SmartMod
Analog Output Module
## HE359DAC007 / HE359DAC107
Selectable 0-20mA or 0-10V
1 µA or 1 mV Resolution
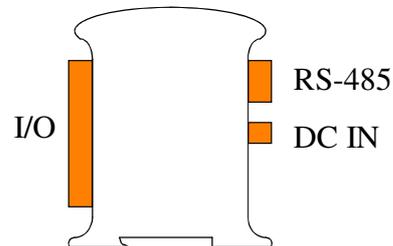
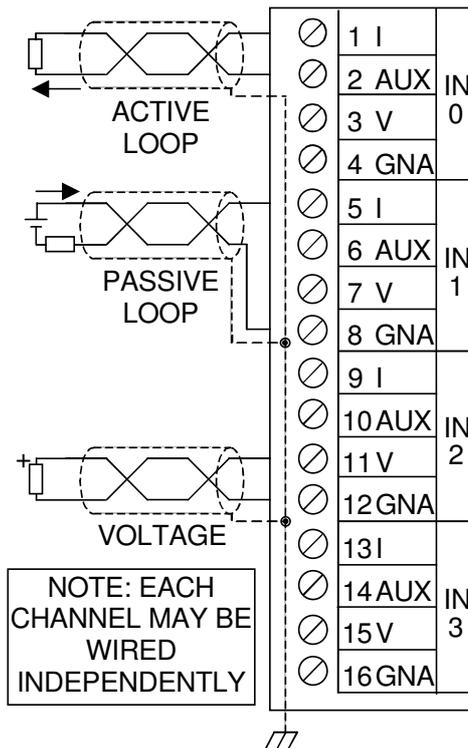## 1   Specifications

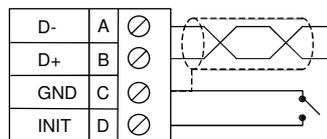|	DAC007	DAC107			DAC007	DAC107
Number of Channels	2	4		Auxiliary Voltage	12 V @ 20 mA (4 channels)	
Output Ranges	0-20 mA or 0-10 V			Terminal Type	Screw Type, Removable	
Resolution	1 µA or 1 mV			Storage Temp.	-40° to 85° C	
Load Resistance	Voltage: >5 kΩ Current: <500 Ω			Operating Temp.	-10° to 60° C	
				Relative Humidity	0 to 90% Non-condensing	
Output Calibration	Voltage: +/-10 mV Current: +/-20 µA			Dimensions W x H x D	17.5 mm x 100 mm x 120 mm 0.69" x 3.94" x 4.72"	
External Power Supply Voltage	18-30 VDC			Weight	150 g (6 oz.)	
Required Power (Steady State)	30 mA @ 24 VDC, typical (100 mA max)			Communications	Modbus/RTU (binary) RS-485 half duplex	
Required Power (Inrush)	Negligible			Factory Default Communications Parameters	38400 bd, N, 8, 1, no h/s Default Modbus ID 1	
Isolation	2000 VAC for 60 seconds (Input/Power & Input/Comms)			Supported Modbus Commands (family)	1,2,3,4,5,6,8,15,16	
CE & UL Compliance	https://hornerautomation.com/certifications/ http://horner-apg.com/en/support/certification.aspx					
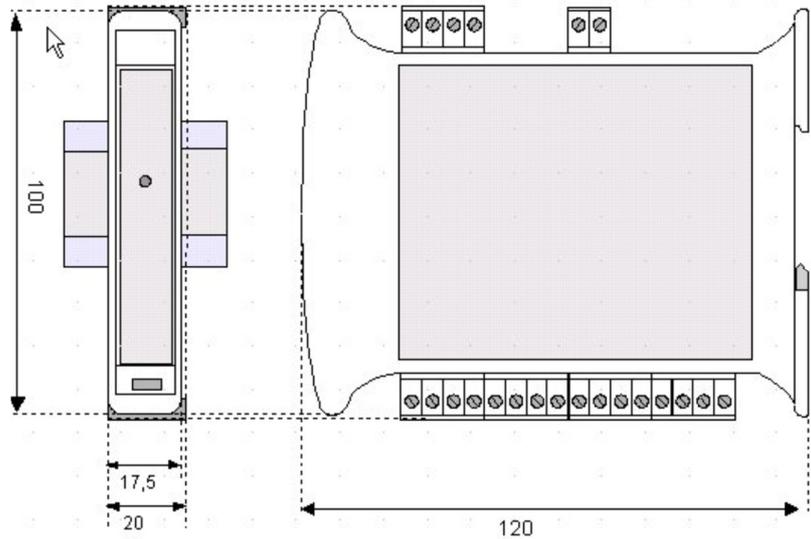
Dimensions are 0.69" W x 3.95" H x 4.72" D
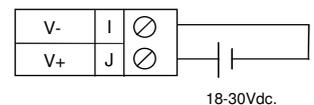Note: Number of I/O terminal connections varies from model to model.

I/O

RS-485

DC IN

2.   Wiring – I/O

ACTIVE LOOP

PASSIVE LOOP

VOLTAGE

NOTE: EACH CHANNEL MAY BE WIRED INDEPENDENTLY

1 I	
2 AUX	IN 0
3 V	
4 GNA	
5 I	
6 AUX	IN 1
7 V	
8 GNA	
9 I	
10 AUX	IN 2
11 V	
12 GNA	
13 I	
14 AUX	IN 3
15 V	
16 GNA	

Pin #	DAC007	DAC107		Pin #	DAC007	DAC107	
1	I	I		9		I	
2	AUX	AUX	OUT 0	10		AUX	OUT 2
3	V	V		11		V	
4	GNA	GNA		12	Only Terminals 1 through 8 are present on the DAC007 model	GNA	
5	I	I		13		I	
6	AUX	AUX	OUT 1	14		AUX	OUT 3
7	V	V		15		V	
8	GNA	GNA		16		GNA	

D-	A
D+	B
GND	C
INIT	D

Wiring RS-485

| V- | I |
| V+ | J |

18-30Vdc.

Wiring DC IN

Notes:
Both ends of the RS-485 network should be terminated with a 100 Ω, 1/4 W, 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.
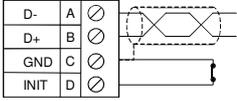
The INIT Default RS485 Settings Are:
Modbus ID = 1
Baud rate = 9600
Parity = None
Stop Bits = 1
Data Bits = 8
No handshake

> **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)

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 has developed a variety of Cscape application files which allow an OCS to act as a SmartMod configuration device. Initial configuration of SmartMod module 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 constantly be rewritten.

Configuration Parameters – Registers 40001 through 40013				
Modbus Register	**Description**	**Min**	**Max**	**Default**
40001-40005	Reserved			
40006	Communications Parameters	See Table		38.4 kBd, N, 8, 1, RTU Mode
40007	Modbus ID(Address)	1	255	1
40008	Rx/Tx Delay (in 2 ms steps)	0	255	0 ms
40009	Watchdog Timer (in 0.5 s steps)	0	255	10 (5 s)
40010	Modbus Coil Data	Not Configuration Data – See I/O Data		
40011	Calibration			
40012	Slew Rate Settings (See Tables)			
40013	Reserved			
40014	Output Type	See Table		0 (All Channels Current)

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 Bd	
		1	Even		1	2400 Bd	
	1 = RTU Mode	2	Odd	1 = 8 Data Bits	2	4800 Bd	
		3	Space		3	9600 Bd	
					4	19200 Bd	
					5-7	38400 Bd	

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		

Slew Rate Settings (Register 40012)				
Bit	15 - 12	11 - 08	07 - 04	03 - 00
Desc.	Slr Output #3	Slr Output #2	Slr Output #1	Slr Output #0

Value	V/s	mA/s		Value	V/s	mA/s
00h	Disabled			07h	9.60	19.2
01h	0.15	0.30		08h	19.2	38.4
02h	0.30	0.60		09h	38.4	76.8
03h	0.60	1.20		0Ah	76.8	153
04h	1.20	2.40		0Bh	153	306
05h	2.40	4.80		0Ch	Immediate	
06h	4.80	9.60				

Specify the slew rate / rising time of rising outputs. The value of each output is made of 4 bits, as shown in the table. Manufacturer default: 0Ch / Immediate

Register 40014 (Output Type) Bit Definition				
Bit 4-15	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Unused	Output 3	Output 2	Output 1	Output 0
	0 = Current (0-20 mA)			
	1 = Voltage (0-10 V)			

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 40010-40026)					
Modbus Register	**Description**	**Access**	**Minimum Volt/Amp**	**Maximum Volt/Amp**	**Units**
40010	Mirror of Coil Data	Read/Write	n/a	n/a	n/a
40015	Output 0	Read/Write	0	10000/20000	1 mV/1 µA
40016	Output 1	Read/Write	0	10000/20000	1 mV/1 µA
40017	Output 2	Read/Write	0	10000/20000	1 mV/1 µA
40018	Output 3	Read/Write	0	10000/20000	1 mV/1 µA
40019-40022	Reserved				
40023	Default/Safe Value Out 0	Read/Write	0	10000/20000	1 mV/1 µA
40024	Default/Safe Value Out 1	Read/Write	0	10000/20000	1 mV/1 µA
40025	Default/Safe Value Out 2	Read/Write	0	10000/20000	1 mV/1 µA
40026	Default/Safe Value Out 3	Read/Write	0	10000/20000	1 mV/1 µA

Modbus Coil	Description	Access
00009	Watchdog Enabled	Read/Write
00010	Watchdog Event	Read/Write
00011	Power-up Event	Read/Write

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 DAC007/107 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 preset safety values to avoid damage to the system in case of a fault occurring. Also, under the alarm condition the green LED on the front of the module blinks and the "Watchdog Event" coil is forced to a value of 1. There is also a Module Watchdog timer that monitors the internal CPU work and activates when the CPU doesn't function correctly.
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.   POWERUP Register Settings

Register	Function
40023	**POWERUP / SAFE OUTPUT VALUE #0**
40024	**POWERUP / SAFE OUTPUT VALUE #1**
40025	**POWERUP / SAFE OUTPUT VALUE #2**
40026	**POWERUP / SAFE OUTPUT VALUE #3**

When the device is turned-on and the watchdog alarm is active, the outputs are automatically forced to the value specified in this register.
- Manufacturer default: 0
The values are expressed in mV for the voltage outputs and in µA for the current outputs:
0 = 0 mA   0 = 0 V
20000 = 20 mA   10000 = 10 V

9.   LED Indicator

LED	COLOR	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   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.

For UL installation, the device must be powered using a power supply unit classified NEC class 2 SELV.

WARNING – **EXPLOSION HAZARD** – Do not disconnect equipment unless power has been switched off.
AVERTISSEMENT - RISQUE D'EXPLOSION - AVANT DE DECONNECTOR L'EQUIPMENT, COUPER LE COURANT.

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.

11.   Technical support

Technical Support at the following locations: