



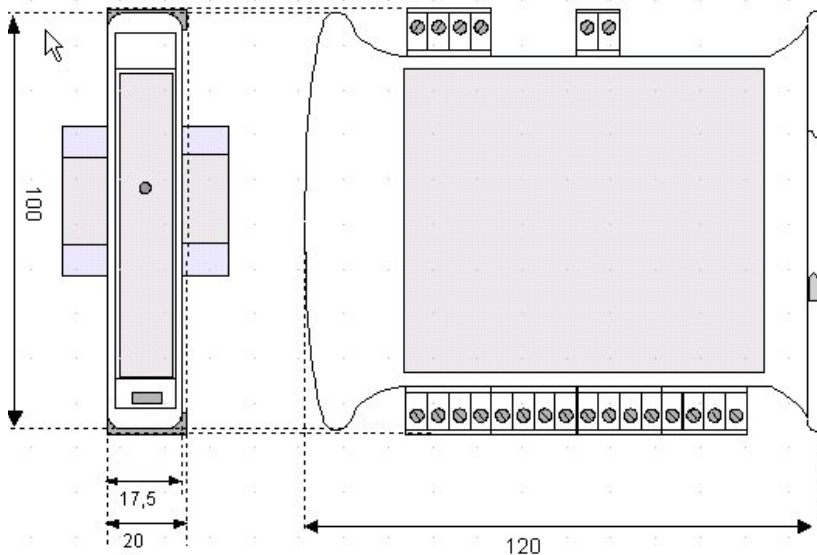
# SmartMod

20mA Analog Input Module  
**HE359ADC120 / HE359ADC220**  
 16-Bit Resolution

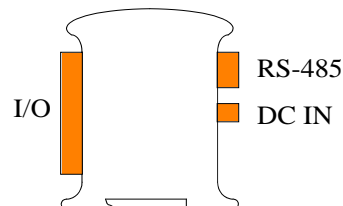


**1 Specifications**

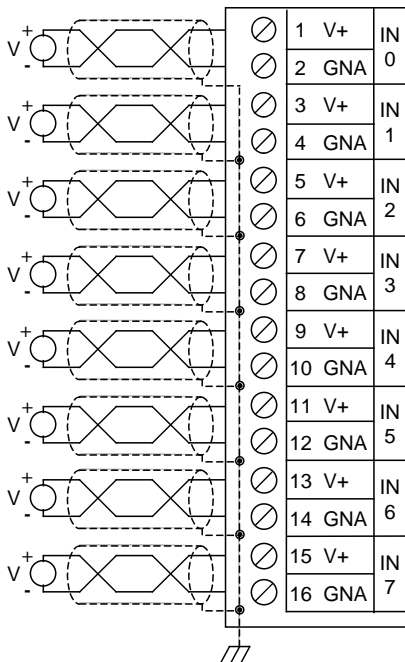
| Specifications                            |   |        |
|---|---|--------|
|   | ADC120  | ADC220 |
| Number of Channels                        | 4   | 8      |
| Input Ranges                              | +/-20mA   |        |
| Resolution                                | Approximately 16-Bit  |        |
| Input Impedance                           | <50 Ohms  |        |
| Linearity                                 | +/-0.1%   |        |
| External Power Supply Voltage             | 10-30Vdc  |        |
| Required Power (Steady State)             | 30mA @ 24Vdc, typical   |        |
| Isolation                                 | 2000 Vac 50Hz, 1 min.   |        |
| Required Power (Inrush)                   | Negligible  |        |
| Isolation                                 | 2000Vac for 60 seconds (Input/Power & Input/Comms)  |        |
| Conversion Time (PLC Update Rate)         | Determined by Communications w/OCS  |        |
| Terminal Type                             | Screw Type, Removable   |        |
| Storage Temp.                             | -40° to 85° Celsius   |        |
| Operating Temp.                           | -10° to 60° Celsius   |        |
| Relative Humidity                         | 5 to 95% Non-condensing   |        |
| Dimensions WxHxD                          | 17.5mm x 100mm x 120mm<br>0.69" x 3.94" x 4.72"   |        |
| Weight                                    | 150g (6 oz.)  |        |
| Communications                            | Modbus/RTU (binary)<br>RS-485 half duplex   |        |
| Factory Default Communications Parameters | 38400 baud, N, 8, 1, no h/s<br>Default Modbus ID 1  |        |
| Supported Modbus Commands                 | 1,2,3,4,5,6,8,15,16   |        |
| CE & UL Compliance                        | <a href="http://www.heapg.com/Pages/TechSupport/ProductCert.html">http://www.heapg.com/Pages/TechSupport/ProductCert.html</a> |        |



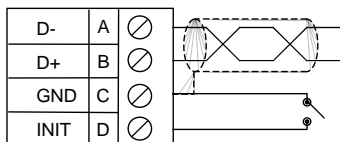
Dimensions in inches are 0.69"W x 3.95"H x 4.72"D  
 Note: Number of I/O terminal connections varies from model to model



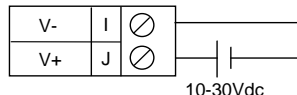
**2 Wiring – I/O**



| Pin # | ADC107   | ADC207        |
|-------|--|---------------|
| 1     | INPUT 0+   | INPUT 0+      |
| 2     | ANALOG COMMON  | ANALOG COMMON |
| 3     | INPUT 1+   | INPUT 1+      |
| 4     | ANALOG COMMON  | ANALOG COMMON |
| 5     | INPUT 2+   | INPUT 2+      |
| 6     | ANALOG COMMON  | ANALOG COMMON |
| 7     | INPUT 3+   | INPUT 3+      |
| 8     | ANALOG COMMON  | ANALOG COMMON |
| 9     | Only Terminals 1 through 8 are present on the ADC107 model | INPUT 4+      |
| 10    |  | ANALOG COMMON |
| 11    |  | INPUT 5+      |
| 12    |  | ANALOG COMMON |
| 13    |  | INPUT 6+      |
| 14    |  | ANALOG COMMON |
| 15    |  | INPUT 7+      |
| 16    |  | ANALOG COMMON |



Wiring RS-485



Wiring DC IN

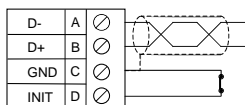
**Notes:**

Both ends of the RS-485 network should be terminated with a 100ohm, 1/4W, 1% resistor. Many OCS controllers feature dip switches or jumpers which enable appropriate termination if the OCS is located on a network end.

### 3 Init Default Setup

Communication parameters will be set to INIT default after performing the following procedure:

1. Install jumper between INIT and GND terminals of the RS-485 port.
2. Apply power to Smartmod unit.
3. Read parameter words to see current parameters.
4. Write changes if necessary.



**The INIT Default RS485 Settings Are:**

Modbus ID = 1  
 Baud rate = 9600  
 Parity = None  
 Stop Bits = 1  
 Data Bits = 8  
 No handshake\*

**Note:** There are 2 types of default settings possible:  
 1. Factory default as described in section 1 (Specifications)  
 2. Default after INIT as described in section 3 (INIT Default Setup)

\*If using downloadable Modbus protocol, in Cscape, select Multidrop Half setting for handshaking.

### 4 Configuration Data

SmartMod Configuration settings are mapped into Modbus Register space. This configuration data may be modified with any Modbus/RTU Master device. For convenience, Horner APG has developed a variety of Cscape application files which allow an OCS (Xle, NX, LX, QX) to act as a SmartMod configuration device. Initial configuration of SmartMod modules should be done on an individual basis, since all modules come from the factory with a default Modbus ID of 1. Once each module on the network has its own unique Modbus ID, further configuration adjustments can be made with the entire network powered.

All configuration parameters listed below (except 40012 Channel Enable) are stored in EPROM. This means they should not be constantly rewritten.

| Configuration Parameters – Registers 40001 through 40013 |                                |                                       |     |                              |
|--|--------------------------------|---------------------------------------|-----|------------------------------|
| Modbus Register  | Description                    | Min                                   | Max | Default                      |
| 40001-40005  | Reserved                       |                                       |     |                              |
| 40006  | Communications Parameters      | See Table                             |     | 38.4kbaud, N, 8, 1, RTU Mode |
| 40007  | Modbus ID                      | 1                                     | 255 | 1                            |
| 40008  | Rx/Tx Delay (in 2mS steps)     | 0                                     | 255 | 1mS                          |
| 40009  | Watchdog Timer (in 0.5s steps) | 0                                     | 255 | 10 (5s)                      |
| 40010  | Modbus Coil Data               | Not Configuration Data – See I/O Data |     |                              |
| 40011  | Input Type                     | 4                                     | 4   | 4 (+/-10V)                   |
| 40012  | Channel Enable                 | See Table                             |     | 255 (Channels 1-8 enabled)   |
| 40013  | Reserved                       |                                       |     |                              |
| 40014  | Reserved                       |                                       |     |                              |

| Register 40006 (Communications Parameters) Bit Definition |                |        |         |                 |           |            |       |
|---|----------------|--------|---------|-----------------|-----------|------------|-------|
| Bits 7-15   | Bit 6          | Bit 5  | Bit 4   | Bit 3           | Bit 2     | Bit 1      | Bit 0 |
| Unused  | Mode           | Parity |         | Data Bits       | Baud Rate |            |       |
|   | 0 = ASCII Mode | Value  | Meaning | 0 = 7 Data Bits | Value     | Meaning    |       |
|   |                | 0      | Mark    |                 | 0         | 1200 baud  |       |
|   | 1 = RTU Mode   | 1      | Even    | 1 = 8 Data Bits | 1         | 2400 baud  |       |
|   |                | 2      | Odd     |                 | 2         | 4800 baud  |       |
|   |                | 3      | Space   |                 | 3         | 9600 baud  |       |
|   |                |        |         |                 | 4         | 19200 baud |       |
|   |                |        |         |                 | 5         | 38400 baud |       |
|   |                |        |         |                 | 6, 7      | Unused     |       |

NOTE:  
 Data bits number is ignored, in ASCII mode it is fixed at 7 and in RTU mode it is fixed to 8. In RTU mode the parity bit is ignored (parity is fixed at NONE).

| Register 40010 (Mirror of Coil Data) Bit Definition |                          |                          |                           |
|---|--------------------------|--------------------------|---------------------------|
| Bit 3-15  | Bit 2                    | Bit 1                    | Bit 0                     |
| Unused  | Power-up Event (Coil 11) | Watchdog Event (Coil 10) | Watchdog Enabled (Coil 9) |
|   | 0 = Disable Input        |                          |                           |
|   |                          |                          | 1 = Enable Input          |

| Register 40012 (Channel Enable) Bit Definition |         |         |         |         |         |         |         |         |
|--|---------|---------|---------|---------|---------|---------|---------|---------|
| Bit 8-15                                       | Bits 7  | Bit 6   | Bit 5   | Bit 4   | Bit 3   | Bit 2   | Bit 1   | Bit 0   |
| Unused   | Input 7 | Input 6 | Input 5 | Input 4 | Input 3 | Input 2 | Input 1 | Input 0 |
| 0 = Disable Input                              |         |         |         |         |         |         |         |         |
| 1 = Enable Input                               |         |         |         |         |         |         |         |         |

It is recommended that all unused channels are disabled.

### 5 Input/Output Data

SmartMod Analog I/O utilizes both Modbus Registers (40001-40030) and Coils (1-11). It is possible to access all data using Registers only, because the Coils can be accessed through Register 40010. The following tables lists all Modbus I/O data available.

| I/O Register Data (Registers 40014-40022) |                     |            |         |         |              |
|---|---------------------|------------|---------|---------|--------------|
| Modbus Register                           | Description         | Access     | Minimum | Maximum | Units        |
| 40010                                     | Mirror of Coil Data | Read/Write | n/a     | n/a     | n/a          |
| 40015                                     | Input 0             | Read-only  | -10000  | 10000   | 1mV (0.001V) |
| 40016                                     | Input 1             | Read-only  | -10000  | 10000   | 1mV (0.001V) |
| 40017                                     | Input 2             | Read-only  | -10000  | 10000   | 1mV (0.001V) |
| 40018                                     | Input 3             | Read-only  | -10000  | 10000   | 1mV (0.001V) |
| 40019                                     | Input 4             | Read-only  | -10000  | 10000   | 1mV (0.001V) |
| 40020                                     | Input 5             | Read-only  | -10000  | 10000   | 1mV (0.001V) |
| 40021                                     | Input 6             | Read-only  | -10000  | 10000   | 1mV (0.001V) |
| 40022                                     | Input 7             | Read-only  | -10000  | 10000   | 1mV (0.001V) |

### 6 Implemented Modbus Functions

| Function | Code                                 |
|----------|--------------------------------------|
| 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                           |

For ADC107/207 SmartMod modules, bank 0xxxx is a mirror of bank 1xxxx, as 3xxxx is a mirror of 4xxxx i.e. the first register can be read independently as 30001 (with the function 04) or 40001 (with the function 03)

**7 Watchdog**

The module has been provided with a Host Watchdog timer which, when it is enabled, issues an alarm event each time the communication between the module and the host is inactive for a period time greater than the programmed one (40009). When the alarm is activated, 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 placed, 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 module blinks 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 once again. There is also a Module Watchdog timer that monitor the internal CPU work and is active when the CPU doesn't function correctly for any reason, and resets the module. After the reset, all outputs will assume their initial default value ("power up value"), This may be different to the output value after the reset.

| Register 40009 Definition  |                |                |
|--|----------------|----------------|
| The Watchdog Timeout value is set in Modbus register 40009 (Resolution of 0.5s)                                      |                |                |
| Coil 00009   | Coil 00010     | Coil 00011     |
| Watchdog Enabled   | Watchdog Event | Power-up Event |
| 0 = Input Disabled   |                |                |
| 1 = Input Enabled  |                |                |
| If Coil 9 (Watchdog Enabled) is set, Coil 10 (Watchdog Event) will set if the Watchdog Timeout value is exceeded.    |                |                |
| When set, Coil 10 can be reset by the controller when normal communications resumes.                                 |                |                |
| The Power-up Event (Coil 11) is set every time the power is applied. It can be cleared by the controller if desired. |                |                |

**8 Sync**

| Register | Function             |
|----------|----------------------|
| 40023    | SYNC INPUT VALUE # 0 |
| 40024    | SYNC INPUT VALUE # 1 |
| 40025    | SYNC INPUT VALUE # 2 |
| 40026    | SYNC INPUT VALUE # 3 |
| 40027    | SYNC INPUT VALUE # 4 |
| 40028    | SYNC INPUT VALUE # 5 |
| 40029    | SYNC INPUT VALUE # 6 |
| 40030    | SYNC INPUT VALUE # 7 |

The Sync function is performed by a command sent to all devices connected on the network. When the devices receive the Sync command, all Input states are saved in the relative register. Doing this, it is possible to read the value of all inputs at the Sync command time. To send the Sync command, write the value 10 in the "Test" register (40001) and send to node ID 255. NOTE: The sync values are not saved in EPROM. When the device receives the Sync command, the actual input values in the 40015-40022 registers are saved in registers 40023-40030, channel by channel, as outlined above. These values will be stored until the next sync command, to be read at a following time.

**9 LED Indicator**

| LED   | COLOUR | STATE          | DESCRIPTION   |
|-------|--------|----------------|---|
| POWER | Green  | ON             | Device Powered  |
|       |        | OFF            | Device Not Powered / Incorrect RS485 Cabling                      |
|       |        | Fast Blink     | Communication in progress/ (blink frequency depends on baud rate) |
|       |        | 1 Second Blink | Watch-dog Alarm Condition (See Section 6 above)                   |

The LED is located on the front of the model.

**10 Calibration**

The calibration procedure 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 do a calibration, it is necessary to use precision instruments and to correctly perform all the steps below. Any error made in the calibration procedure reduces the accuracy and the good operation of the device.

NOTE: For the RTDs, the device uses the calibration of 0-500 Ohm or 0-2000 Ohm input type.

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 (40001) the value 20.
- 6 – Set the calibrator to the full-scale value (10V or 20mA)
- 7 – Write on the "Test" register (40001) the value 30.
- 8 – Repeat point 3 to 7 for each input type to be calibrated.

**11 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:



**12 Troubleshooting Tips**

If not communicating

- Verify that the wiring is correct
  - Pin 1 on the XL series serial ports is RS-485 positive (+) and is connected to positive (+)
  - Pin 2 on the XL series serial ports is RS-485 negative (-) and is connected to negative (-)
- If the ground pin is not being used, verify that only one device on the network is supplying bias. This is set from the system menu on the XL series controllers.
- Tie the INIT pin to GND then power cycle the SmartMod. Then attempt to communicate with it at the default parameters
- If using the INIT settings, verify with an ohm meter that the jumper is shorted to GND. Then try power cycling the SmartMod unit again.

If any I/O seems unresponsive

- Verify the Modbus offset that you are polling e.g. 40010 (command 3, 6, or 16 offset 00009)
- Verify any registers from the device that may affect the I/O. These will vary between modules. For example, enable, type selection or raw value.

**13 Technical support**

Technical Support at the following locations:

|   |  |
|---|--|
| <p><b>North America:</b><br/>                 Tel: 317 916-4274<br/>                 Fax: 317 639-4279<br/>                 Web: <a href="http://www.heapg.com">http://www.heapg.com</a><br/>                 Email: <a href="mailto:techspt@heapg.com">techspt@heapg.com</a></p> | <p><b>Europe:</b><br/>                 Tel: +353-21-4321266<br/>                 Fax: +353-21-4321826<br/>                 Web: <a href="http://www.horner-apg.com">http://www.horner-apg.com</a><br/>                 Email: <a href="mailto:tech.support@horner-apg.com">tech.support@horner-apg.com</a></p> |
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