	2	1
CME_8	CME_7	CME_6	CME_5	CME_4	CME_3	CME_2	CME_1
16	15	14	13	12	11	10	9
IOE_8	IOE_7	IOE_6	IOE_5	IOE_4	IOE_3	IOE_2	IOE_1

- If the CME_n bit is ON, there is a Configuration Mismatch Error in SmartRail slot n.
- If the IOE_n bit is ON, there is an I/O Error in SmartRail slot n. Only the RTD100 (open channel), THM100 (open channel) and MIX116 (illegal analog output value) support the I/O Error Diagnostic.

4   SAFETY

This equipment is suitable for use in Class I, Division 2, Groups A, B, C and D or Non-hazardous locations only

WARNING - EXPLOSION HAZARD -
Do not disconnect equipment unless power has been removed or the area is known to be non-hazardous

WARNING - EXPLOSION HAZARD -
Substitution of any component may impair suitability for Class I, Division 2

WARNING – POSSIBLE EQUIPMENT DAMAGE
Remove power from the I/O Base and any peripheral equipment connected to this local system before adding or replacing this or any module.

When found on the product, the following symbols specify:

Warning: Consult user documentation.

Warning: Electrical Shock Hazard.

> **WARNING: To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.**
>
> **WARNING: To reduce the risk of fire, electrical shock, or physical injury it is strongly recommended to fuse the voltage measurement inputs. Be sure to locate fuses as close to the source as possible.**
>
> **WARNING: Replace fuse with the same type and rating to provide protection against risk of fire and shock hazards.**
>
> **WARNING: In the event of repeated failure, do not replace the fuse again as a repeated failure indicates a defective condition that will not clear by replacing the fuse.**
>
> **WARNING: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.**

- All applicable codes and standards need to be followed in the installation of this product.
- For I/O wiring (discrete), use the following wire type or equivalent: Belden 9918, 18 AWG or larger.

Adhere to the following safety precautions whenever any type of connection is made to the module.

- Connect the green safety (earth) ground first before making any other connections.
- When connecting to electric circuits or pulse-initiating equipment, open their related breakers. Do not make connections to live power lines.
- Make connections to the module first; then connect to the circuit to be monitored.
- Route power wires in a safe manner in accordance with good practice and local codes.
- Wear proper personal protective equipment including safety glasses and insulated gloves when making connections to power circuits.
- Ensure hands, shoes, and floor are dry before making any connection to a power line.
- Make sure the unit is turned OFF before making connection to terminals. Make sure all circuits are de-energized before making connections.
- Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

5   TECHNICAL SUPPORT

For assistance and manual updates, contact Technical Support at the following locations:

North America:
Tel: 317 916-4274
Fax: 317 639-4279
Web: http://www.heapg.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

> No part of this publication may be reproduced without the prior agreement and written permission of Horner APG, Inc. Information in this document is subject to change without notice.