Analog Output Module

AOMS-4U / AOMS-8U

4 / 8 Channels
DIN-Rail Mount
MODBUS over Serial

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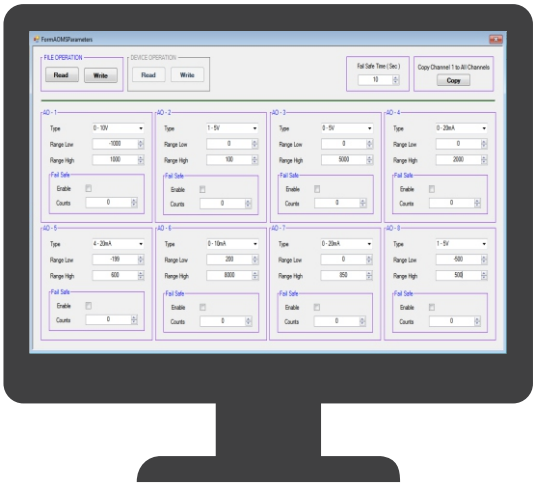
User Manual

AOMS-4U

AOMS-8U

Configuration Tool

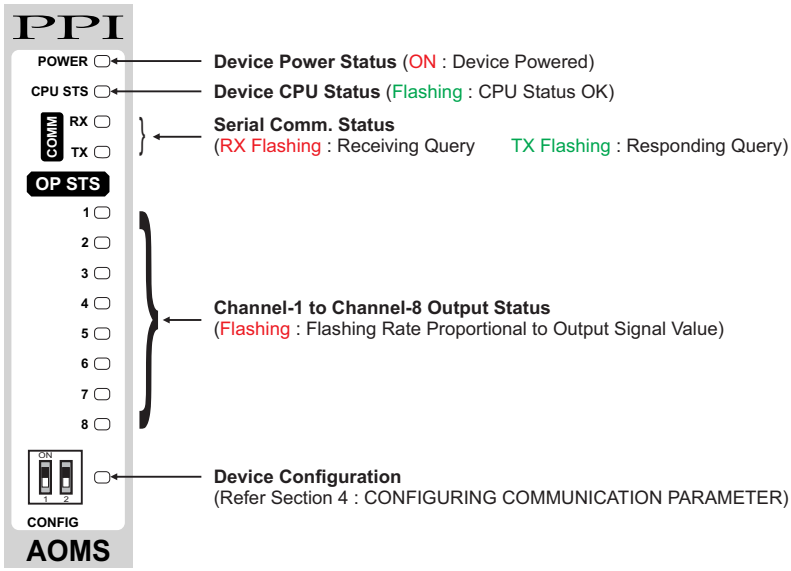


CONTENTS

Section 1

FRONT PANEL & ELECTRICAL CONNECTIONS

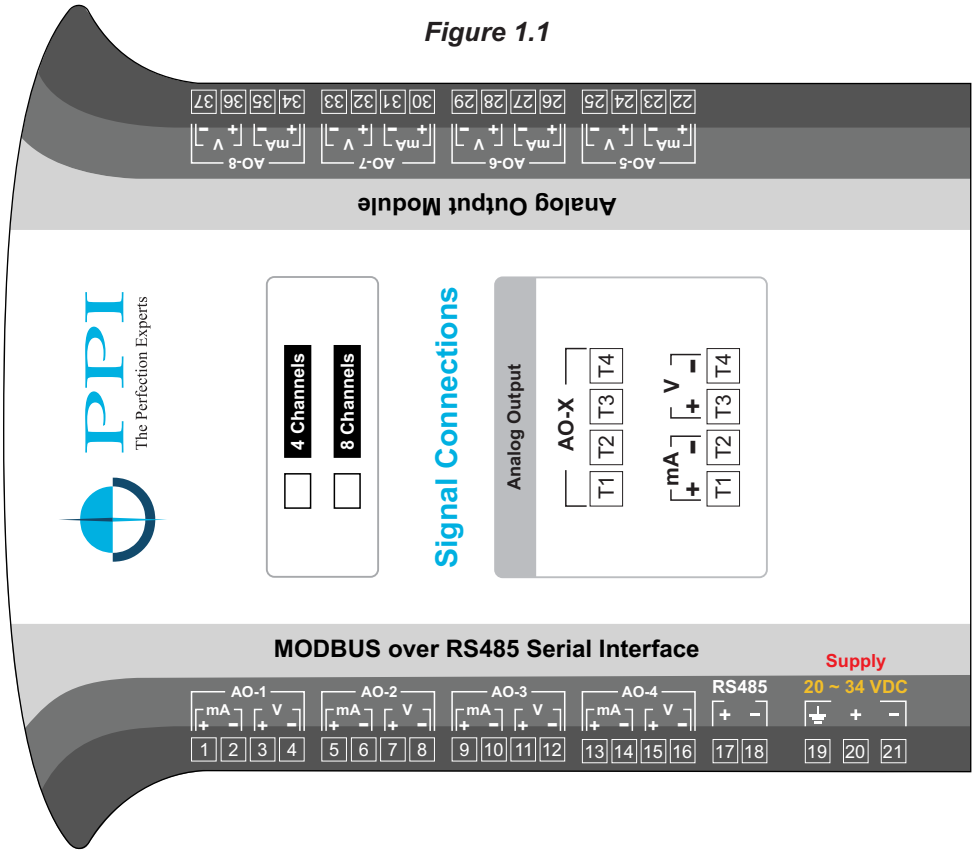
FRONT PANEL



ELECTRICAL CONNECTIONS

The Figure 1.1 illustrates Electrical Connection Diagrams. For 4 Channel Version the connectors from AO-5 to AO-8 are not fitted.

Figure 1.1



ANALOG OUTPUT CHANNELS

Each of 4 or 8 Analog Channels can be independently configured as either Current (4-20, 0-20 or 0-10 mA) or Voltage (0-5, 1-5 or 0-10 V) output.

The Figures 1.2 (a), 1.2 (b) & 1.2(c) below show the connection details for Current / Voltage outputs. All Analog output channels are identical from wiring connection viewpoint.

Figure 1.2(a)

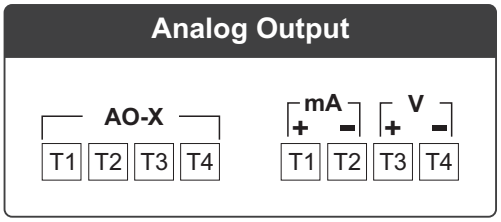


Figure 1.2(b)

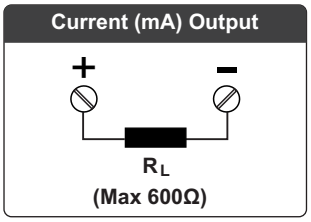
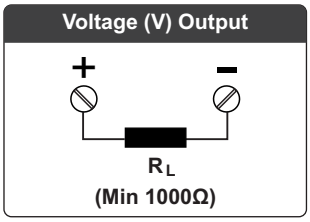
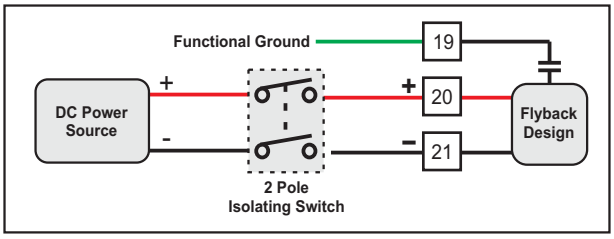


Figure 1.2(c)



POWER SUPPLY (Terminals 19, 20 & 21)

Figure 1.3



As standard, the connections are suited for 18 to 32 VDC power sources. The accuracy or performance of the Module is not affected by the variations in the supply within specified limits of 18 to 32 VDC.

Use well-insulated copper conductor wire of a size not smaller than 0.5mm² for power supply connections ensuring proper polarity, as shown in Figure 1.3. The Module is not provided with a power switch. If necessary, mount them separately.

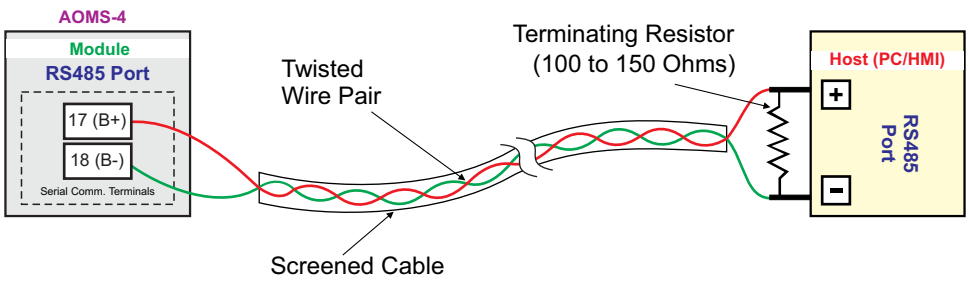
For safety and enhanced electrical noise immunity, it is highly recommended to connect the Mains Power Supply 'Earth' to terminal 19.

Serial Communication Port (Terminals 17, 18)

Figure 1.4 shows the wiring connections for interfacing the Host (PC/HMI) with AOMS.

Use a pair of twisted wires inside the screened cable for reliable noise-free communication. The wire should have less than 100 ohms/km nominal DC resistance (typically 24 AWG or thicker). Connect the terminating resistor (typically 100 to 150 ohm) at one end to improve noise immunity.

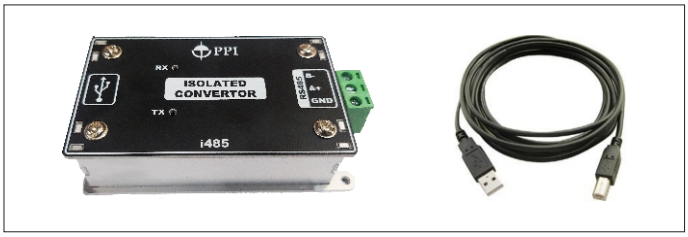
Figure 1.4



Note

In case of non-availability of an RS485 port on the Host PC, use the appropriate Serial Protocol Converter to match the available serial port on the host like “USB to RS485” and “RS232 to RS485” (Refer few images below). Please ensure that the appropriate Device Driver for the selected converter is installed on the Host PC.

RS232 to RS485



USB to RS485

Section 2

ANALOG OUTPUT CONFIGURATION

For user convenience, most parameters are accessible both as Bit-Mapped / 16-Bit Signed or Unsigned Modbus Registers & Discrete Input Coils.

Each Analog Output is provided with a pair of 2-Pin terminals; one each for Current & Voltage output. Use appropriate terminals in accordance with the configured Output Signal Type (Current or Voltage).

The Analog Output Signal value is scaled to *Range Low* (corresponding to Signal Low) & *Range High* (Corresponding to Signal High) parameters. The Analog Output varies in proportion to the *Analog Output Counts* parameter value.

The Analog Output configuration & operation parameters are described in below table 2.1.

Table 2.1 : Analog Output Parameters

<table>
<tr><th>Modbus Data Type</th><th>MODBUS Address</th><th>Values</th></tr>
<tr><td colspan="3">Analog Output Type (Registers)
Configuration Parameter (Stored in Non-Volatile memory)
This parameter sets the Output Signal Type. Each Analog Output Channel can be independently configured for the output type. The Current & Voltage signals are available on separate terminal pairs. Note that, either Current or Voltage signal is available (not both) depending on the selected type.</td></tr>
<tr><td>Holding Register
Function Code (0x06 & 0x10)</td><td>21 to 24
(4 Channels)

21 to 28
(8 Channels)</td><td><table><tr><th>Value</th><th>Type</th></tr><tr><td>0</td><td>0 to 10 V</td></tr><tr><td>1</td><td>1 to 5 V</td></tr><tr><td>2</td><td>0 to 5 V</td></tr><tr><td>3</td><td>0 to 20 mA</td></tr><tr><td>4</td><td>4 to 20 mA</td></tr><tr><td>5</td><td>0 to 10 mA</td></tr></table>(Default : 0 to 10 V)</td></tr>
<tr><td colspan="3">Range Low (Registers)
Configuration Parameter (Stored in Non-Volatile memory)
This parameter sets the counts corresponding to the minimum signal output level (0/1 V or 0/4 mA).</td></tr>
<tr><td>Holding Register
Function Code (0x06 & 0x10)</td><td>29 to 32
(4 Channels)

29 to 36
(8 Channels)</td><td>-30000 to 30000
(Default : 0)</td></tr>
<tr><td colspan="3">Range High (Registers)
Configuration Parameter (Stored in Non-Volatile memory)
This parameter sets the counts corresponding to the maximum signal output level (5/10 V or 10/20 mA).</td></tr>
<tr><td>Holding Register
Function Code (0x06 & 0x10)</td><td>37 to 40
(4 Channels)

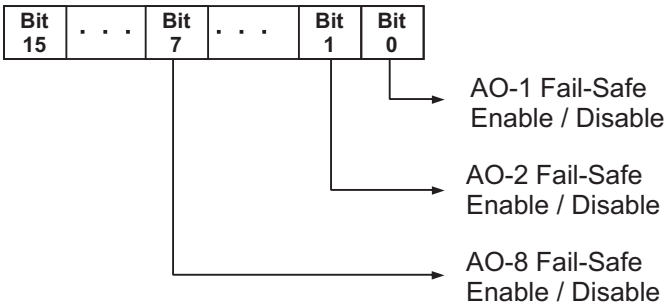
37 to 44
(8 Channels)</td><td>-30000 to 30000
(Default : 1000)</td></tr>
</table>

<table>
<tr><th>Modbus Data Type</th><th>MODBUS Address</th><th>Values</th></tr>
<tr><td colspan="3">Analog Output Counts (Registers)
Run-Time Parameter
This parameter value sets the output signal level. When this value equals Range Low or Range High; the output signal level is minimum or maximum, respectively.

Note that the Signal Output is restricted to 4% of the Signal Span above & below the Signal High & Signal Low, respectively. However if Signal Low value is 0 mA or 0 V then the minimum signal level is close to 0. For example 4% of 1 to 5 V span is 0.16 V. Thus, the maximum signal is restricted to 5.16 V & the minimum signal is restricted to 0.84 V.

For details Refer Appendix-A : ANALOG OUTPUT SIGNAL v/s COUNTS.</td></tr>
<tr><td>Holding Register
Function Code (0x06 & 0x10)</td><td>53 to 56
(4 Channels)

53 to 60
(8 Channels)</td><td>-30000 to 30000

(Default : 0)</td></tr>
<tr><td colspan="3">Fail-Safe Output Mode (Register & Coils)
Configuration Parameter (Stored in Non-Volatile memory)
All Analog Outputs can be independently enabled to latch to a fail-safe output signal level if the Serial MODBUS communication link between the host & the module is broken for more than a user programmed Time Interval.</td></tr>
<tr><td>Bit-Mapped Holding Register
Function Code (0x06 & 0x10)</td><td>1</td><td> 

4 Channel : Bits 4 to 15 are unused - ignore
8 Channel : Bits 8 to 15 are unused - ignore

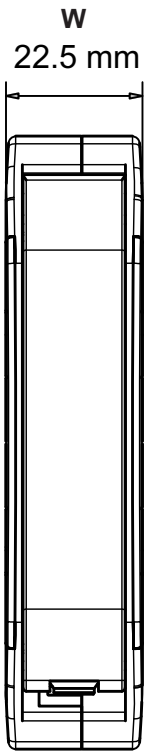
<table><tr><th>Bit Value</th><th>Enable / Disable</th></tr><tr><td>0</td><td>Fail-Safe Disable</td></tr><tr><td>1</td><td>Fail-Safe Enable</td></tr></table></td></tr>
<tr><td>Coils
Function Code (0x05 & 0x0F)</td><td>1 to 4
(4 Channels)

1 to 8
(8 Channels)</td><td><table><tr><th>Coil Value</th><th>Enable / Disable</th></tr><tr><td>0</td><td>Fail-Safe Disable</td></tr><tr><td>1</td><td>Fail-Safe Enable</td></tr></table></td></tr>
</table>

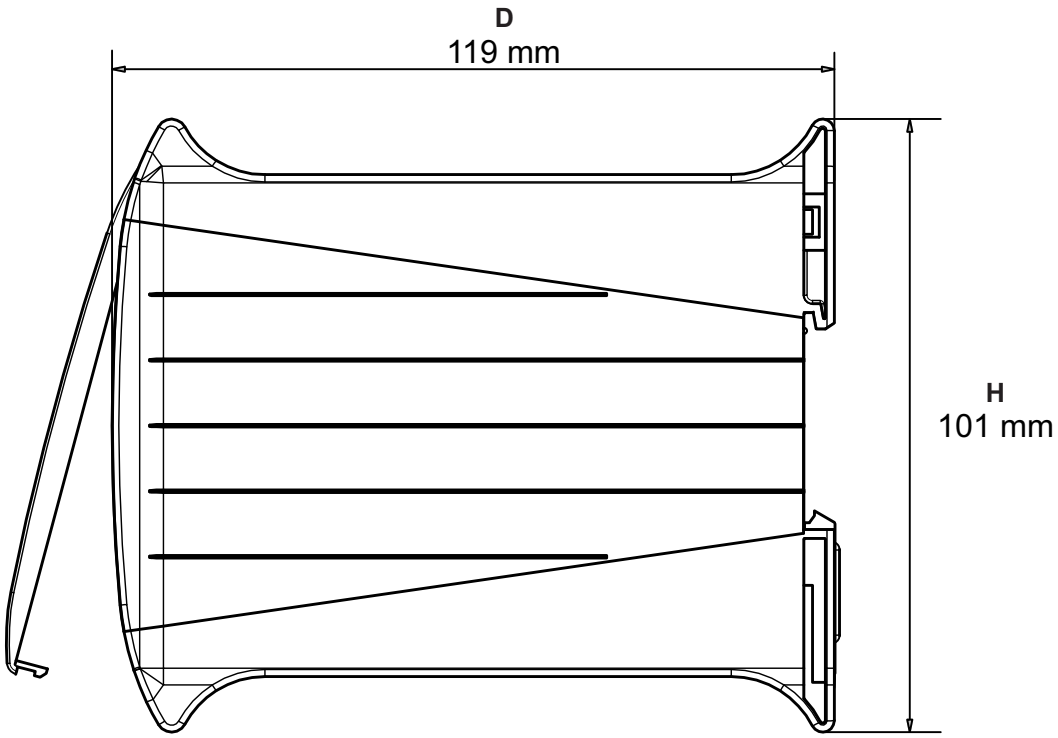
Modbus Data Type	MODBUS Address	Values
Fail-Safe Output Counts (Registers) ***Configuration Parameter (Stored in Non-Volatile memory)*** If the Analog Output channel is enabled for Fail-Safe output mode against communication link failure then the counts set for this parameter determines the output signal level. The Fail-Safe output signal level is latched as long as the communication link failure persists.		
Holding Register Function Code (0x06 & 0x10)	45 to 48 (4 Channels) 45 to 52 (8 Channels)	Minimum : Range Low Counts - 4% of Span* Maximum : Range High Counts + 4% of Span* * Span = Range High Counts - Range Low Counts
Communication Link Fail-Safe Time Period (Register) ***Configuration Parameter (Stored in Non-Volatile memory)*** This parameter value is applicable to Analog & Digital Output Channels that are Fail-Safe Enabled.		
Holding Register Function Code (0x06 & 0x10)	61	1 to 300 Seconds (Default : 10 Seconds)

Section 3

MECHANICAL DIMENSIONS



Front View



Side View

Width (W)	22.5 mm
Height (H)	101.0 mm
Depth (D)	119.0 mm

Section 4

CONFIGURING COMMUNICATION PARAMETERS

The Analog Output Module supports industry standard **MODBUS RTU over Serial** Protocol for Configuration and Operation.

The Serial Communication Port specification are shown in Table 4.1 below.

Table 4.1

Port	RS485, 2-wire, Half duplex, Start-stop synchronized	
Protocol	Modbus RTU	
Communication Parameters	**Parameter**	**Settings**
	Slave ID	1 to 127
	Baud Rate	2400, 4800, 9600, 19200, 38400 bps
	Parity	None (1 or 2 Stop Bits) Even (1 Stop Bit) odd (1 Stop Bit)
Max. No. of Units per Loop	31	
Maximum Distance	1200 Meters	

The Module is shipped from the factory with the following default values for the Communication Parameters.

Slave ID : 1	Baud Rate : 9600 bps	Parity : Even

The above parameters can be altered to match with the Host (Master) parameters by putting the Module in **Configuration Mode**. In Configuration Mode, the Module always communicates with the host with the **fixed** communication parameter values (Slave ID : **1**, Baud Rate : **9600** & Parity : **None**) regardless of the actual set values. The user set values are applicable only when the Module is put back in the **Normal Operation Mode**.

A Slide Switch Set is provided on the Module, as shown in the Figure 4.1, to select between the Configuration and Normal Operation modes. The Table 4.2 shows the Switch Positions and the respective mode.

It is important to note that the switch position is detected only upon power-up. Select the desired Mode while the Module is OFF. That is changing the switch position while the Module is powered does not have any effect on the Mode.

Figure 4.1

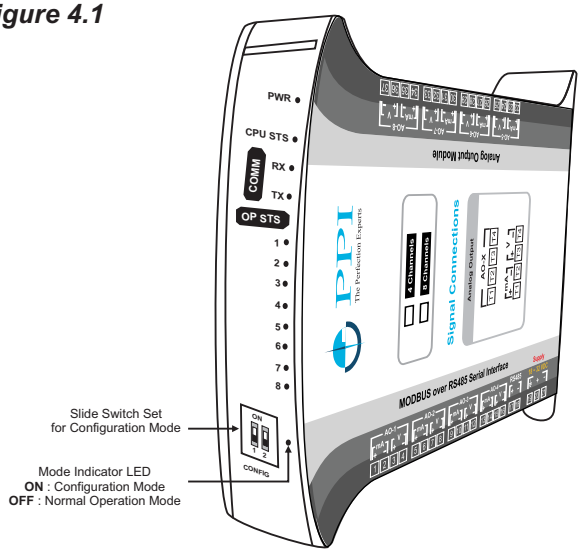
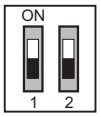
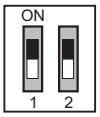


Table 4.2

Switch Position	 Down	 Up
Mode Indicator	OFF	ON
Operation Mode	Normal	Configuration
Communication Parameter Values	User Set values for *Module Slave ID, Baud Rate & Parity*	*Module Slave ID : 1* *Baud Rate : 9600* *Parity : None*

The Communication Parameters values can be altered by using the MODBUS RTU protocol while the Module is in Configuration Mode. Set the host (Master) Baud Rate to “9600 bps” and Parity to “None”. The MODBUS Addresses and Settings for the Module communication parameters are listed in the Table 4.3 below.

Table 4.3

<table>
<tr><th>Parameter Description</th><th>MODBUS Address</th><th>Settings (Default Value)</th></tr>
<tr><td>Module Slave ID

Unique numeric value assigned to the module for identification by the host.

Set the value as required by the host.</td><td>1</td><td>1 to 127
(Default : 1)</td></tr>
<tr><td>Baud Rate

Communication speed in ‘Bits per Second’.

Set the value to match with the host baud rate.</td><td>2</td><td><table><tr><th>Value</th><th>Baud Rate</th></tr><tr><td>0</td><td>2400 bps</td></tr><tr><td>1</td><td>4800 bps</td></tr><tr><td>2</td><td>9600 bps</td></tr><tr><td>3</td><td>19200 bps</td></tr><tr><td>4</td><td>38400 bps</td></tr></table>(Default : 9600 bps)</td></tr>
<tr><td>Parity

One of the communication error trapping features.

Set the data packet parity as implemented by the host protocol.</td><td>3</td><td><table><tr><th>Value</th><th>Parity</th></tr><tr><td>0</td><td>None</td></tr><tr><td>1</td><td>Even</td></tr><tr><td>2</td><td>Odd</td></tr></table>(Default : Even)</td></tr>
</table>

APPENDIX A

ANALOG OUTPUT SIGNAL v/s COUNTS

The Analog output signal is produced proportional to the analog output counts by solving the mathematical equation for Straight-Line in the form:

$$Y = mX + C$$

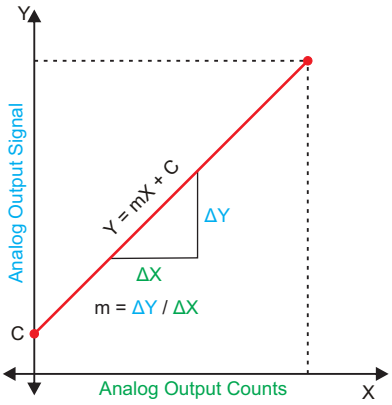
Where;

X : Analog Output Counts

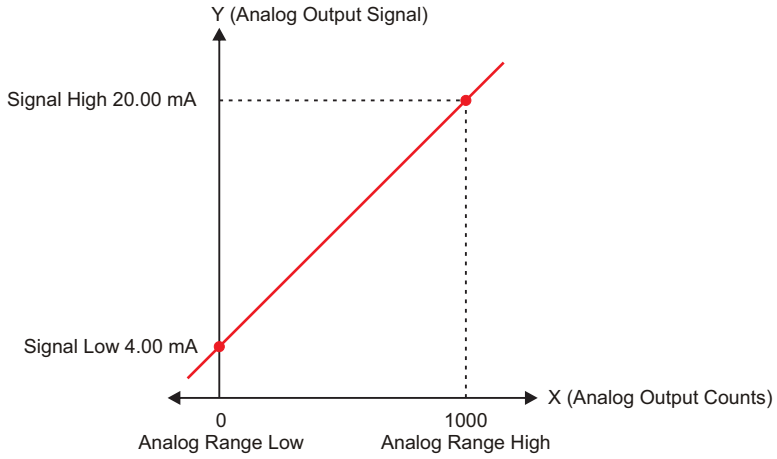
Y : Analog Signal Output Corresponding to Counts X

C : Output Signal Value Corresponding to X = 0 (Y-intercept)

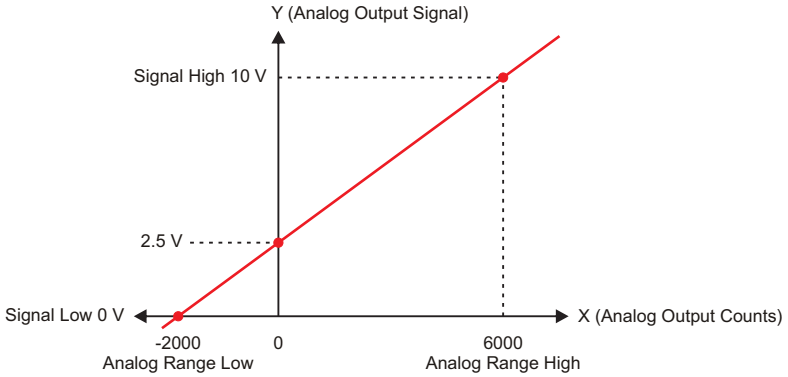
m : Change in output signal per unit change in counts (Slope)



Example 1 : Output Type **4 to 20 mA**, Analog Range Low **0**, Analog Range High **1000**



Example 2 : Output Type **0 to 10 V**, Analog Range Low **-2000**, Analog Range High **6000**



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