Combo Module-2288

COMS-2288
2 AI + 2 AO + 8 DI + 8 DO
DIN-Rail Mount
MODBUS over Serial
18~32 VDC Operated

Process Precision Instruments
Vasai Road (E), Dist. Palghar - 401210,
Maharashtra, India

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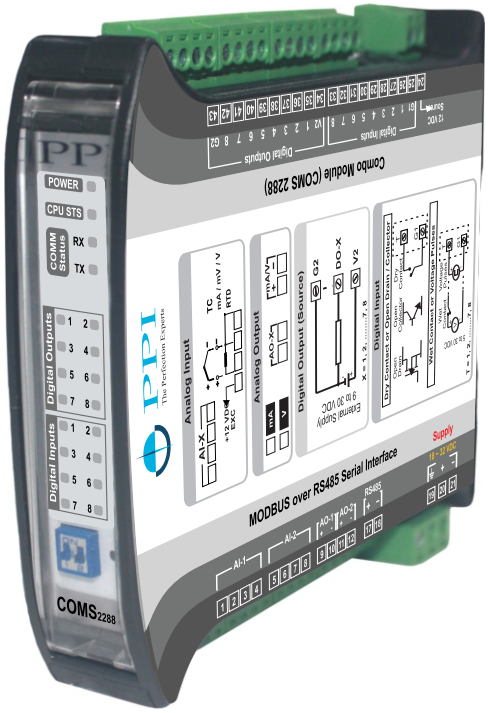
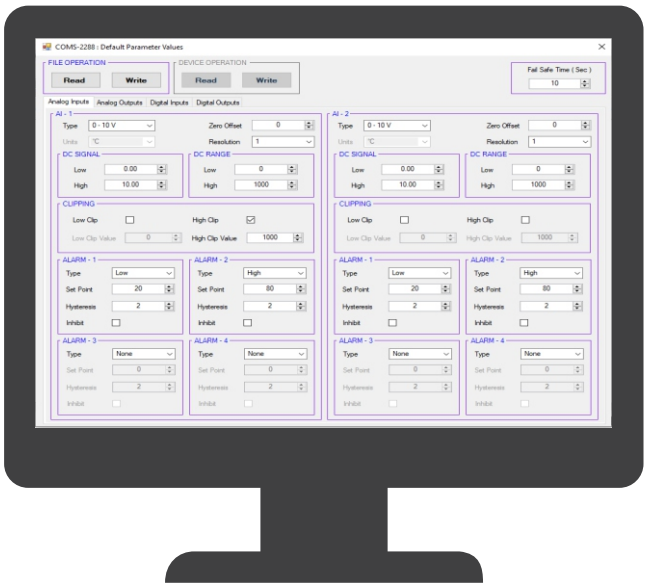
User Manual



Configuration Tool



CONTENTS

Section 1

ELECTRICAL CONNECTIONS

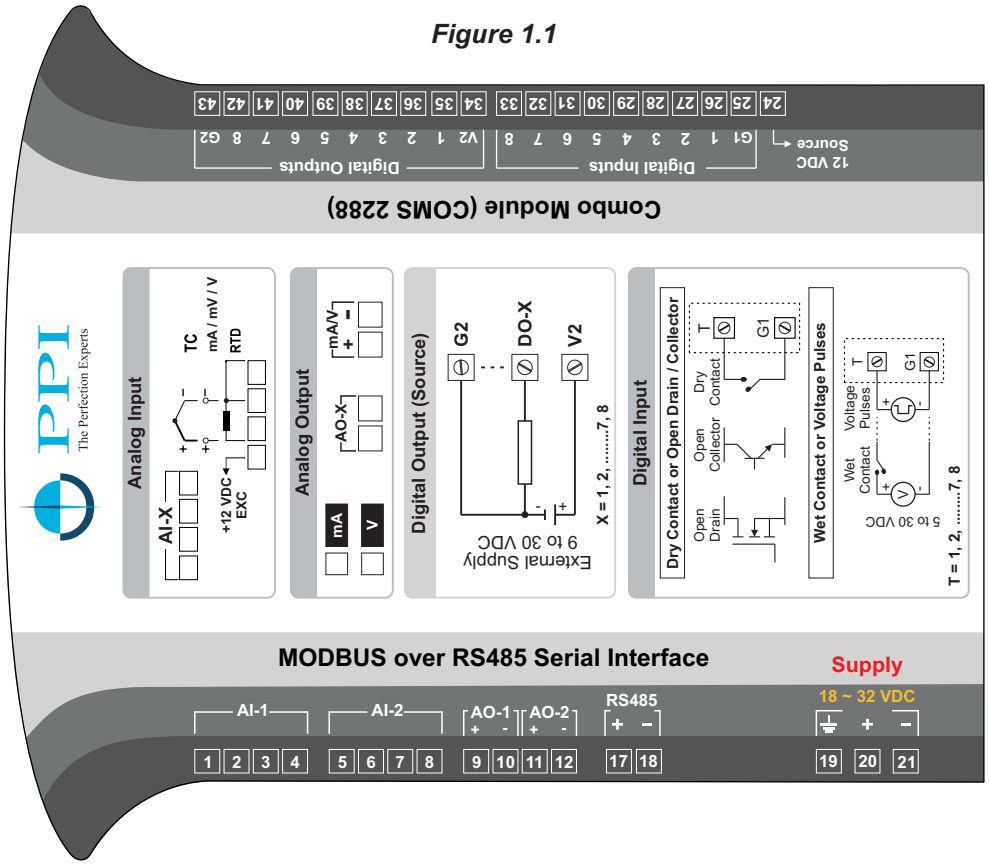
WARNING
MISHANDLING / NEGLIGENCE CAN RESULT IN PERSONAL DEATH OR SERIOUS INJURY.

1. The user must rigidly observe the Local Electrical Regulations.
2. Do not make any connections to the unused terminals for making a tie-point for other wires (or for any other reasons) as they may have some internal connections. Failing to observe this may result in permanent damage to the indicator.
3. Run power supply cables separated from the low-level signal cables (like RTD, Thermocouples, DC Linear Current / Voltage etc.). If the cables are run through conduits, use separate conduits for power supply cable and low-level signal cables.
4. Use appropriate fuses and switches, wherever necessary, for driving the high voltage loads to protect the module from any possible damage due to high voltage surges of extended duration or short-circuits on loads.
5. Take care not to over-tighten the terminal screws while making connections.
6. Make sure that the module supply is switched-off while making/removing any connections.

CONNECTION DIAGRAM

The Figure 1.1 illustrates Electrical Connection Diagrams.

Figure 1.1



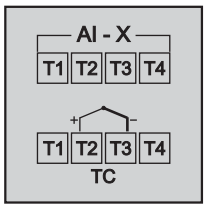
ANALOG INPUT CHANNELS

Both the input channels are identical from wiring connection viewpoint. For explanation purpose, the 4 terminals pertaining to each channel have been marked as T1, T2 ,T3 & T4 in the following pages. The descriptions below apply to all the channels with no deviations.

Thermocouple

Connect Thermocouple Positive (+) to terminal T2 and Negative (-) to terminal T3 as shown in **Figure 1.2**. Use the correct type of Thermocouple extension lead wires or compensating cable for the entire distance ensuring the correct polarity throughout. Avoid joints in the cable.

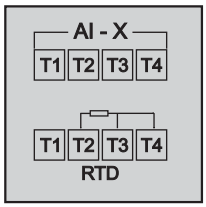
Figure 1.2



RTD Pt100, 3-wire

Connect single leaded end of **RTD** bulb to terminal T2 and the double leaded ends to terminals T3 and T4 (interchangeable) as shown in **Figure 1.3.** Use copper conductor leads of very low resistance ensuring that all 3 leads are of the same gauge and length. Avoid joints in the cable.

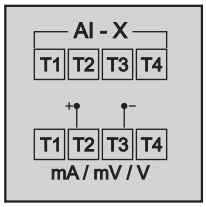
Figure 1.3



DC Linear Current / Voltage (mA / mV / V)

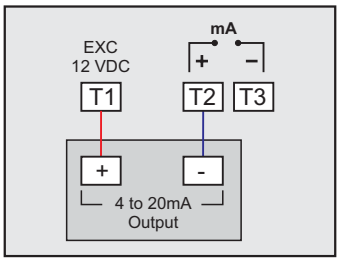
Use a shielded twisted pair with the shield grounded at the signal source for connecting mA / mV / V source. Connect common (-) to terminal T3 and the signal (+) to terminal T2, as shown in **Figure 1.4.**

Figure 1.4

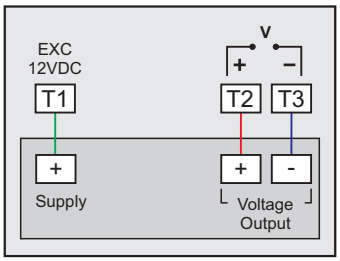


12 VDC EXC : Excitation Voltage for Transmitters

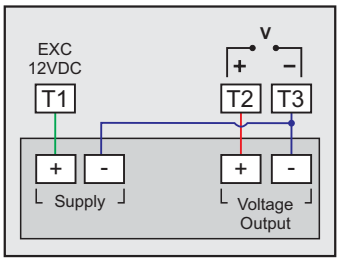
Each Analog Input is accompanied with 12 VDC @ 25 mA Excitation power source. This is primarily meant for exciting 2-wire or 4-wire Current / Voltage output transmitters. The Sensor negative terminal is used as Return terminal (ground) for excitation output.



2-wire Current Transmitter
(12VDC Supply)



3-wire Voltage Transmitter
(12VDC Supply)



4-wire Voltage Transmitter
(12VDC Supply)

ANALOG OUTPUT CHANNELS

The two Analog Output Channels are factory-configured as either Current (4-20, 0-20 or 0-10 mA) or Voltage (0-5, 1-5 or 0-10 V) outputs.

The Figures 1.5(a), 1.5(b) & 1.5(c) below show the connection details for Current / Voltage outputs. All Analog output channels are identical from wiring connection viewpoint.

Figure 1.5(a)

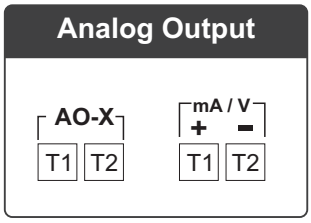


Figure 1.5(b)

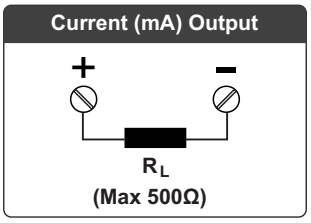
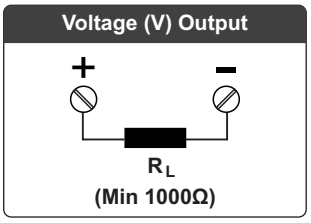


Figure 1.5(c)



DIGITAL INPUT CHANNELS

The eight Digital Input Channels can be programmed to accept one of the followings :

(a) Dry Contact **or** Potential-Free Contacts / Open Drain / Open Collector
(b) 5 to 30 VDC Wet Contact / Voltage Pulses

Each of the 8 digital input channels are identical from wiring connection viewpoint. The figures below apply to all the channels with no deviations.

Figure 1.6 (a)

Dry Contact / Open Drain / Open Collector

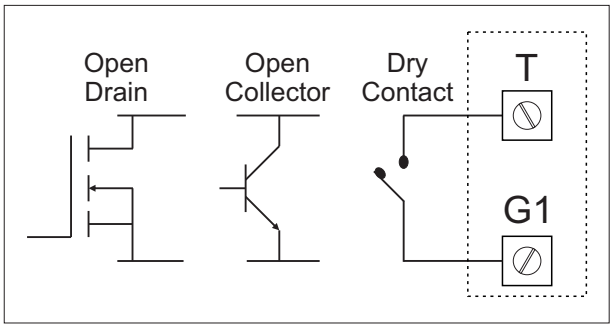
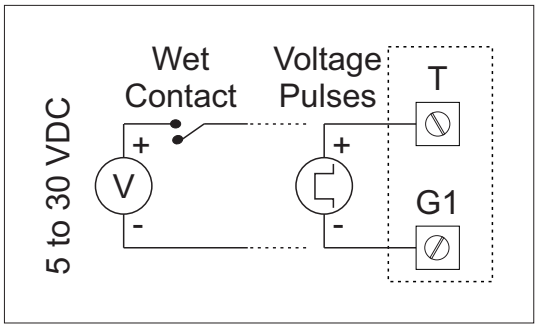


Figure 1.6 (b)

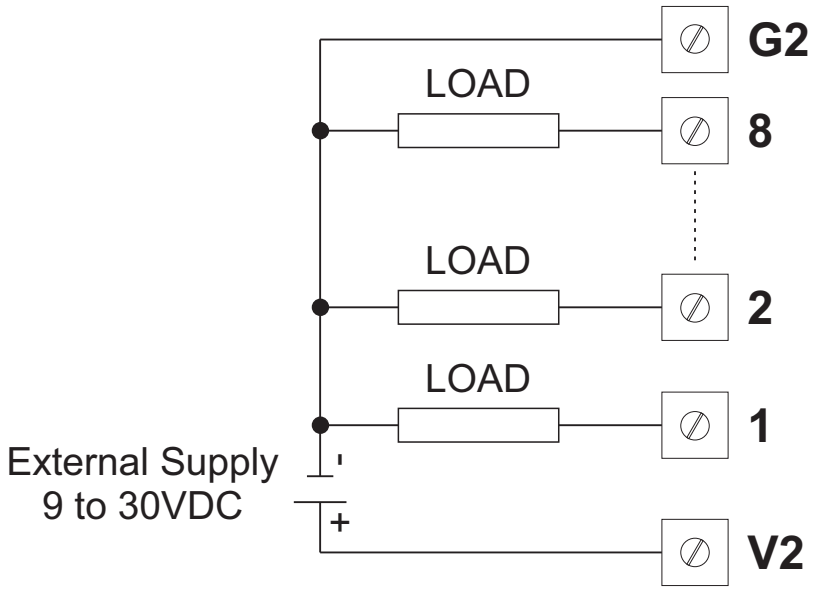
Wet Contact / Voltage Pulses



T = 1, 2, ...7, 8

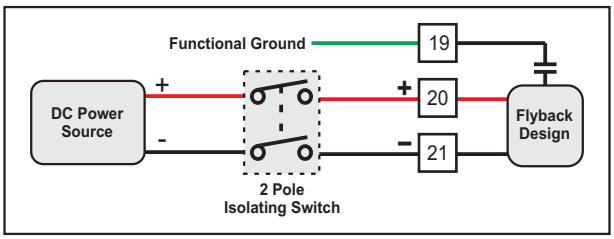
DIGITAL OUTPUT CHANNELS

The Digital Outputs are Source type. Each of the eight output channels are identical from a wiring connection viewpoint.



POWER SUPPLY (Terminals 20, 21)

Figure 1.7



As standard, the Module is supplied with power connections suited for 18 to 32 VDC power source. The accuracy / 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 the size not smaller than 0.5mm² for power supply connections ensuring proper polarity as shown in Figure 1.7. The Module is not provided with fuse and power switch. If necessary, mount them separately. Use a slow blow fuse rated for 0.5A current.

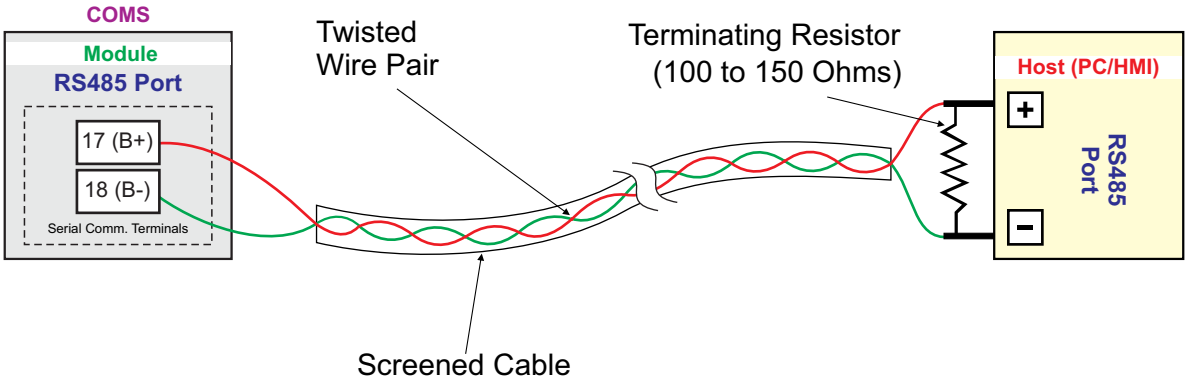
For safety and enhanced electrical noise immunity, it is highly recommended to connect Main Power Supply 'Earth' to terminal 19.

SERIAL COMMUNICATION PORT

Figure 1.8 shows the wiring connections for interfacing the Host (PC/HMI) with COMS.

For reliable noise free communication, use a pair of twisted wires inside screened cable. 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 1.8



Note

In case of non-availability of RS485 port on Host PC, use 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 INPUT PARAMETERS

The Table 2.1 describes Input Registers (Read only parameters) and Table 2.2 describes Holding Registers (Read/Write Parameters), respectively. The MODBUS addresses are also specified.

Table 2.1 **: Input Registers (Read-Only Parameters)**

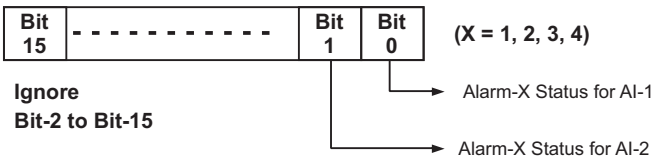
<table>
<tr><th>Parameter Description</th><th>MODBUS Address</th><th>Values</th></tr>
<tr><td>Process Value (Note 1)

Measured Temperature (in °C / °F) for Thermocouple / RTD inputs or Scaled Counts for DC Volts / mA inputs.

Note :
The Process Values are also available in 32-Bit Single Precision Float format. Refer Appendix-C.</td><td>1561 (AI-1)
&
1562 (AI-2)</td><td>Signed integer values from -30000 to +30000 representing the measured process values. Refer Table 2.3 for the various input types and the corresponding measured ranges.

The following constant counts indicate PV Errors.

<table><tr><th>Value</th><th>PV Error Type</th></tr><tr><td>-32768</td><td>Under Range</td></tr><tr><td>+32752</td><td>Over Range</td></tr><tr><td>+32767</td><td>Sensor Open</td></tr></table></td></tr>
<tr><td>Alarm-1 Status</td><td>1577</td><td rowspan="4">Refer Appendix-D for accessing the Alarm Status as Discrete Inputs / Coils.

<table><tr><th>Bit Value</th><th>Status</th></tr><tr><td>0</td><td>Alarm OFF</td></tr><tr><td>1</td><td>Alarm ON</td></tr></table></td></tr>
<tr><td>Alarm-2 Status</td><td>1578</td></tr>
<tr><td>Alarm-3 Status</td><td>1579</td></tr>
<tr><td>Alarm-4 Status</td><td>1580</td></tr>
<tr><td>Digital Filter

IIR (Infinite Impulse Response) digital filter is applied to the measured PV. The filter helps smoothing / averaging the signal input and removing the undesired noise. It is settable from 0% (Cut-Off) to 90% (Max. Suppression). The higher values slow down the response to PV changes.</td><td>1612 (AI-1)
&
1613 (AI-2)</td><td>0 to 90%
(Default : 0%)</td></tr>
<tr><td>Ambient Temperature

Room Temperature (in °C) measured by the sensor mounted inside the instrument.</td><td>82</td><td>Signed integer values from -30000 to +30000 representing the measured Ambient Temperature through the semi-conductor sensor mounted on the Module. The measured value is always in °C with 0.1 resolution. For example, 30.0°C is represented as 300.</td></tr>
</table>

Table 2.2 **: Holding Registers (Read/Write Parameters)**

<table>
<tr><th>Parameter Description</th><th>MODBUS Address</th><th>Settings (Default Value)</th></tr>
<tr><td>Input Type

Select Input type in accordance with the type of Thermocouple or RTD sensor or transducer output connected for process value measurement.</td><td>83 (AI-1)
&
84 (AI-2)</td><td>
<table>
<tr><th>Value</th><th>Type</th></tr>
<tr><td>0</td><td>Type J Thermocouple</td></tr>
<tr><td>1</td><td>Type K Thermocouple</td></tr>
<tr><td>2</td><td>Type T Thermocouple</td></tr>
<tr><td>3</td><td>Type R Thermocouple</td></tr>
<tr><td>4</td><td>Type S Thermocouple</td></tr>
<tr><td>5</td><td>Type B Thermocouple</td></tr>
<tr><td>6</td><td>Type N Thermocouple</td></tr>
<tr><td>7</td><td>Type E Thermocouple</td></tr>
<tr><td>8</td><td>RTD Pt100, 3-wire</td></tr>
<tr><td>9</td><td>0 to 20 mA</td></tr>
<tr><td>10</td><td>4 to 20 mA</td></tr>
<tr><td>11</td><td>0 to 80 mV</td></tr>
<tr><td>12</td><td>Reserved (Default: 0 to 80 mV)</td></tr>
<tr><td>13</td><td>0 to 1.25 V</td></tr>
<tr><td>14</td><td>0 to 5 V</td></tr>
<tr><td>15</td><td>0 to 10 V</td></tr>
<tr><td>16</td><td>1 to 5 V</td></tr>
</table>
(Default : 0 to 10 V)
</td></tr>
<tr><td>Temperature Units

(Applicable only for Thermocouples & RTD Pt100 Inputs)

Selects temperature measurement units in °C or °F.</td><td>99 (AI-1)
&
100 (AI-2)</td><td>Conditional Parameter (Note2)

<table>
<tr><th>Value</th><th>Unit</th></tr>
<tr><td>0</td><td>°C</td></tr>
<tr><td>1</td><td>°F</td></tr>
</table>
(Default : °C)
</td></tr>
<tr><td>DC Resolution (Note1)

(Applicable only for mA / mV / V Inputs)

This parameter value should be used in conjunction with the process value for interpretation of decimal place.

For example if the value for this parameter is 0.01 then the measured process value of 3000 should be interpreted as 30.00.</td><td>115 (AI-1)
&
116 (AI-2)</td><td>Conditional Parameter (Note2)

<table>
<tr><th>Value</th><th>Resolution</th></tr>
<tr><td>0</td><td>1</td></tr>
<tr><td>1</td><td>0.1</td></tr>
<tr><td>2</td><td>0.01</td></tr>
<tr><td>3</td><td>0.001</td></tr>
<tr><td>4</td><td>0.0001</td></tr>
</table>
(Default : 1 Unit for DC Linear input &
0.1 for Thermocouple & RTD)
</td></tr>
</table>

<table>
<tr><th>Parameter Description</th><th>MODBUS Address</th><th>Settings (Default Value)</th></tr>
<tr><td>Signal Low

(Applicable only for mA / mV / V Inputs)

The transmitter output signal value corresponding to Range Low process value.

Refer Appendix-A : DC Linear Signal Interface for details.

Note : The value should be set as integer counts ignoring decimal value. For e.g. 4.00 mA should be set as 400 counts.</td><td>501 (AI-1)
&
502 (AI-2)</td><td>Conditional Parameter (Note 2)

<table><tr><th>Input Type</th><th>Settings</th><th>Default</th></tr><tr><td>0 to 20 mA</td><td>0.00 to Signal High</td><td>0.00</td></tr><tr><td>4 to 20 mA</td><td>4.00 to Signal High</td><td>4.00</td></tr><tr><td>0 to 80 mV</td><td>0.00 to Signal High</td><td>0.00</td></tr><tr><td>0 to 1.25 V</td><td>0.000 to Signal High</td><td>0.000</td></tr><tr><td>0 to 5 V</td><td>0.000 to Signal High</td><td>0.000</td></tr><tr><td>0 to 10 V</td><td>0.00 to Signal High</td><td>0.00</td></tr><tr><td>1 to 5 V</td><td>1.000 to Signal High</td><td>1.000</td></tr></table></td></tr>
<tr><td>Signal High

(Applicable only for mA / mV / V Inputs)

The transmitter output signal value corresponding to Range High process value.

Refer Appendix-A : DC Linear Signal Interface for details.

Note : The value should be set as integer counts ignoring decimal value. For e.g. 80.00 mV should be set as 8000 counts.</td><td>517 (AI-1)
&
518 (AI-2)</td><td>Conditional Parameter (Note 2)

<table><tr><th>Input Type</th><th>Settings</th><th>Default</th></tr><tr><td>0 to 20 mA</td><td>Signal Low to 20.00</td><td>20.00</td></tr><tr><td>4 to 20 mA</td><td>Signal Low to 20.00</td><td>20.00</td></tr><tr><td>0 to 80 mV</td><td>Signal Low to 80.00</td><td>80.00</td></tr><tr><td>0 to 1.25 V</td><td>Signal Low to 1.250</td><td>1.250</td></tr><tr><td>0 to 5 V</td><td>Signal Low to 5.000</td><td>5.000</td></tr><tr><td>0 to 10 V</td><td>Signal Low to 10.00</td><td>10.00</td></tr><tr><td>1 to 5 V</td><td>Signal Low to 5.000</td><td>5.000</td></tr></table></td></tr>
<tr><td>Range Low

(Applicable only for mA / mV / V Inputs)

The process value corresponding to the Signal Low value from the transmitter.

Refer Appendix-A : DC Linear Signal Interface for details.</td><td>131 (AI-1)
&
132 (AI-2)</td><td>Conditional Parameter (Note 2)

-30000 to 30000

(Default : 0)</td></tr>
<tr><td>Range High

(Applicable only for mA / mV / V Inputs)

The process value corresponding to the Signal High value from the transmitter.

Refer Appendix-A : DC Linear Signal Interface for details.</td><td>147 (AI-1)
&
148 (AI-2)</td><td>Conditional Parameter (Note 2)

-30000 to 30000

(Default : 1000)</td></tr>
<tr><td>Offset for PV (Note 1)

This value is algebraically added to the measured PV to derive the final PV.

Final PV = Measured PV + Offset</td><td>163 (AI-1)
&
164 (AI-2)</td><td>-30000 to 30000

(Default : 0)</td></tr>
</table>

<table>
<tr><th>Parameter Description</th><th>MODBUS Address</th><th>Settings (Default Value)</th></tr>
<tr><td>Alarm-1 Type

Refer Alarm-4 Type</td><td>179 (AI-1)
&
180 (AI-2)</td><td rowspan="4"><table><tr><th>Value</th><th>Type</th></tr><tr><td>0</td><td>None</td></tr><tr><td>1</td><td>Process Low</td></tr><tr><td>2</td><td>Process High</td></tr></table>
(Default : None)</td></tr>
<tr><td>Alarm-2 Type

Refer Alarm-4 Type</td><td>243 (AI-1)
&
244 (AI-2)</td></tr>
<tr><td>Alarm-3 Type

Refer Alarm-4 Type</td><td>307 (AI-1)
&
308 (AI-2)</td></tr>
<tr><td>Alarm-4 Type

None
The Alarm function is disabled.

Process Low
The Alarm is activated upon the PV equaling or falling below the ‘Alarm Set-point’ value.

Process High
The Alarm is activated upon the PV equaling or rising above the ‘Alarm Set-point’ value.</td><td>371 (AI-1)
&
372 (AI-2)</td></tr>
<tr><td>Alarm-1 Set-point (Note1)

Refer Alarm-4 Set-point</td><td>195 (AI-1)
&
196 (AI-2)</td><td rowspan="4">Min. to Max. Range specified for the selected Input Type
Refer Table 2.3

(Default : Min or Max Range depending on the Alarm type)</td></tr>
<tr><td>Alarm-2 Set-point (Note1)

Refer Alarm-4 Set-point</td><td>259 (AI-1)
&
260 (AI-2)</td></tr>
<tr><td>Alarm-3 Set-point (Note1)

Refer Alarm-4 Set-point</td><td>323 (AI-1)
&
324 (AI-2)</td></tr>
<tr><td>Alarm-4 Set-point (Note1)

Sets limit for Process-High or Process-Low Alarm.</td><td>387 (AI-1)
&
388 (AI-2)</td></tr>
</table>

<table>
<tr><th>Parameter Description</th><th>MODBUS Address</th><th>Settings (Default Value)</th></tr>
<tr><td>Alarm-1 Hysteresis (Note 1)

Refer Alarm-4 Hysteresis</td><td>211 (AI-1)
&
212 (AI-2)</td><td rowspan="4">1 to 30000

(Default : 20)</td></tr>
<tr><td>Alarm-2 Hysteresis (Note 1)

Refer Alarm-4 Hysteresis</td><td>275 (AI-1)
&
276 (AI-2)</td></tr>
<tr><td>Alarm-3 Hysteresis (Note 1)

Refer Alarm-4 Hysteresis</td><td>339 (AI-1)
&
340 (AI-2)</td></tr>
<tr><td>Alarm-4 Hysteresis (Note 1)

Sets differential (dead) band between Alarm switching ON and OFF states.</td><td>403 (AI-1)
&
404 (AI-2)</td></tr>
<tr><td>Alarm-1 Inhibit

Refer Alarm-4 Inhibit</td><td>227 (AI-1)
&
228 (AI-2)</td><td rowspan="4"><table><tr><th>Value</th><th>Inhibit</th></tr><tr><td>0</td><td>Disable</td></tr><tr><td>1</td><td>Enable</td></tr></table>
(Default : Disable)</td></tr>
<tr><td>Alarm-2 Inhibit

Refer Alarm-4 Inhibit</td><td>291 (AI-1)
&
292(AI-2)</td></tr>
<tr><td>Alarm-3 Inhibit

Refer Alarm-4 Inhibit</td><td>355 (AI-1)
&
356 (AI-2)</td></tr>
<tr><td>Alarm-4 Inhibit

Enable
The Alarm activation is suppressed until the PV is within Alarm limits from the time the Module is Powered-on. This allows suppressing the Alarm during the start-up Alarm conditions.

Disable
The Alarm is not suppressed during the start-up Alarm conditions.</td><td>419 (AI-1)
&
420 (AI-2)</td></tr>
</table>

Parameter Description	MODBUS Address	Settings (Default Value)
Enable Bottom Clipping ***(Applicable only for mA / mV / V Inputs)*** Refer Appendix-B.	435 (AI-1) & 436 (AI-2)	Value: 0 = No, 1 = Yes (Default : No)
Bottom Clip Value ***(Applicable only for mA / mV / V Inputs)*** Refer Appendix-B.	451(AI-1) & 452 (AI-2)	-30000 to 30000 (Default : 0)
Enable Top Clipping ***(Applicable only for mA / mV / V Inputs)*** Refer Appendix-B.	467 (AI-1) & 468 (AI-2)	Value: 0 = No, 1 = Yes (Default : No)
Top Clip Value ***(Applicable only for mA / mV / V Inputs)*** Refer Appendix-B.	483 (AI-1) & 484 (AI-2)	-30000 to 30000 (Default : 1000)

Note 1

Thermocouples (J, K, T, R, S, B, N, E) and RTD Pt100 (3-wire) Inputs

The process value is always measured in 0.1°C/°F resolution. That is, for example, the value 300 means 30.0°C / °F.

The same should be followed while setting the values for the parameters that are resolution based (like Zero Offset, Alarm Set-point, Alarm Hysteresis, etc.). That is for example, set 300 counts for 30.0°C / °F.

DC mA/mV/V Inputs

(Also Refer *Appendix A : DC Linear Signal Interface*)

The measured PV is a Resolution-less Scaled Value derived using the values for the parameters : Signal Low, Signal High, Range Low and Range High. The parameter 'DC Resolution' holds the desired resolution that can be used to insert *appropriate Decimal Place* in the scaled PV. For example, if the DC Resolution value is 2 (0.01) then the scaled value of 3000 can be read as 30.00.

Similarly the corresponding parameters like Zero Offset, Alarm Set-point, Alarm Hysteresis, etc., are also resolution less and, if desired, the parameter value for 'DC Resolution' should be used for *appropriate Decimal Place.*

Note 2

Conditional Parameters are those whose usage depend upon the values set for some other parameters. For example; the parameters 'Signal Low' & 'Signal High' for a selected channel are used only if the input type for the selected channel is DC Input (mA / mV / V). The access to the conditional parameters for Read / Write operation, however, is not restricted.

Table 2.3

Input Type	Range (Min. to Max.)	Resolution
Type J Thermocouple	0 to +960.0°C / +32.0 to +1760.0°F	0.1 °C / °F
Type K Thermocouple	-200.0 to +1376.0°C / -328.0 to +2508.0°F	
Type T Thermocouple	-200.0 to +387.0°C / -328.0 to +728.0°F	
Type R Thermocouple	0 to +1771.0°C / +32.0 to +3219.0°F	
Type S Thermocouple	0 to +1768.0°C / +32.0 to +3214.0°F	
Type B Thermocouple	0 to +1826.0°C / +32.0 to +3318.0°F	
Type N Thermocouple	0 to +1314.0°C / +32.0 to +2397.0°F	
Type E Thermocouple	-200.0 to +1000.0°C / -328.0 to +1832.0°F	
3-wire, RTD Pt100	-199.0 to +850.0°C / -328.0 to +1562.0°F	
0 to 20mA DC current	-30000 to 30000 units	1 0.1 0.01 0.001 0.0001 Units
4 to 20mA DC current		
0 to 80mV DC voltage		
0 to 1.25V DC voltage		
0 to 5.0V DC voltage		
0 to 10.0V DC voltage		
1 to 5.0V DC voltage		

Section 3

ANALOG OUTPUT CONFIGURATION

Each Analog Output is factory-configured for either Current (mA) or Voltage output. Select appropriate input type as per ordered configuration.

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.

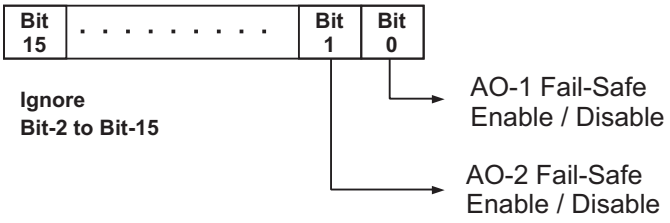
Table 3.1 : Analog Output Parameters

<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>4002 (AO-1)
&
4003 (AO-2)</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>4018 (AO-1)
&
4019 (AO-2)</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>4034 (AO-1)
&
4035 (AO-2)</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>4066 (AO-1)
&
4067 (AO-2)</td><td>Minimum : Range Low Counts - 4% of Span*
Maximum : Range High Counts + 4% of Span*

* Span = Range High Counts - Range Low Counts</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>4001</td><td> 

<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>401 (AO-1)
&
402 (AO-2)</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)	4050 (AO-1) & 4051 (AO-2)	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)	3007	1 to 300 Seconds (Default : 10 Seconds)

Section 4

DIGITAL INPUT PARAMETERS

For user convenience, most parameters are accessible both as Bit-Mapped Modbus Registers & Discrete Inputs / Coils.

1. Select Digital Input Type

This parameter selects all the eight digital inputs as one of the followings :

(a) Dry Contact **or** Potential-Free Contacts / Open Drain / Open Collector
(b) 5 to 30 VDC Wet Contact / Voltage Pulses

Table 4.1

Configuration Parameter (Stored in Non-Volatile memory)

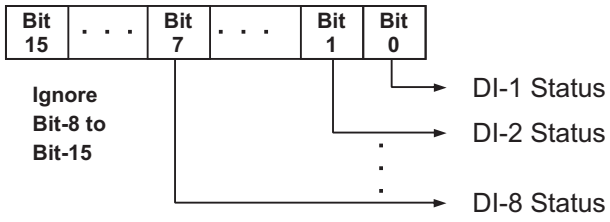
<table>
<tr><th>Modbus Data Type</th><th>MODBUS Address</th><th>Values</th></tr>
<tr><td>Holding Register
Function Code (0x06 & 0x10)</td><td>2033</td><td>
<table>
<tr><th>Value</th><th>DI Type</th></tr>
<tr><td>0</td><td>Dry (Potential-Free) Open / Close Contact or Open Drain / Collector (Sink)</td></tr>
<tr><td>1</td><td>Wet Open / Close Contact or Voltage Pulses</td></tr>
</table>
Default : Dry (Potential-Free) Open / Close Contact or Open Drain / Collector (Sink)
</td></tr>
</table>

2. Instantaneous Digital Input Status (Read-Only Parameters)

These parameters reflect the current DI Status at the time of reading the Bit-Mapped Modbus Register / Coils.

Table 4.2

Run Time Parameter (Read Only)

<table>
<tr><th>Modbus Data Type</th><th>MODBUS Address</th><th>Values</th></tr>
<tr><td>Bit-Mapped Input or Holding Register
Function Code (0x03 or 0x04)</td><td>38</td><td>


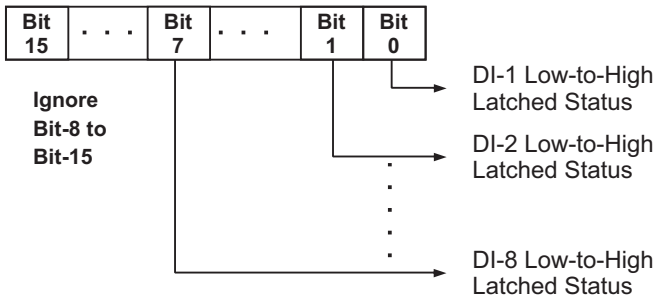
<table>
<tr><th>Bit Value</th><th>DI Status</th></tr>
<tr><td>0</td><td>Contact Open / Logic Low</td></tr>
<tr><td>1</td><td>Contact Close / Logic High</td></tr>
</table>
</td></tr>
<tr><td>Discrete Input (Coils)
Function Code (0x01 & 0x02)</td><td>1 (DI-1)
to
8 (DI-8)</td><td>
<table>
<tr><th>Coil Value</th><th>DI Status</th></tr>
<tr><td>0</td><td>Contact Open / Logic Low</td></tr>
<tr><td>1</td><td>Contact Close / Logic High</td></tr>
</table>
</td></tr>
</table>

3 (a). Low-to-High Latched Digital Input Status (Read-Only Parameters)

This parameter value is set to 1 upon detecting the change in status from 'Open-to-Close' for a Dry / Wet Contact Closure input or from 'Low-to-High' logic level for PNP / NPN Sensor Input. This value is latched until acknowledged by writing to 'Low-to-High Acknowledge Command' Register / Coil.

Table 4.3

Run Time Parameter (Read Only)

<table>
<tr><th>Modbus Data Type</th><th>MODBUS Address</th><th>Values</th></tr>
<tr><td>Bit-Mapped Input or Holding Register
Function Code (0x03 or 0x04)</td><td>40</td><td>


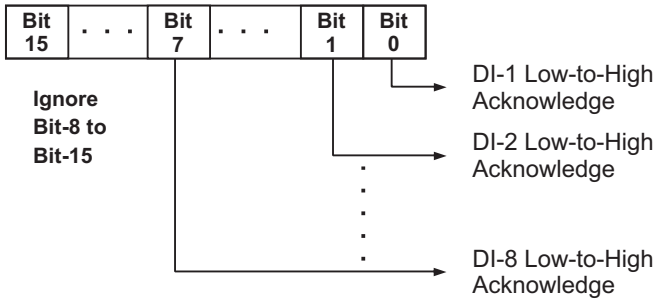
<table>
<tr><th>Bit Value</th><th>DI Status</th></tr>
<tr><td>0</td><td>No 'Low-to-High' Transition</td></tr>
<tr><td>1</td><td>'Low-to-High' Transition Detected</td></tr>
</table>
</td></tr>
<tr><td>Discrete Input (Coils)
Function Code (0x01 & 0x02)</td><td>33 (DI-1)
to
40 (DI-8)</td><td>
<table>
<tr><th>Coil Value</th><th>DI Status</th></tr>
<tr><td>0</td><td>No 'Low-to-High' Transition</td></tr>
<tr><td>1</td><td>'Low-to-High' Transition Detected</td></tr>
</table>
</td></tr>
</table>

3 (b). Low-to-High Acknowledge Command

This parameter is used to acknowledge the 'Low-to-High' latched status by writing the value '1'. Reading this parameter always returns the value '0'.

Table 4.4

Run Time Parameter (Not Stored in non-volatile memory)

<table>
<tr><th>Modbus Data Type</th><th>MODBUS Address</th><th>Values</th></tr>
<tr><td>Bit-Mapped Holding Register
Function Code (0x06 & 0x10)</td><td>2101</td><td>


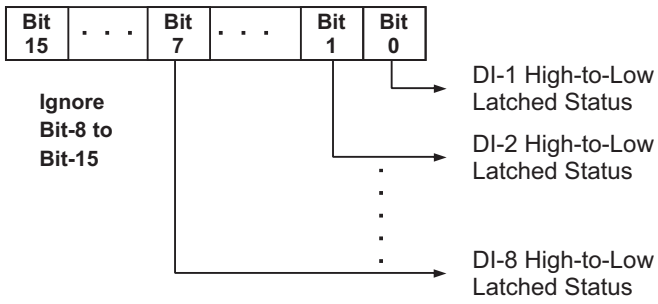
<table>
<tr><th>Bit Value</th><th>Result</th></tr>
<tr><td>0</td><td>No Effect</td></tr>
<tr><td>1</td><td>'Low-to-High' Status Cleared</td></tr>
</table>
</td></tr>
<tr><td>Coils
Function Code (0x05 & 0x0F)</td><td>101 (DI-1)
to
108 (DI-8)</td><td>
<table>
<tr><th>Coil Value</th><th>Result</th></tr>
<tr><td>0</td><td>No Effect</td></tr>
<tr><td>1</td><td>'Low-to-High' Status Cleared</td></tr>
</table>
</td></tr>
</table>

4 (a). High-to-Low Latched Digital Input Status (Read-Only Parameters)

This parameter value is set to 1 upon detecting the change in status from 'Close-to-Open' for a Dry / Wet Contact Closure input or from 'High-to-Low' logic level for PNP / NPN Sensor Input. This value is latched until acknowledged by writing to 'High-to-Low Acknowledge Command' Register / Coil.

Table 4.5

Run Time Parameter (Read Only)

<table>
<tr><th>Modbus Data Type</th><th>MODBUS Address</th><th>Values</th></tr>
<tr><td>Bit-Mapped Input or Holding Register
Function Code (0x03 or 0x04)</td><td>42</td><td>


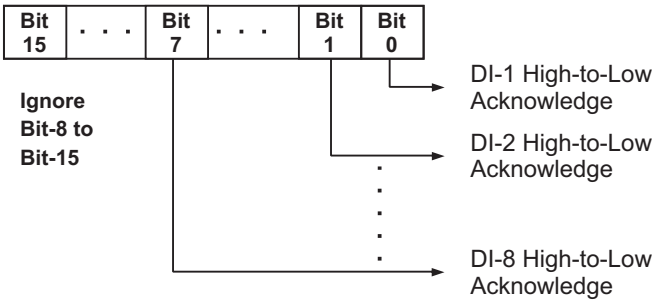
<table>
<tr><th>Bit Value</th><th>DI Status</th></tr>
<tr><td>0</td><td>No 'High-to-Low' Transition</td></tr>
<tr><td>1</td><td>'High-to-Low' Transition Detected</td></tr>
</table>
</td></tr>
<tr><td>Discrete Input (Coils)
Function Code (0x01 & 0x02)</td><td>65 (DI-1)
to
72 (DI-8)</td><td>
<table>
<tr><th>Coil Value</th><th>DI Status</th></tr>
<tr><td>0</td><td>No 'High-to-Low' Transition</td></tr>
<tr><td>1</td><td>'High-to-Low' Transition Detected</td></tr>
</table>
</td></tr>
</table>

4 (b). High-to-Low Acknowledge Command

This parameter is used to acknowledge the 'High-to-Low' latched status by writing the value '1'. Reading this parameter always returns the value '0'.

Table 4.6

Run Time Parameter (Not Stored in non-volatile memory)

<table>
<tr><th>Modbus Data Type</th><th>MODBUS Address</th><th>Values</th></tr>
<tr><td>Bit-Mapped Holding Register
Function Code (0x06 & 0x10)</td><td>2103</td><td> 

<table>
<tr><th>Bit Value</th><th>Result</th></tr>
<tr><td>0</td><td>No Effect</td></tr>
<tr><td>1</td><td>'High-to-Low' Status Cleared</td></tr>
</table></td></tr>
<tr><td>Discrete Input (Coils)
Function Code (0x05 & 0x0F)</td><td>133 (DI-1)
to
140 (DI-8)</td><td><table>
<tr><th>Coil Value</th><th>Result</th></tr>
<tr><td>0</td><td>No Effect</td></tr>
<tr><td>1</td><td>'High-to-Low' Status Cleared</td></tr>
</table></td></tr>
</table>

5. Digital Filter

This parameter helps remove any unwarranted signal noise on PNP / NPN Sensor Inputs or mechanical de-bounce on Dry / Wet Contact Closure Inputs. As illustrated in Figure 4.1 (a) & 4.1 (b) any state change (transition) is accepted only if the changed state is held constant for the time period (in milli-Second) set for the Digital Filter parameter.

Figure 4.1 (a) : Low-to-High / Open-to-Close State Change

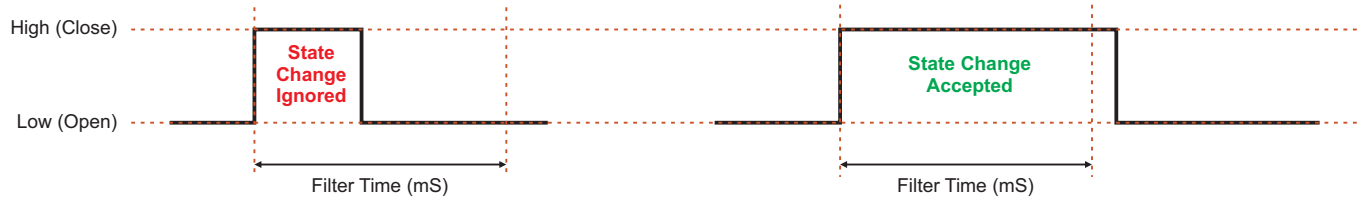


Figure 4.1 (b) : High-to-Low / Close-to-Open State Change

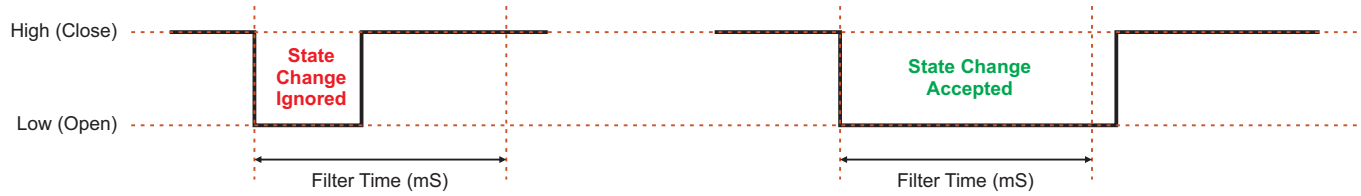


Table 4.7

Configuration Parameter (Stored in Non-Volatile memory)

Modbus Data Type	MODBUS Address	Values
Holding Registers *Function Code (0x06 & 0x10)*	2035 (DI-1) to 2042 (DI-8)	1 to 30000 mSec (Default : 10 mSec)

Section 5

DIGITAL OUTPUT PARAMETERS

1. Digital Output Function Modes & Associated Parameters

Each Digital Output can be independently programmed to function as **On-Off, Re-triggerable Single Pulse**, or continuous **Pulse Train** output.

For Single Pulse output, the Pulse-Time is settable. For Pulse Train output, the Pulse-On & Pulse-Off times are settable.

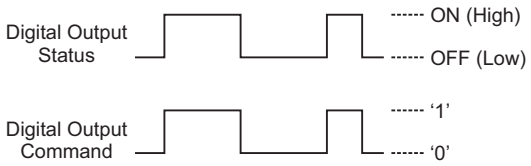
The outputs are switched/triggered by writing to the Digital Output Command Register / Coils.

The three modes & the parameters are described below.

On-Off Mode (High-Low Levels)

In this mode, the output switches On (Logic High) or Off (Logic Low) following the Digital Output Command Value. If Digital Output Command is written '1', the output turns On. If Digital Output Command is written '0', the output turns OFF. Refer to Figure 5.1.

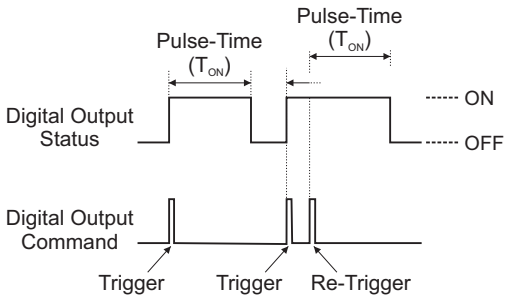
Figure 5.1



Re-triggerable Single Pulse Mode

In this mode, the output generates a single Logic High Pulse whenever the Digital Output Command is written '1'. The module automatically writes '0' to the Digital Output Command as soon as the output pulse is initiated. If the Output Command is again written '1' while the pulse is still Logic High, the pulse time restarts (Re-triggered). Refer to Figure 5.2.

Figure 5.2



Pulse Train Mode

In this mode, the output initiates a continuous series of High-Low Pulses when the Digital Output Command is written '1'. The Pulse Train continues as long as the Digital Output Command remains '1'. The Pulse-Train stops immediately upon writing '0' to the Digital Output Command. Refer to Figure 5.3.

Figure 5.3

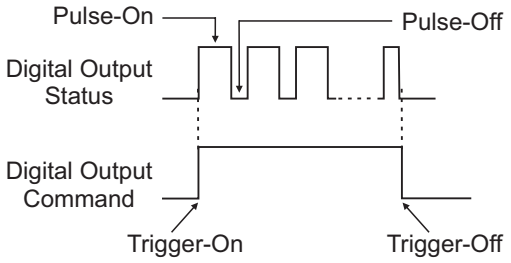
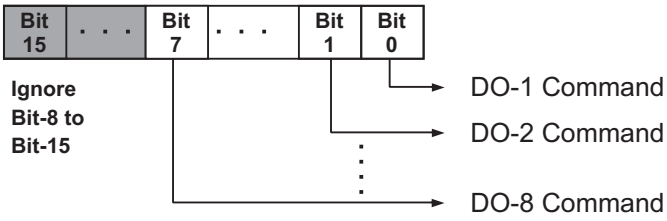


Table 5.1 (a) : Output Status Command Register

Run-Time Parameter

<table>
<tr><th>Modbus Data Type</th><th>MODBUS Address</th><th>Values</th></tr>
<tr><td>Bit-Mapped Holding Register
Function Code (0x06 & 0x10)</td><td>3001</td><td>


Write Operation (Bit Positions 0 to 7)
<table>
<tr><th>Bit Value</th><th>Mode</th><th>DO Status</th></tr>
<tr><td rowspan="3">1</td><td>On-Off</td><td>Output ON</td></tr>
<tr><td>Single Pulse</td><td>Start a new pulse or re-trigger a running pulse</td></tr>
<tr><td>Pulse Train</td><td>Start / Keep running a Pulse-Train</td></tr>
<tr><td rowspan="3">0</td><td>On-Off</td><td>Output OFF</td></tr>
<tr><td>Single Pulse</td><td>No effect</td></tr>
<tr><td>Pulse Train</td><td>Stop Pulse-Train</td></tr>
</table>
</td></tr>
<tr><td>Coils
Function Code (0x05 & 0x0F)</td><td>301 (DO-1)
to
308 (DO-8)</td><td>Write Operation (Coil Address 301 to 308)
<table>
<tr><th>Coil Value</th><th>Mode</th><th>DO Status</th></tr>
<tr><td rowspan="3">1</td><td>On-Off</td><td>Output ON</td></tr>
<tr><td>Single Pulse</td><td>Start a new pulse or re-trigger a running pulse</td></tr>
<tr><td>Pulse Train</td><td>Start / Keep running a Pulse-Train</td></tr>
<tr><td rowspan="3">0</td><td>On-Off</td><td>Output OFF</td></tr>
<tr><td>Single Pulse</td><td>No effect</td></tr>
<tr><td>Pulse Train</td><td>Stop Pulse-Train</td></tr>
</table>
</td></tr>
</table>

Table 5.1 (b) : Output Function Mode

Configuration Parameter (Stored in Non-Volatile memory)

Modbus Data Type	MODBUS Address	Values
Holding Register *Function Code (0x06 & 0x10)*	3008 (DO-1) to 3015 (DO-8)	<table><tr><th>Value</th><th>Function Mode</th></tr><tr><td>0</td><td>ON-OFF</td></tr><tr><td>1</td><td>Single Pulse</td></tr><tr><td>2</td><td>Pulse Train</td></tr></table> (Default : ON-OFF Mode)

Table 5.1 (c) : Pulse-ON Time

Run-Time / Configuration Parameter (Refer Parameter : 'Save Pulse-ON & Pulse-OFF Times to Non-Volatile Memory')

Modbus Data Type	MODBUS Address	Values
Holding Register *Function Code (0x06 & 0x10)*	3040 (DO-1) to 3047 (DO-8)	**Applicable for 'Single Pulse' & 'Pulse-Train' Mode Only** 0 to 30000 Counts (0.01 to 300 Seconds) ***1 count = 10 milli-Seconds*** (Default : 10 Counts)

Table 5.1 (d) : Pulse-OFF Time

Run-Time / Configuration Parameter (Refer Parameter : 'Save Pulse-ON & Pulse-OFF Times to Non-Volatile Memory')

Modbus Data Type	MODBUS Address	Values
Holding Register *Function Code (0x06 & 0x10)*	3072 (DO-1) to 3079 (DO-8)	**Applicable for 'Pulse-Train' Mode Only** 0 to 30000 Counts (0.01 to 300 Seconds) ***1 count = 10 milli-Seconds*** (Default : 10 Counts)

Table 5.1 (e) : Save Pulse-ON & Pulse-OFF Times to Non-Volatile Memory

Modbus Data Type	MODBUS Address	Values
Holding Register *Function Code (0x06 & 0x10)*	3104	**Applicable for 'Single Pulse' & 'Pulse-Train' Mode Only** **Value** / **Save to Memory** 0 – No 1 – Yes If Pulse ON and / or Pulse OFF times are constant for a given application, it is advisable to store these values in module's non-volatile memory. This feature eliminates the need for programming the Pulse ON & Pulse OFF parameter values each time the module is powered. To store values in non-volatile memory, set this Register value (Modbus Address 3104) to '1' after setting the values for Pulse ON & Pulse OFF parameters.

2. Output Fail-Safe Status

Each of the 8 outputs can be independently enabled to enter into a fail-safe On or Off output state. If enabled, the outputs enter into the fail-safe states if there is no communication (read/write request) from the host to the module for a user-programmed time interval.

The following three sets of Registers / Coils configure the Fail-Safe feature.

Table 5.2 (a) : 'Fail-Safe Enable' Register / Coils
Configuration Parameter (Stored in Non-Volatile memory)

Modbus Data Type	MODBUS Address	Values
Bit-Mapped Holding Register *Function Code (0x06 & 0x10)*	3003	Bit 15 . . . Bit 7 . . . Bit 1 Bit 0 Ignore Bit-8 to Bit-15 DO-1 Fail-Safe Enable / Disable DO-2 Fail-Safe Enable / Disable DO-8 Fail-Safe Enable / Disable **Bit Value** / **Enable / Disable** 0 – Fail-Safe Disable 1 – Fail-Safe Enable (Default : Disable)
Coils *Function Code (0x05 & 0x0F)*	333 (DO-1) to 340 (DO-8)	**Coil Value** / **Enable / Disable** 0 – Fail-Safe Disable 1 – Fail-Safe Enable (Default : Disable)

Table 5.2 (b) : 'Fail-Safe Status' Register / Coils

(This parameter is applicable only if 'Fail-Safe' is enabled)

Configuration Parameter (Stored in Non-Volatile memory)

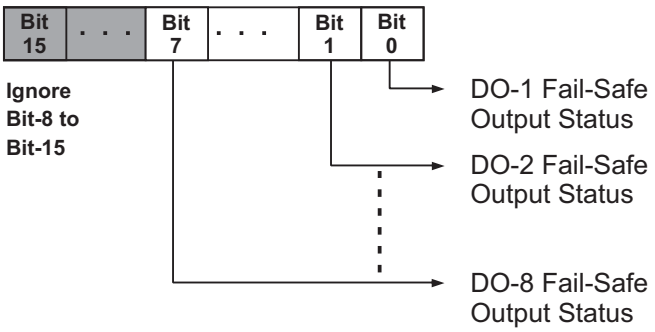
Modbus Data Type	MODBUS Address	Values
Bit-Mapped Holding Register *Function Code (0x06 & 0x10)*	3005	 **Bit Value / Output Status** 0 – OFF 1 – ON (Default : OFF)
Coils *Function Code (0x05 & 0x0F)*	365 (DO-1) to 372 (DO-8)	**Coil Value / Output Status** 0 – OFF 1 – ON (Default : OFF)

Table 5.2 (c) : 'Fail-Safe Time Period' Register

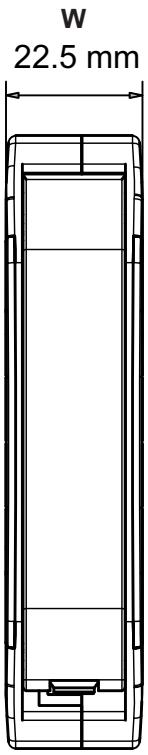
(This parameter is applicable only if 'Fail-Safe' is enabled)

Configuration Parameter (Stored in Non-Volatile memory)

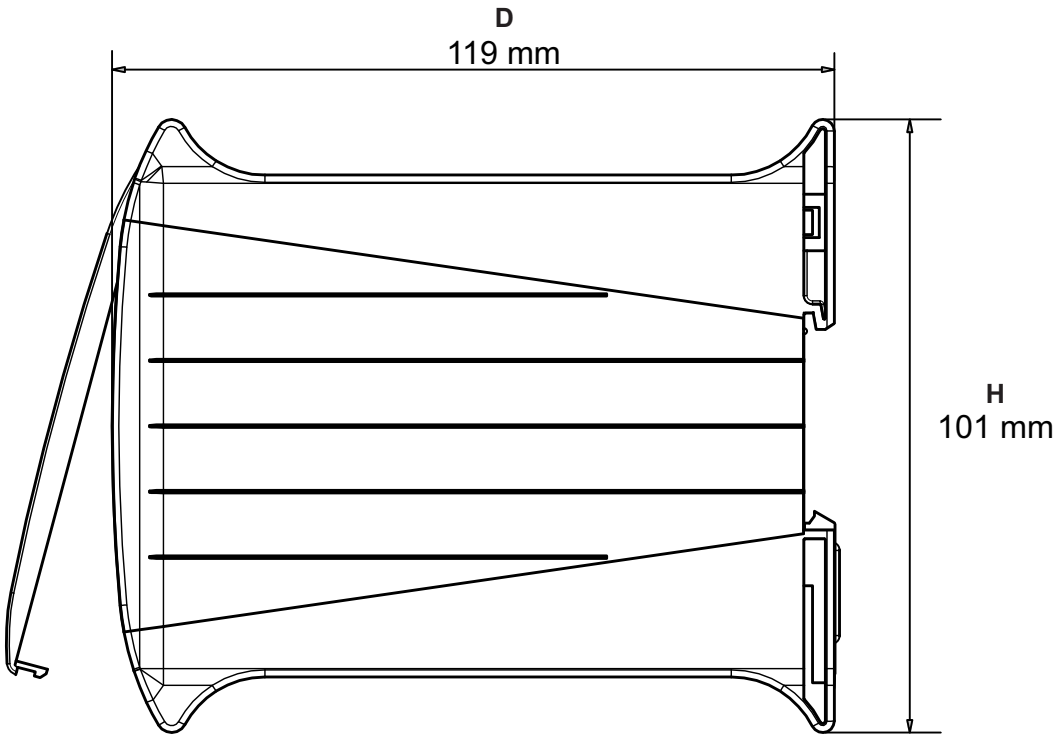
Modbus Data Type	MODBUS Address	Values
Holding Register *Function Code (0x06 & 0x10)*	3007	1 to 300 Seconds (Default : 10 Seconds)

Section 6

MECHANICAL DIMENSIONS



Front View



Side View

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

Section 7

CONFIGURING COMMUNICATION PARAMETERS

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

The Serial Communication Port specification are shown in Table 7.1 below.

Table 7.1

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 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 7.1, to select between the Configuration and Normal Operation modes. The Table 7.2 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 7.1

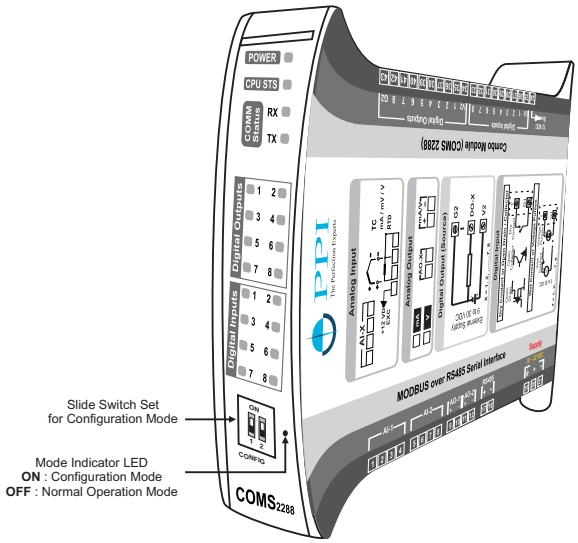
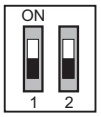
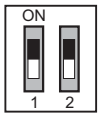


Table 7.2

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 7.3 below.

Table 7.3

<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 indicator 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></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>

Section 8

PC BASED DEVICE SETUP UTILITY

OVERVIEW

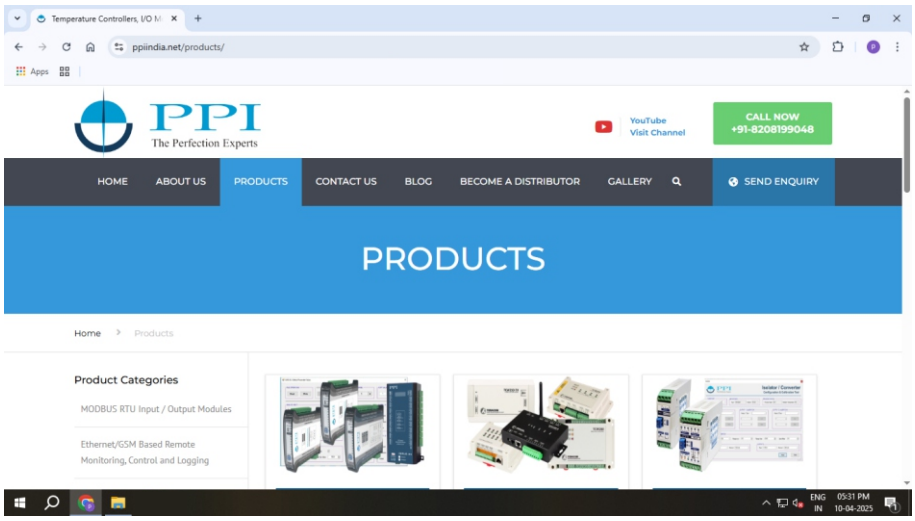
UniSet is a free Windows-based configuration utility developed by PPI to simplify the setup, parameter configuration, and monitoring of its MODBUS-compatible product range. It eliminates the need for manual MODBUS commands and streamlines device commissioning and testing.

This utility offers a quick, reliable, and user-friendly interface for configuring and validating this device during initial setup and field deployment.

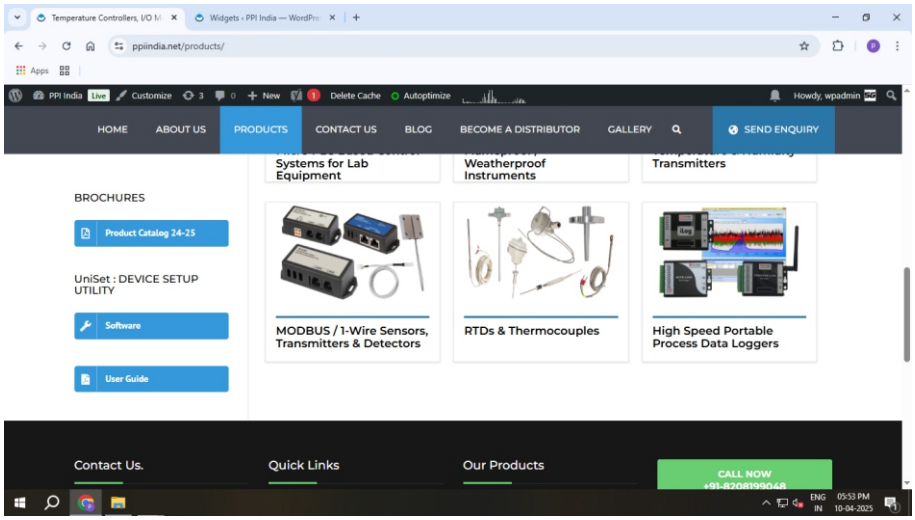
8.1 DOWNLOADING THE SETUP TOOL

The tool is available for **free download** from the **PPI website** and can be accessed from the **PRODUCTS** section. To download and launch the tool:

1. **Visit** www.ppiindia.net and click on the **PRODUCTS** tab in the main navigation menu.



2. In the **left-hand panel**, scroll to **UniSet : Device Setup Utility**.



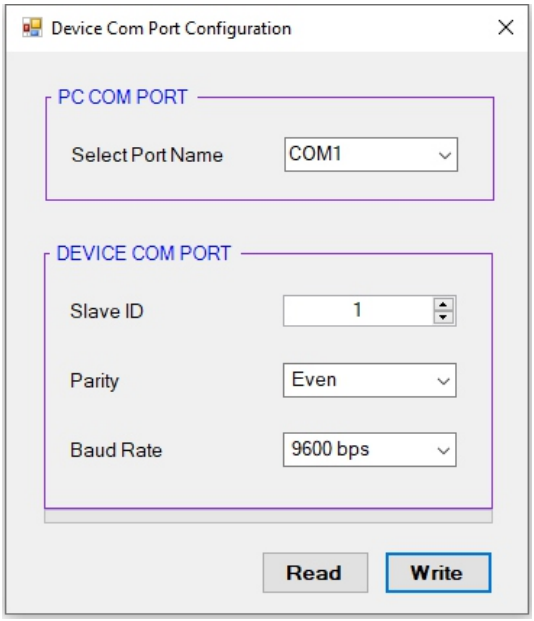
3. Two buttons will be visible under this section:
   - **Software** – Click to download the configuration utility archive (IO-Module-Configuration-Tool.rar).
   - **User Guide** – Click to download the PDF manual for reference.

4. After downloading the archive file:
   - Extract the contents into a folder (e.g., IO-Module-Configuration-Tool).
   - Open the folder and double-click on IO Module Configuration Tool.exe to launch the application.

The **UniSet** interface for this device includes the following key task panels:

8.2 DEVICE COM PORT SETTING

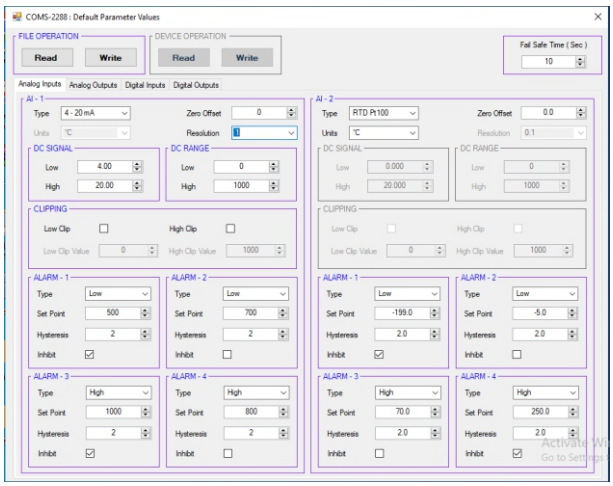
Used to select the appropriate COM port and configure baud rate, parity, and slave ID to match the connected device.

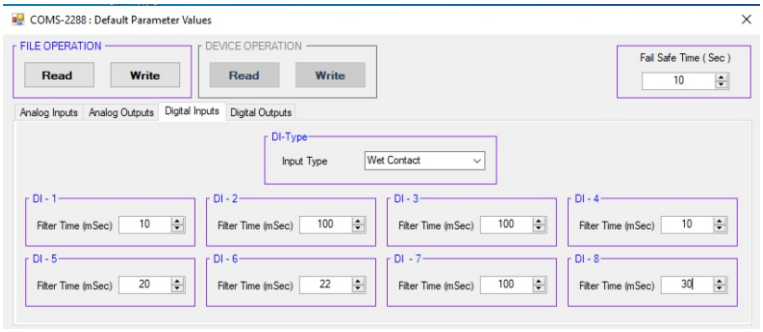


8.3 PARAMETER SETTINGS

Used to configure parameters for Analog Input channels, Analog Output channels, Digital Input channels, and Digital Output channels.

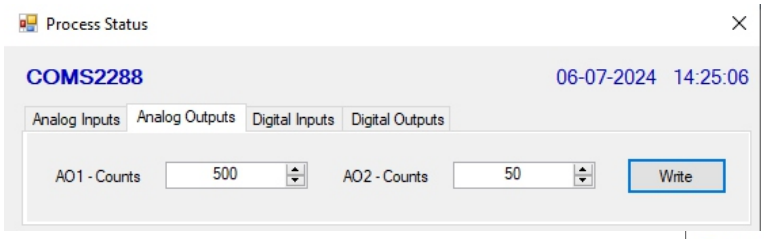
The user can save (Write) or retrieve (Read) the parameter configuration to the Device or to a File.

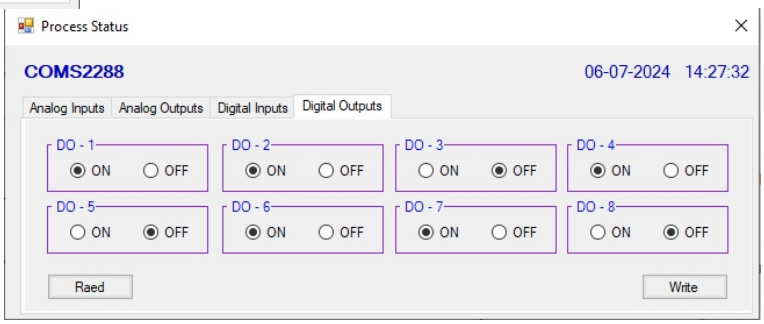




8.4 ON-LINE MONITORING

Displays real-time process values, alarms, and I/O statuses (as applicable). Useful for system diagnostics and validation.





APPENDIX A
DC LINEAR SIGNAL INTERFACE

This appendix describes the parameters required to interface process transmitters that produce Linear DC Voltage (mV/V) or Current (mA) signals in proportion to the measured process values. A few examples of such transmitters are;

1. Pressure Transmitter producing **4 to 20 mA** for **0 to 5 psi**
2. Relative Humidity Transmitter producing **1 to 4.5 V** for **5 to 95 %RH**
3. Temperature Transmitter producing **0 to 20 mA** for **-50 to 250 °C**

The instrument (indicator / controller / recorder) that accepts the linear signal from the transmitter computes the measured process value by solving the mathematical equation for Straight-Line in the form:

$$Y = mX + C$$

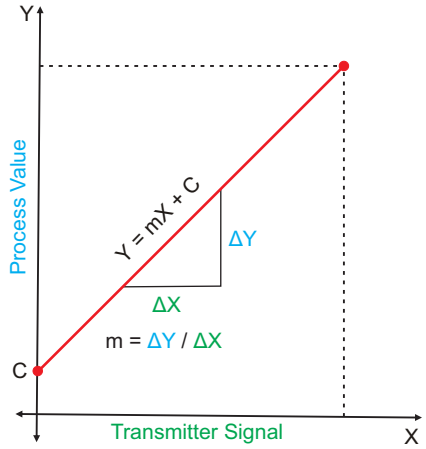
Where;

X : Signal Value from Transmitter

Y : Process Value Corresponding to Signal Value X

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

m : Change in Process Value per unit Change in Signal Value (Slope)



As is evident from the aforementioned transmitter examples, different transmitters produce signals varying both in type (mV/V/mA) and range. Most PPI instruments, thus, provide programmable Signal Type and Range to facilitate interface with a variety of transmitters. A few industry standard signal types and ranges offered by the PPI instruments are: ± 80mV, ± 5 V, ± 1 to ± 5 V, ± 10V, 0-20 mA, 4-20 mA, etc.

Also, the output signal range (e.g. 1 to 4.5 V) from different transmitters corresponds to different process value range (e.g. 5 to 95 %RH); the instruments thus also provide facility for programming the measured process value range with programmable Resolution.

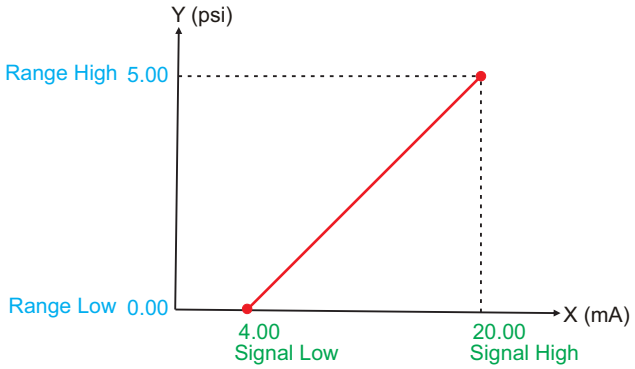
The linear transmitters usually specify two signal values (Signal Low and Signal High) and the corresponding Process Values (Range Low and Range High). In the example Pressure Transmitter above; the Signal Low, Signal High, Range Low & Range High values specified are: 4 mA, 20 mA, 0 psi & 5 psi, respectively.

In summary, the following 6 parameters are required for interfacing Linear Transmitters:

1. Input Type : Standard DC Signal Type in which the transmitter signal range fits (e.g. 4-20 mA)
2. Signal Low : Signal value corresponding to Range Low process value (e.g. 4.00 mA)
3. Signal High : Signal value corresponding to Range High process value (e.g. 20.00 mA)
4. PV Resolution : Resolution (least count) with which to compute process value (e.g. 0.01)
5. Range Low : Process value corresponding to Signal Low value (e.g. 0.00 psi)
6. Range High : Process value corresponding to Signal High value (e.g. 5.00 psi)

The following examples illustrate appropriate parameter value selections.

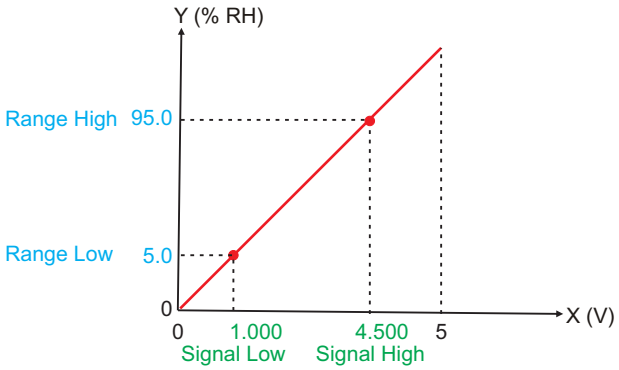
Example 1: Pressure Transmitter producing **4 to 20 mA** for **0 to 5 psi**



Presume the pressure is to be measured with 0.01 Resolution, that is 0.00 to 5.00 psi.

Input Type	:	4-20 mA
Signal Low	:	4.00 mA
Signal High	:	20.00 mA
PV Resolution	:	0.01
Range Low	:	0.00
Range High	:	5.00

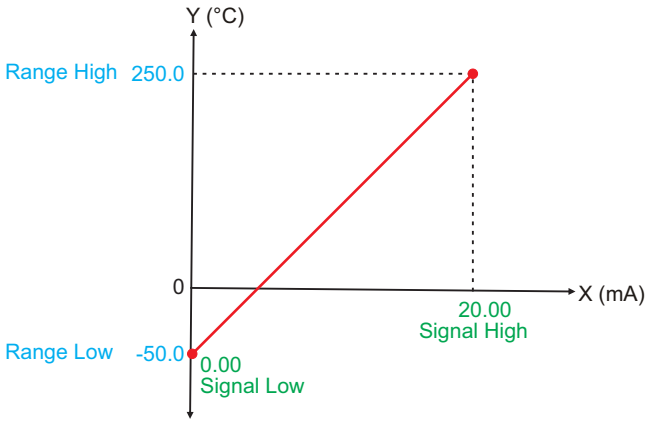
Example 2: Relative Humidity Transmitter producing **1 to 4.5 V** for **5 to 95 %RH**



Presume the humidity is to be measured with 0.1 Resolution, that is 0.0 to 100.0 %.

Input Type	:	0-5 V
Signal Low	:	1.000 V
Signal High	:	4.500 V
PV Resolution	:	0.1
Range Low	:	5.0
Range High	:	95.0

Example 3: Temperature Transmitter producing **0 to 20 mA** for **-50 to 250 °C**



Presume the Temperature is to be measured with 0.1 Resolution, that is -50.0 to 250.0°C.

Input Type	:	0-20 mA
Signal Low	:	0.00 mA
Signal High	:	20.00 mA
PV Resolution	:	0.1
Range Low	:	-50.0
Range High	:	250.0

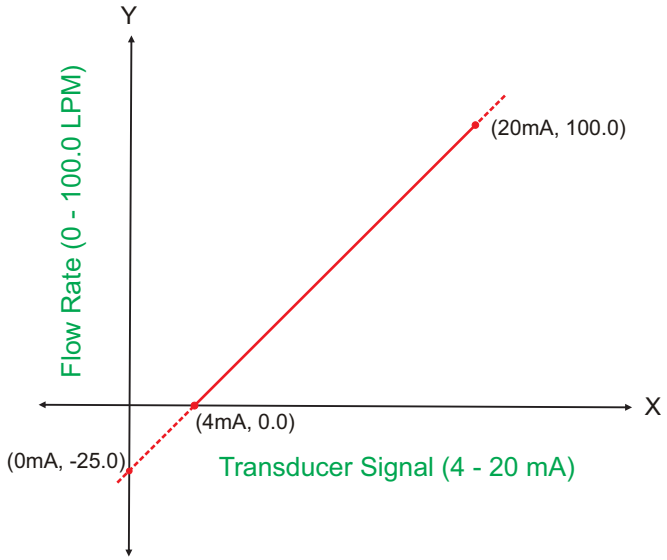
APPENDIX B

BOTTOM / TOP CLIPPING

For mA/mV/V inputs the measured PV is a scaled value between the set values for 'PV Range Low' and 'PV Range High' parameters corresponding to the Signal Minimum and Signal Maximum values respectively. Refer Appendix A.

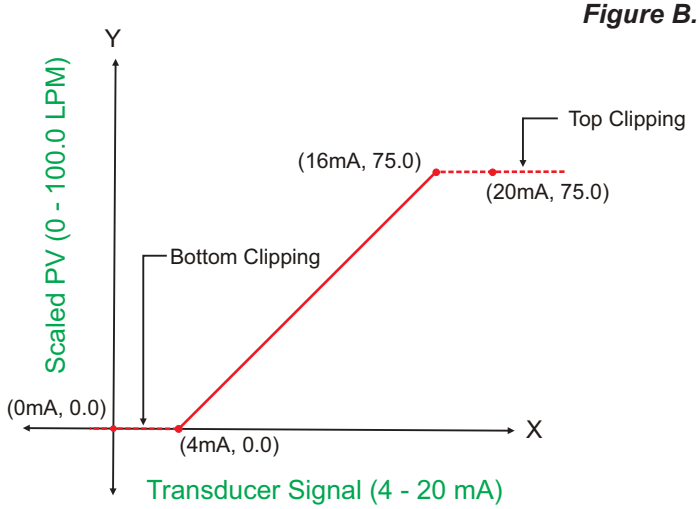
The Figure B.1 below illustrates an example of flow rate measurement using a transmitter / transducer producing a signal range of 4 - 20 mA corresponding to 0.0 to 100.0 Liters per Minute (LPM).

Figure B.1



If this transmitter is to be used for a system having a flow rate range of 0.0 to 75.0 LPM then the actual useful signal range from the example transmitter is 4 mA (~ 0.0 LPM) to 16 mA (~ 75.0 LPM) only. If no Clipping is applied on the measured flow rate then the scaled PV will also include 'out-of-range' values for the signal values below 4 mA and above 16 mA (may be due to open sensor condition or calibration errors). These out-of-range values can be suppressed by enabling the Bottom and/or Top Clippings with appropriate Clip values as shown in figure B.2 below.

Figure B.2



Parameter Values

PV Range Low	: 0.0
PV Range High	: 100.0
Enable Bottom Clipping	: Yes
Bottom Clip Value	: 0.0
Enable Top Clipping	: Yes
Top Clip Value	: 75.0

APPENDIX C

PROCESS VALUE IN 'FLOAT' DATA FORMAT

The measured Process Values for all channels can be read in 32-Bit Single Precision Float format at Modbus Addresses listed in the following table.

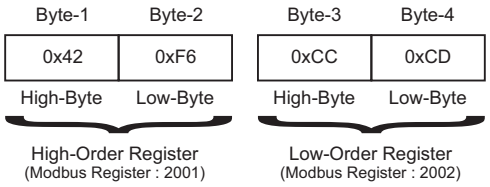
Read-Only Parameter

Parameter Description	MODBUS Address	Values
Process Value Measured Temperature (in °C / °F) for Thermocouple / RTD inputs or Scaled Counts for DC Volts / mA inputs.	2001 (AI-1) to 2003 (AI-2)	Single Precision Float values from -30000 to +30000 representing the measured process values. Refer Table 2.3 (Section 2) for the various input types and the corresponding measured ranges. The following constant counts indicate PV Errors. **Value** / **PV Error Type** -32768 / Under Range +32752 / Over Range +32767 / Sensor Open

The Process Values can be read in IEEE single precision floating point format in two adjacent 16-bit Modbus registers, the high order register first. The high-order register always starts at an odd Modbus address. For example, the process value for channel-1 is read in addresses 2001 (high-order register) & 2002 (low-order register). Within the register, the high-order byte is sent first in accordance to standard Modbus RTU format. The following example illustrates the register & byte sequence.

	Decimal Format	Hexa-decimal Format
Process Value for Channel-1	123.4	0x42F6CCCD

The data is transferred in the following Byte-Sequence.



The Process Values for Thermocouple & RTD Pt100 Inputs is always transferred with 0.1 count resolution.

The resolution for Process Values for DC Linear inputs is dependent on the value set for the Parameter *DC Resolution* (Modbus Addresses : 115 & 116). For example, if the dc resolution parameter value is 2 & if the measured scaled integer counts are 12345 then the communicated process value is 123.45.

APPENDIX D

ALARM STATUS AS DISCRETE INPUTS / COILS

Alarm Status (Read Only)

<table>
<tr><th>Modbus Data Type</th><th>MODBUS Address</th><th>Values</th></tr>
<tr><td>Alarm-1 Status
Function Code (0x01 & 0x02)</td><td>417 (AI-1)
&
418 (AI-2)</td><td rowspan="4"><table><tr><th>Coil Value</th><th>Status</th></tr><tr><td>0</td><td>Alarm OFF</td></tr><tr><td>1</td><td>Alarm ON</td></tr></table></td></tr>
<tr><td>Alarm-2 Status
Function Code (0x01 & 0x02)</td><td>433 (AI-1)
&
434 (AI-2)</td></tr>
<tr><td>Alarm-3 Status
Function Code (0x01 & 0x02)</td><td>449 (AI-1)
&
450 (AI-2)</td></tr>
<tr><td>Alarm-4 Status
Function Code (0x01 & 0x02)</td><td>465 (AI-1)
&
466 (AI-2)</td></tr>
</table>

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