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Innovative Electronics For You
NABCB QM 004, EM 016
IQC ISO 9001 : 2015 IND/QMS/NAB-C1978/2658

Smart Box Operation and Installation Manual
Model –M1448
Document Number: M4 006 010 020 03 (R10)
(Suitable for HW Version-101 and SW Version – 106)

Contents

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1. Warnings

- Installation at site should be done by skilled and qualified personal after taking required approvals.
- Use proper protection gear and tool while installing the device.
- Be aware of your surroundings while doing the installation work.
- Serious injury can occur if proper safety norms are not followed.
- Compliance with all utility and electrical safety codes regulations are mandatory.
- Read the manual and get acquainted with the SmartBox connections and terminals before commencing installation activity.
- Before connecting the SmartBox, read its label to confirm power supply requirements.
- All connections should be done only when power to SmartBox is switched off.
- Improper installation and connections may damage the device and sensor connected to the same.
- Protect from overvoltage and static electricity.
- Physically damaged SmartBox should not be used or connected to main power.
- Use proper earth connection.
- **Use proper size screwdriver (tools) and cable for connection else the terminals might get damaged.**

2. Technical Specifications SmartBox

Technical specifications for the SmartBox are provided in table-2.1 below.

Sr. No	Parameter		Specification
1	Power Supply	Model- M1448-A	220VAC Power supply
		Model- M1448-D	9-32VDC Power Supply
2	Analog input Channel 1	0-1000mV	Either mV or mA input is user selectable at site. Optional calibration constant for mV input. Option for four sample average filter.
		4-20mA	
3	Analog input Channel 2	0-1000mV	Either mV or mA input is user selectable at site. Optional calibration constant for mV input. Option for four sample average filter.
		4-20mA	
4	RTD Input	PT100	RTD input class A Range -20 to +120ºC Unit selectable at site ºC, ºK or ºF
		PT1000	
5	ADC resolution		24 bits
6	Sampling rate		10Hz
7	Accuracy		0.1%
9	Output communication		Isolated (1.5KV) two wire RS485

		Modbus RTU
9	Output data format	32 bits signed integer and 32 Bits floating point (without any scaling factor)
10	Baud rates	Configurable 4200, 9600 and 19200
11	Ingress protection	IP-65
12	Housing Material	Powder coated aluminum enclosure
13	Dimension (L X B X D)	125mm X 80mm X 57mm
14	Weight	500gm approx.

Table-2.1: SmartBox technical specifications

3. SmartBox – Installation

3.1 Mounting the SmartBox

Step – 1: Drill two holes (M5) at site where the SmartBox is intended to be mounted according to the following diagram

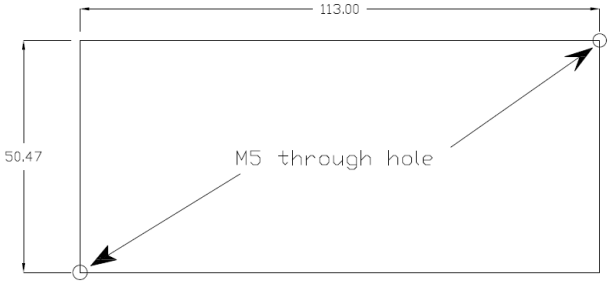

Fig – 3.1.1: Mounting hole dimensions

Step – 2: Open the cover to access the mounting hole of the enclosure

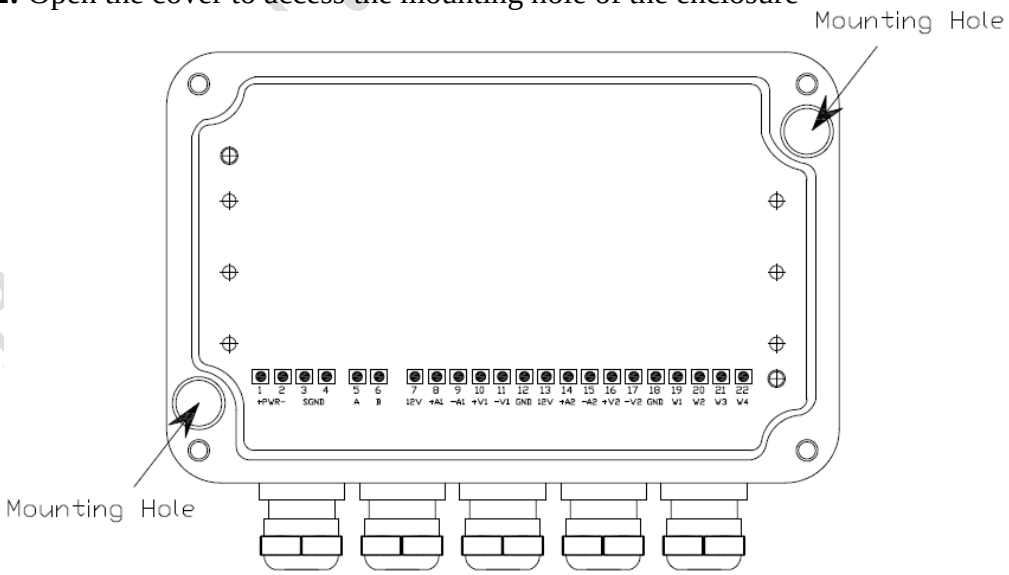

Fig – 3.1.2: SmartBox mounting details

Step – 3: Mount the enclosure with the M5 X 36mm screw nut and washer set provided along with the package

Note:

1. **Mounting should not be done using cable tie.**
2. **SmartBox should be mounted to metal body with the screws provided.**
3. **Proper earth is to be connected to the. For extra protection.**
4. **See figure-3.1.3 for proper mounting orientation for SmartBox**

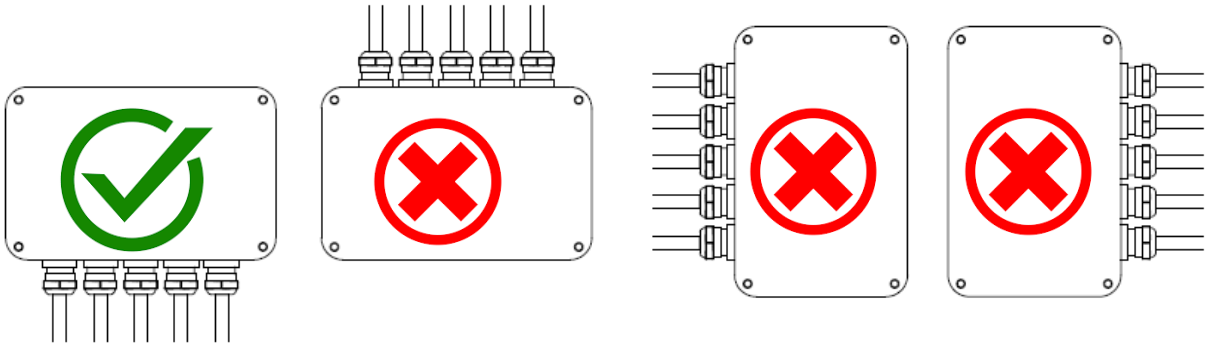

Fig – 3.1.3: Proper way of mounting the SmartBox

4. SmartBox – Connections

Connection for SmartBox are provided below.

4.1 Power Supply Connections – AC (for M1448-A)

AC power supply connections for the SmartBox are shown in figure – 4.1 and table – 4.1 below.

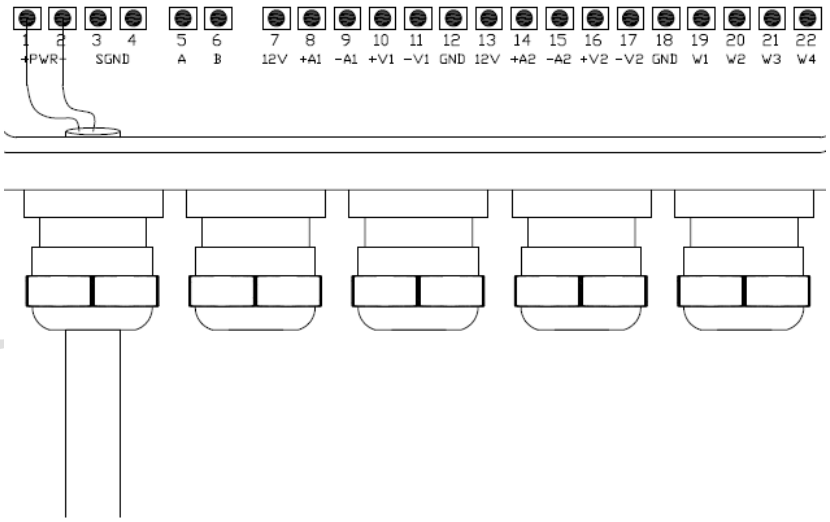

Fig – 4.1.1: Cable connection for 220VAC power supply

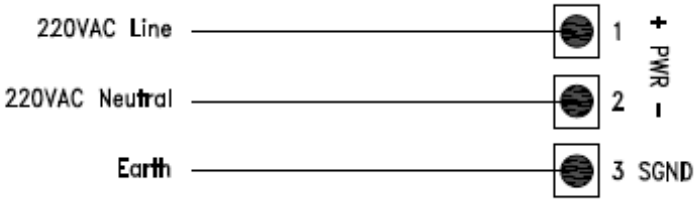

Fig – 4.1.2: Connection for 220VAC power supply

Terminal No	Connected to
1	220VAC Line
2	220VAC Neutral
3	Earth connection

Table-4.1: 220VAC power supply connections

Note: Verify power supply rating for the SmartBox prior to connection. Wrong power supply connection will damage the device.

4.2 Power Supply Connections – DC (for M1448-D)

DC power supply connections for the SmartBox are shown in figure-4.2 and table-4.2below.

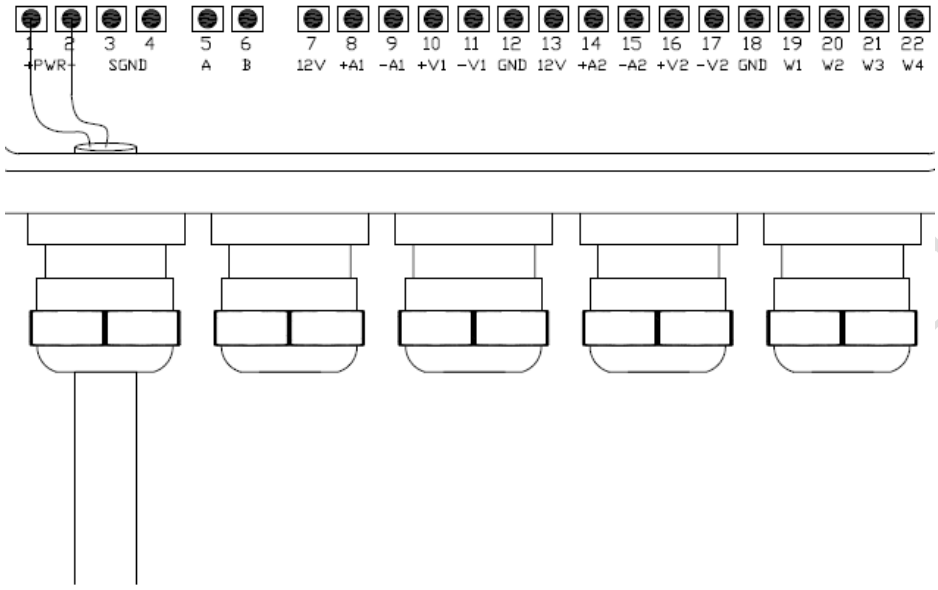

Fig – 4.2.1: Cable connection for DC power supply

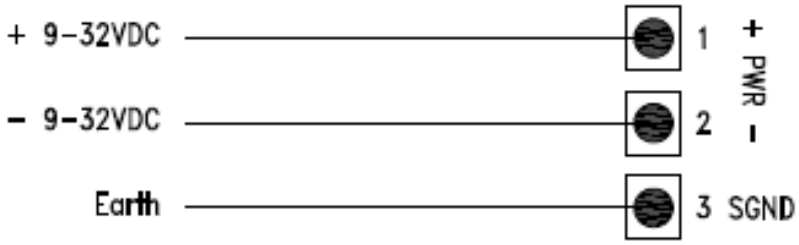

Fig – 4.2.1: Connection for DC power supply

Terminal No	Connected to
1	9-32V DC +V
2	9-32V DC -V
3	Earth connection

Table-4.2: 9-32VDC power supply connections

Note: Verify power supply rating and for the SmartBox prior to connection. Wrong power supply connection will damage the device.

4.3 Serial RS485 Communication

Connections for RS485 communication are shown in figure-4.3 and table-4.3below.

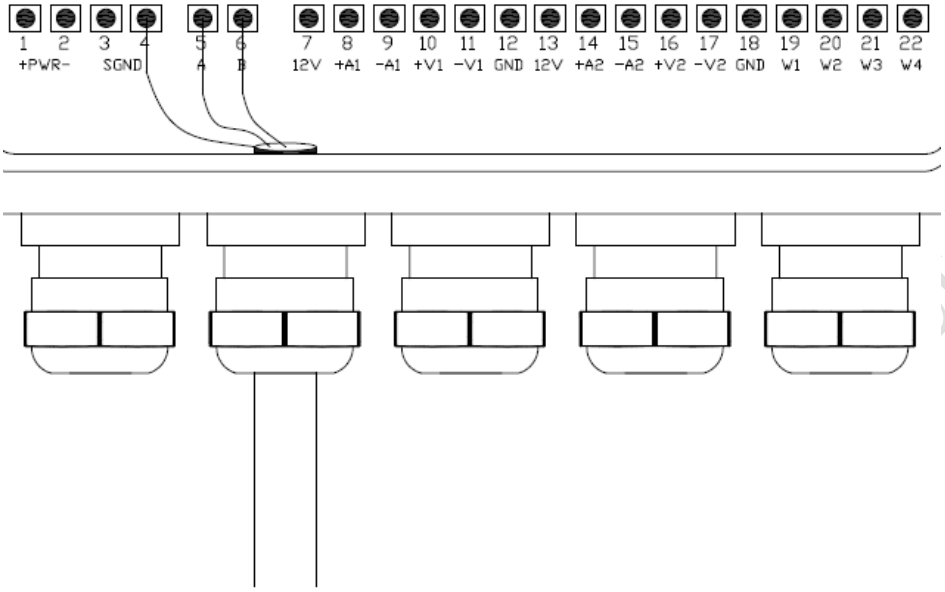

Fig – 4.3.1: Cable connection for RS485 cable connection

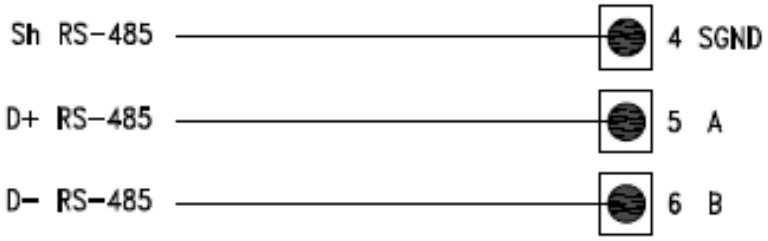

Fig – 4.3.1: Connection for RS485 cable connection

Terminal No	Connected to
4	RS485 Shield
5	A – RS485 D+
6	B – RS485 D-

Table-4.3: RS485 Modbus RTU connections

4.4 Analog Channel-1 Connections

Analog channel-1 can be used to measure differential mV or mA inputs. Required input type can be configured as explained in section 7.

4.4.1 Connections for differential mV Input Signal:

Connection for differential mV (20mV to 1000mV differential) input signal is shown in figure-4.4.1 and table-4.4.1.1 below.

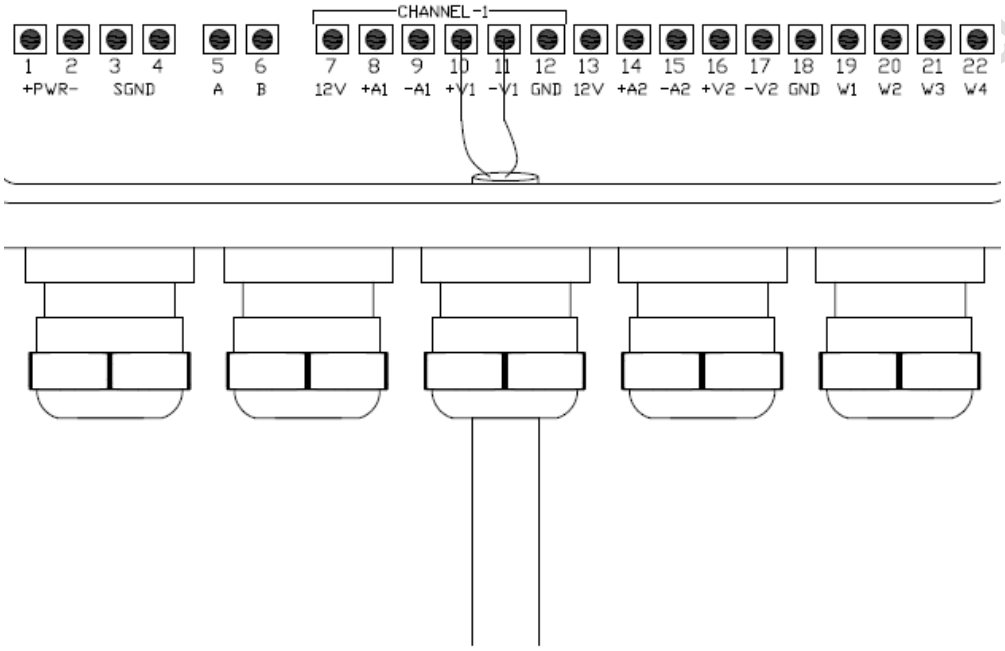

Fig – 4.4.1.1: Cable connection for Analog Channel 1 (0-1000mV) without excitation voltage

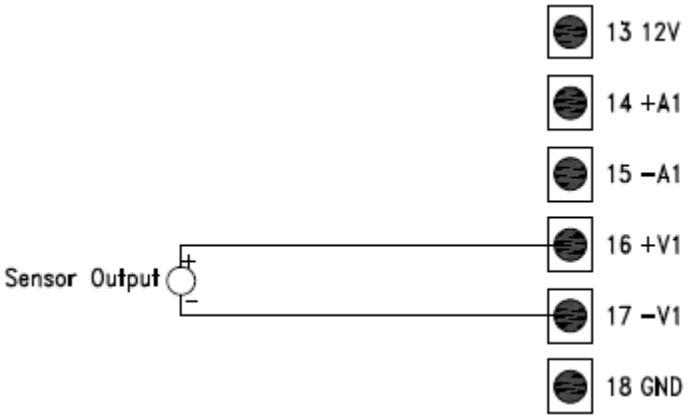

Fig – 4.4.1.2: Connection for Analog Channel 1 (0-1000mV)

Terminal No	Connected to
Terminal no – 10	0-1000mV +V
Terminal no – 11	0-1000mV -V

Table-4.4.1.1: Channel-1 0-1000mV connection for sensors without excitation voltage requirement

4.4.2 Connections for differential mV Input Signal (with excitation voltage requirement):

Connection for differential mV (20mV to 1000mV differential) input signal is shown in figure-4.4.2.

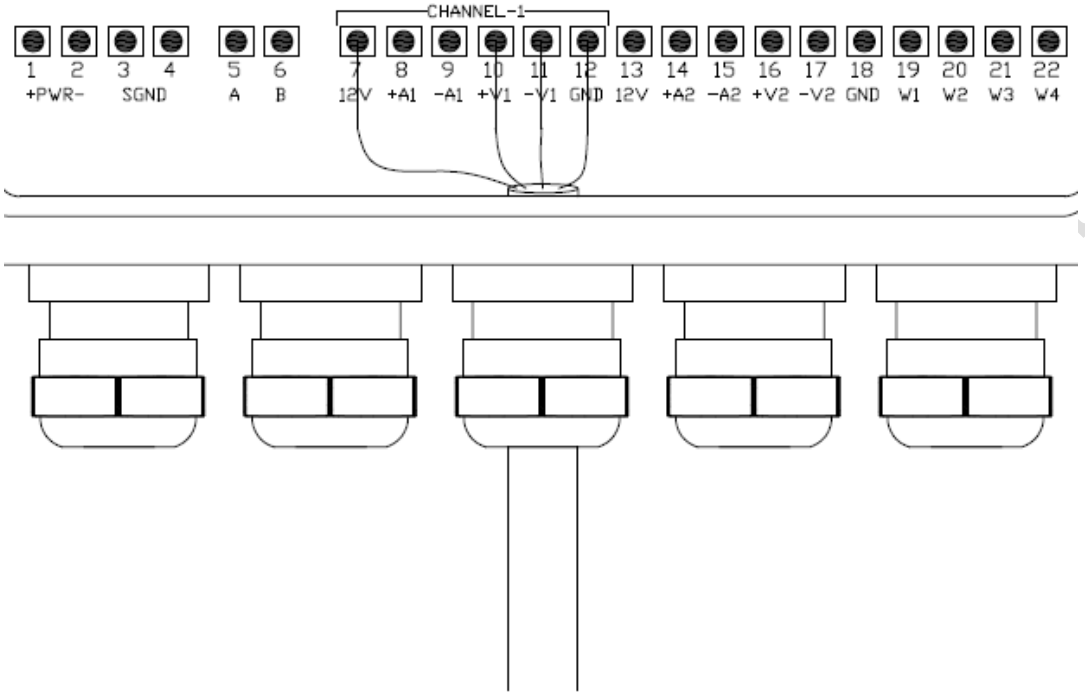

Fig – 4.4.2.1: Cable connection for Analog Channel 1 (0-1000mV) with 12VDC excitation voltage

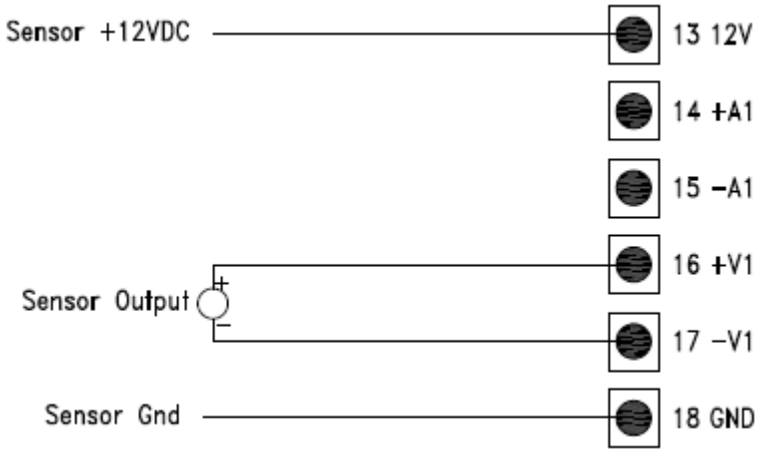

Fig – 4.4.2.2: Electrical drawing for Analog Channel 1 (0-1000mV) where there is requirement for 12VDC excitation voltage

Note: Sensor excitation voltage (maximum 25mA load) can be used if required.

Terminal No	Connected to
7	12VDC out for excitation power supply
10	0-1000mV +V
11	0-1000mV -V
12	GND

Table-4.4.2: Channel-1 0-1000mV terminals for sensors with excitation voltage requirement

4.4.3 Connections for loop powered mA transducer:

Connection for loop powered mA transducer is shown in figure-4.4.3.

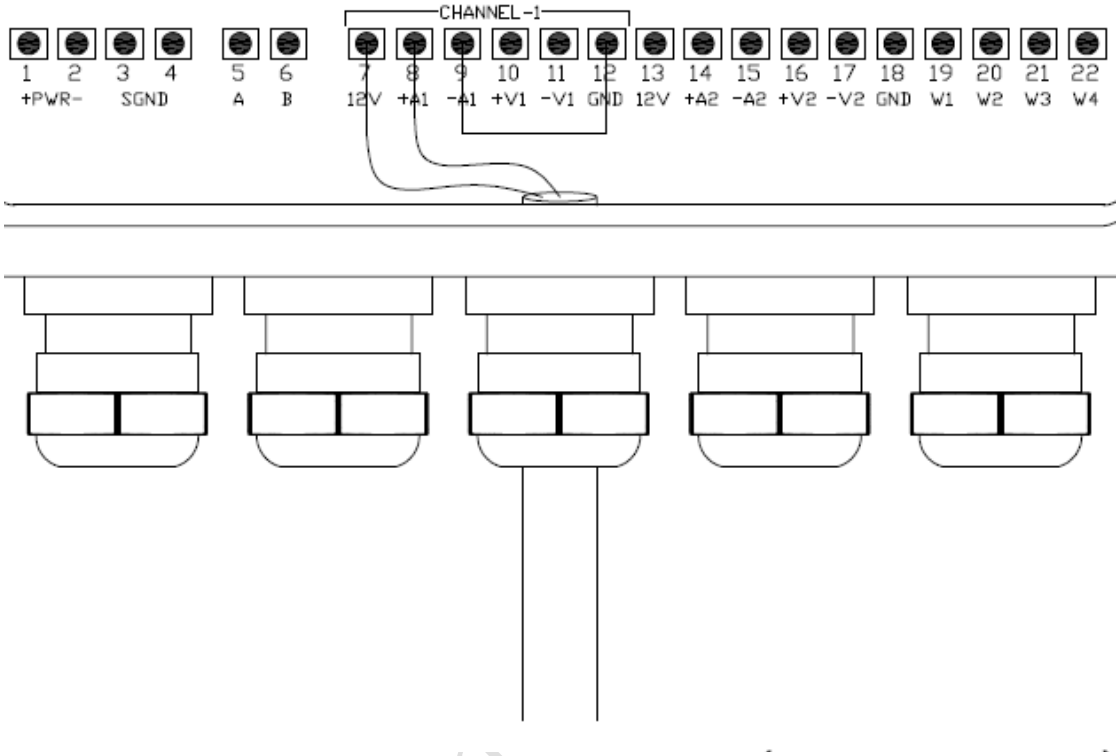

Fig – 4.4.3.1: Cable connection for Analog Channel 1(4-20mA) for loop powered sensors

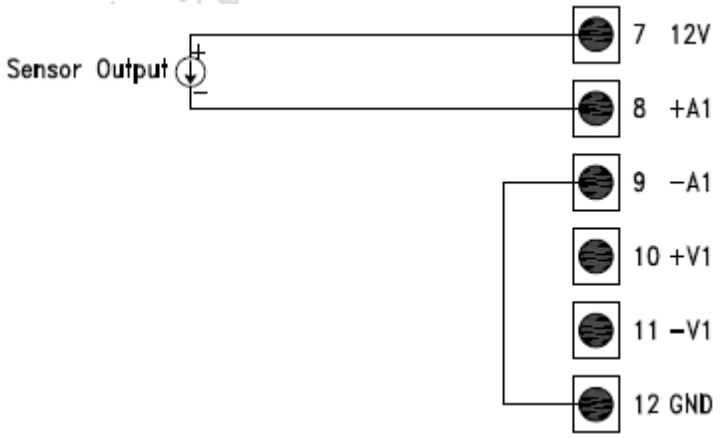

Fig – 4.4.3.1: Connection for Analog Channel 1(4-20mA) for loop powered sensors

Terminal No	Connected to
7	+12VDC
8	Signal cable (+4-20mA)
9 (– 4-20mA)	Short terminals 9 and 12
12	

Table-4.4.3: Channel-1 4-20mA terminals for self-loop powered sensor

4.4.4 Connections for mA Input Signal (with excitation voltage requirement):

Connection for sensors with external power supply requirement, 4-20mA input signal is shown in figure-4.4.4.

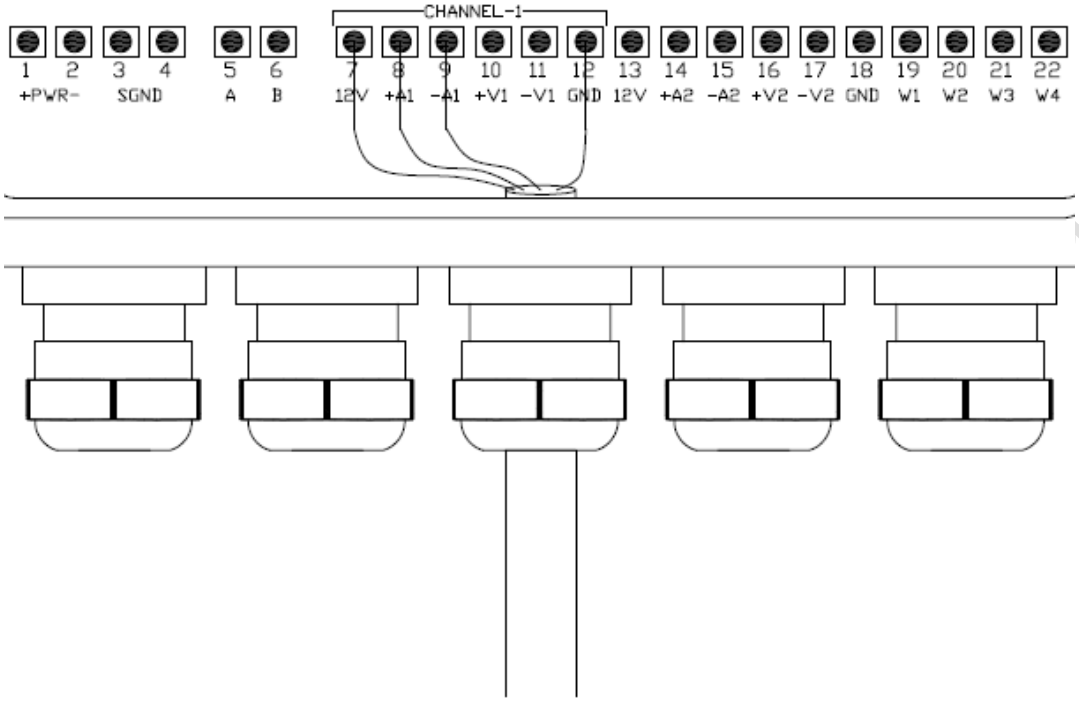

Fig – 4.4.4.1: Cable connection for Analog Channel 1(4-20mA) for sensors with excitation voltage

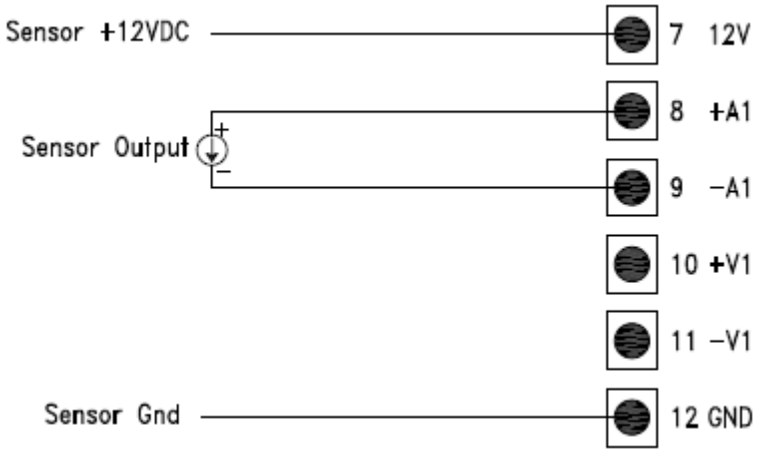

Fig – 4.4.4.2: Connection diagram for Analog Channel 1(4-20mA) for sensors with excitation voltage

Terminal No	Connected to
7	12VDC out for excitation power supply
8	+ 4-20mA
9	- 4-20mA
12	GND

Table-4.4.4: Channel-1 4-20mA terminals for sensors with excitation voltage

4.5 Analog Channel-2 Connections

Analog channel-2 can be used to measure differential mV or mA inputs. Required input type can be configured as explained in section 7.

4.5.1 Connections for differential mV Input Signal (with no excitation voltage):

Connection for differential mV (20mV to 1000mV differential) input signal is shown in figure-4.5.1.

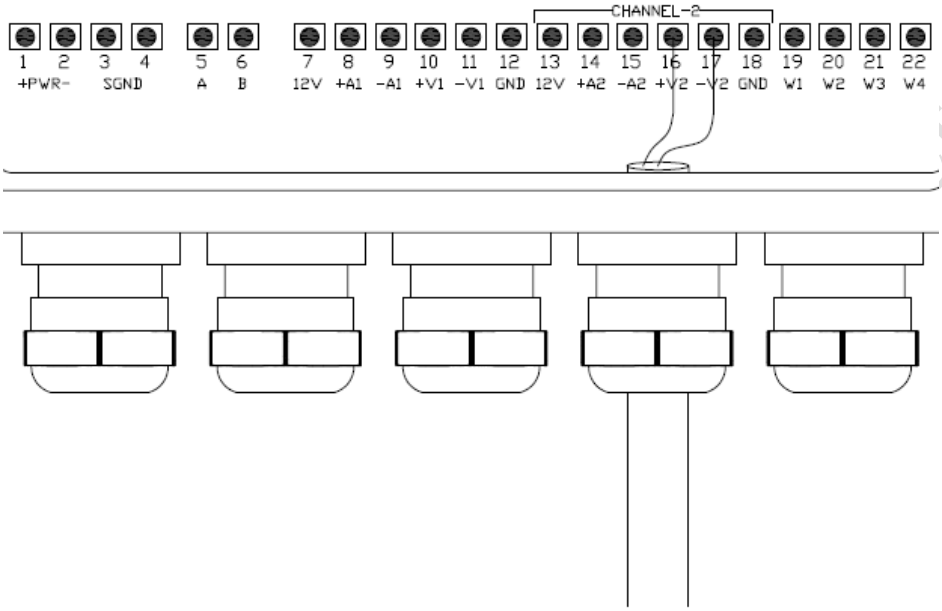

Fig – 4.5.1.1: Cable connection for Analog Channel 2 (0-1000mV) where there is no excitation voltage

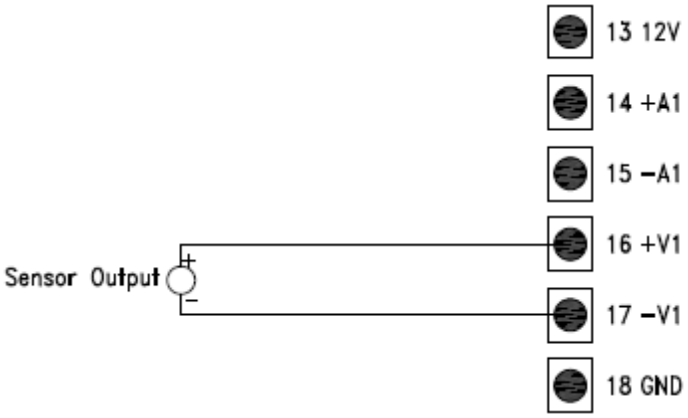

Fig – 4.5.1.2: Connection diagram for Analog Channel 2 (0-1000mV) without excitation voltage

Terminal No	Connected to
16	0-1000mV +V
17	0-1000mV -V

Table-4.5.1: Channel-2 0-1000mV terminals for sensors without excitation voltage

4.5.2 Connections for differential mV Input Signal (with excitation voltage):

Connection for differential mV (20mV to 1000mV differential) input signal is shown in Fig-4.5.2.

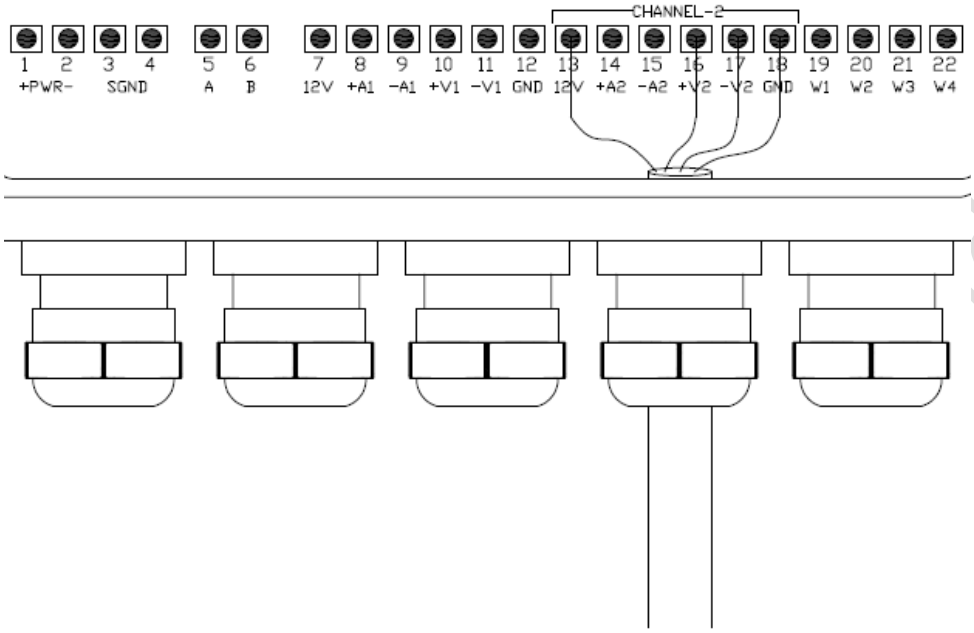

Fig – 4.5.2.1: Cable connection for Analog Channel 2 (0-1000mV) with 12VDC excitation voltage

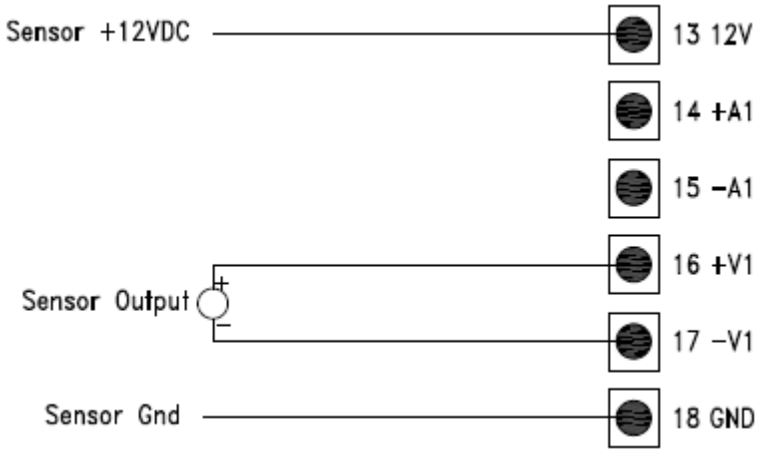

Fig – 4.5.2.2: Connection diagram for Analog Channel 2 (0-1000mV) with requirement for 12VDC excitation voltage

Note: Sensor excitation voltage (maximum 25mA load) can be used if required.

Terminal No	Connected to
13	12VDC out for excitation power supply
16	0-1000mV +V
17	0-1000mV -V
18	GND

Table-4.5.2: Channel-2 0-1000mV terminals for sensors with excitation voltage

4.5.3 Connections for loop powered mA transducer:

Connection for loop powered mA transducer is shown in Fig-4.5.3.

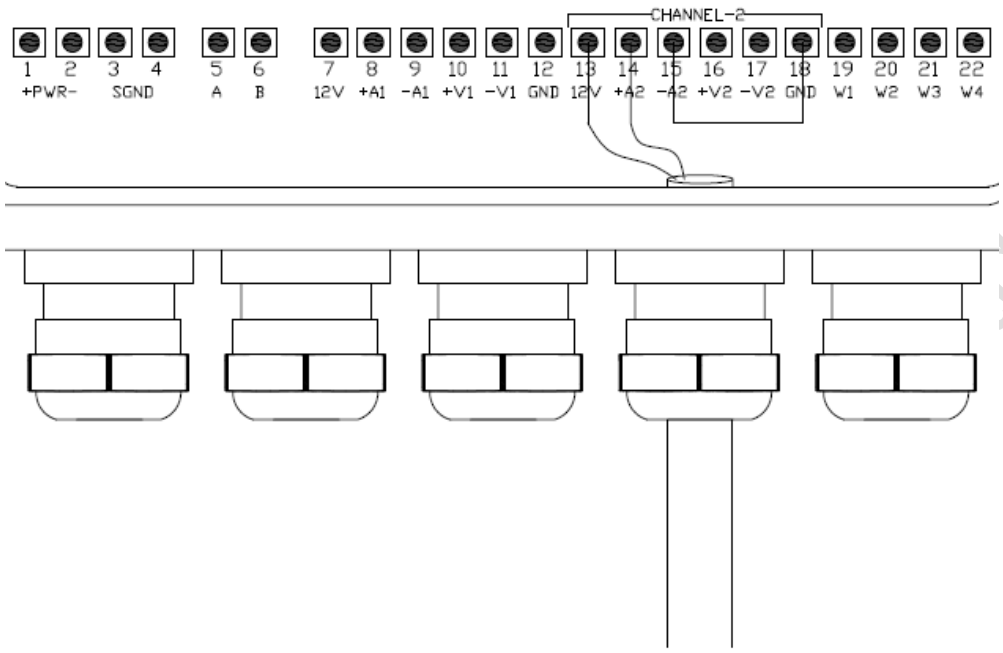

Fig – 4.5.3.1: Physical diagram for Analog Channel 2(4-20mA) for sensors with loop power

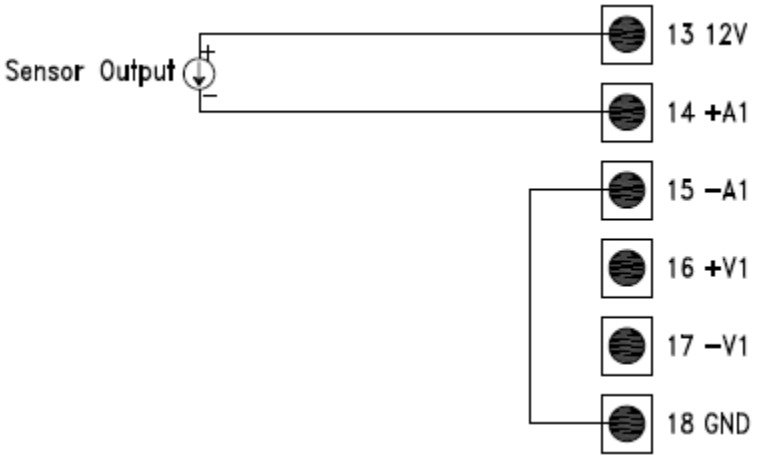

Fig – 4.5.3.2: Connection diagram for Analog Channel 2(4-20mA) for sensors with self-loop power

Terminal No	Connected to
13	+12VDC
14	Signal cable (+4-20mA)
15 (– 4-20mA)	Short to Terminal no – 15 and 18
18	

Table-4.5.3: Channel-2 4-20mA terminals for self-loop powered sensor

4.5.4 Connections for mA Input Signal (with excitation voltage requirement):

Connection for sensors with extra power supply requirement, 4-20mA input signal is shown in Fig-4.5.4.

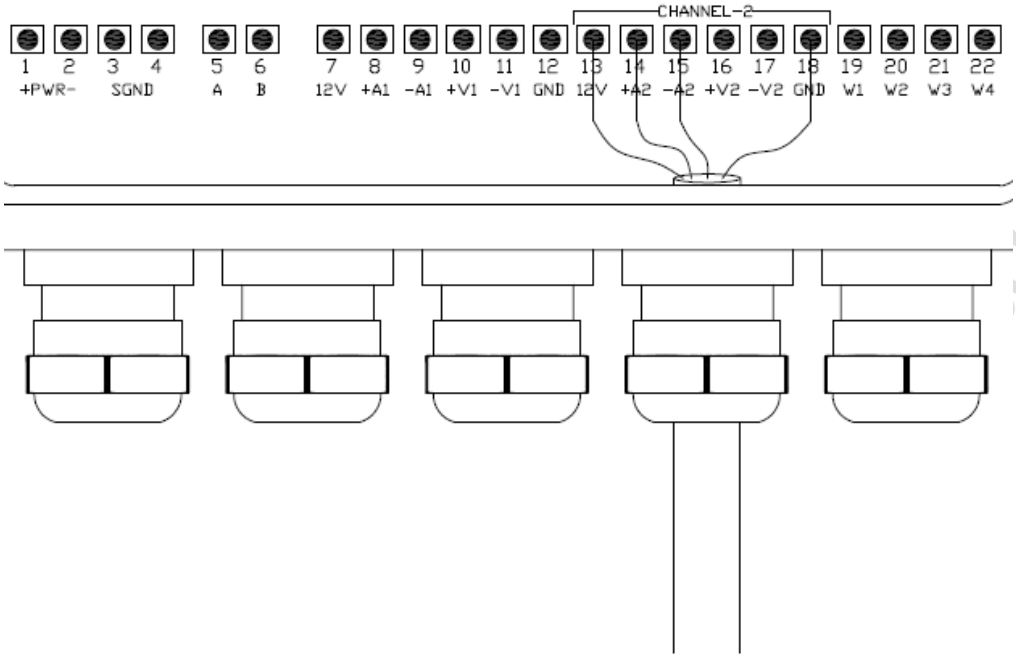

Fig – 4.5.4.1: Cable connection for Analog Channel 2(4-20mA) for sensors with excitation voltage

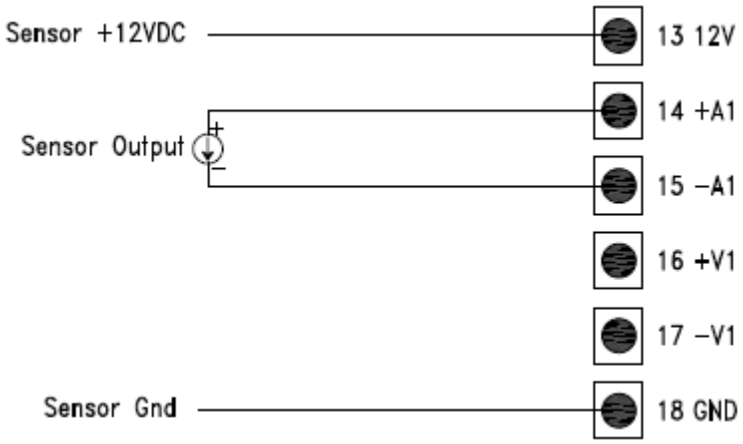

Fig – 4.5.4.2: Connection diagram for Analog Channel 2(4-20mA) for sensors with excitation voltage requirement

Terminal No	Connected to
13	12VDC out for excitation power supply
14	+ 4-20mA
15	- 4-20mA
18	GND

Table-4.5.4: Channel-2 4-20mA terminals for sensors with excitation voltage requirement

4.6 RTD Temperature Sensor Connections:

4.6.1 Connections for Four Wire RTD Temperature Sensor:

Connection for four wire RTD (PT1000 or PT100) is shown in Fig 4.6.1 below.

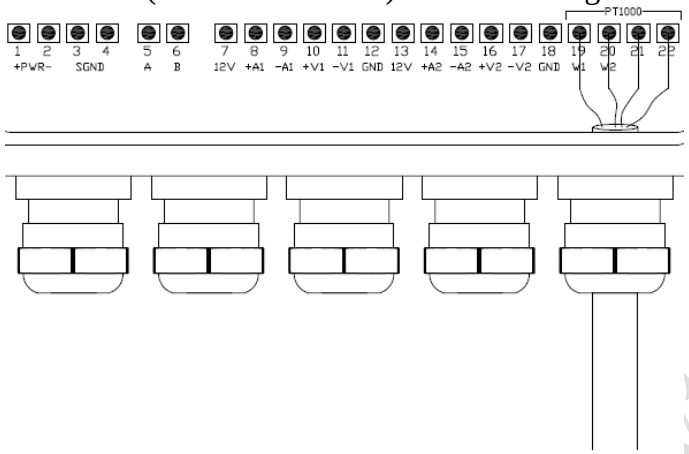

Fig – 4.6.1: Connection for four wire RTD sensors

Terminal No	Connected to
19	Red Wire
20	Red Wire
21	White Wire
22	White Wire

Table-4.6.1: Four wire RTD connection

4.6.2 Connections for three Wire RTD Temperature Sensor:

Connection for three wire (PT1000 or PT100) is shown in Fig 4.6.2 below.

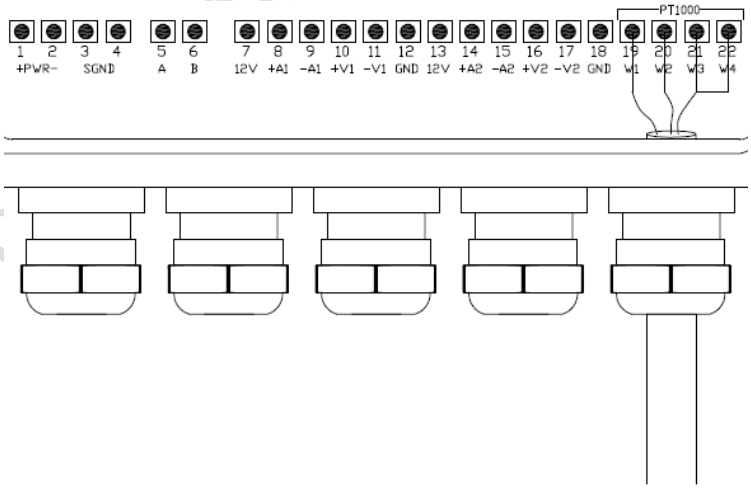

Fig – 4.6.2: Connection for three wire RTD

Terminal No	Connected to
19	Red Wire
20	Red Wire
21	White Wire
22	Shorted with terminal 21

Table-4.6.2: Three wire RTD connection

4.7 Device Health Status LED

Device health status LED on board provides indication about operation of the SmartBox. Details are provided in table 5.1 below.

Health LED	Operation
Slow Flash	Device in normal operation
Fast Flash	Device in calibration mode
Steady	Device operations fail

Table-4.7: Health LED status

5. SmartBox – Default Configuration

Default configuration for SmartBox is provided in table-5 below.

Sr. No	Parameter	Default Setting
1	**Communication Parameters**	
1.1	Device MODBUS address	1
1.2	Baud rate	9,600
1.3	Parity	None
1.4	Stop bits	1
2	**Analog Input Channel-1**	
2.1	Input Signal type	mA (4-20mA)
2.2	Enable Filter	Disabled
2.3	Low range (4 mA)	0
2.4	High range (20 mA)	1000
2.5	Calibration Constant	Disabled
2.6	Calibration Constant Value	1*100
3	**Analog Input Channel-2**	
3.1	Input Signal type	mA (4-20mA)
3.2	Enable Filter	Disabled
3.3	Low range (4 mA)	0
3.4	High range (20 mA)	1000
3.5	Calibration Constant	Disabled
3.6	Calibration Constant Value	1*100
4.	**RTD Channel**	
4.1	Temperature Unit	ºC

Table-5: Default configuration for SmartBox

6. MODBUS Registers for Reading Measured Parameters

Parameters from SmartBox can be read via MODBUS protocol in both signed integer and float data formats.

6.1 MODBUS Registers for reading measured parameters in signed integer format

MODBUS Register Address	Measured Parameter	Register Length (bits)	Register Type	Parameters Type
0	Temperature (Resolution 0.1C)	16	Read only	Signed Integer
1	Analog Channel-1 Parameter	16	Read only	Signed Integer
2	Analog Channel-2 Parameter	16	Read only	Signed Integer

Table No: 6.1 – Modbus Addresses for reading parameters via MODBUS RTU

6.2 MODBUS Registers for reading measured parameters in float data format

MODBUS Register Address	Measured Parameter	Register Length (bits)	Register Type	Parameters Type
20	Temperature (Resolution 0.1C)	32	Read only	Float
22	Analog Channel-1 Parameter	32	Read only	Float
24	Analog Channel-2 Parameter	32	Read only	Float

Table No: 6.2 – Modbus Addresses for reading parameters via MODBUS Float

7. Configuration – SmartBox Communication Parameters

Configuration details of MODBUS communication parameters are provided here.

7.1 Register Addresses for MODBUS Communication Parameters

MODBUS Register Address	Parameter	Default Values	Length (bits)	Register Type	Parameters Type
100	MODBUS ID 1<ID<247	1	16	Read/Write	Unsigned Integer
101	Baud rate 0=4800; 1=9600; 2=19200	1	16	Read/Write	Unsigned Integer

102	Parity 0=None; 1=Odd; 2=Even	0	16	Read/Write	Unsigned Integer
103	Stop bits 1 (only stop bit 1 setting is allowed)	1	16	Read/Write	Unsigned Integer
104	Save communication parameters	0	16	Write only	Unsigned Integer

Table No: 7.1 – Modbus communication parameters

Note: To save the communication parameters, write '1' in register 104 else the settings will not be saved.

7.2 Configuration of MODBUS Communication Parameters

Example is provided below for setting following communication parameters for the SmartBox.

Modbus ID: 10
Baud rate: 19200
Parity: Even
Stop Bit: 2

Step-1: Connect the SmartBox to the Modbus Master Software with the default settings.

Step-2: Set the following in the MODBUS Master:
Function: Write Multiple Registers
Starting Address: 100
Number of registers: 5
Data Type: 16 bits Integer

Step-3: Set the communication parameters as per your requirement. (See example settings)

MODBUS Register Address	Parameter	Parameter Value
100	MODBUS ID	10 (Modbus ID=10)
101	Baud rate	2 (Baud Rate = 19200)
102	Parity	2 (Parity = Even)
103	Stop bits	1 (Stop Bit = 1)
104	Save	1 (Save)

Table No: 7.2 – Modbus communication parameter configuration

Notes:

i) To save the communication parameters, write 1 in register 104 else the settings will not be saved.

ii) Please note that writing single register is not allowed. All the registers are to be written in one MODBUS write command.

Step-4: After all the parameters are set in MODBUS Master, write the same to the SmartBox. The SmartBox will stop communication and restart again with modified parameters.

Step-5: Connect to SmartBox using the modified MODBUS communication parameters in the MODBUS Master that is set in Step-3. The SmartBox will start communicating.

Step-6: Configured communication parameters can be verified by reading the communication MODBUS registers (100 to 103) of the SmartBox.

7.3 Setting Default MODBUS Communication Parameters

Procedure for re-setting default communication parameters is as follows.

Step-1: Switch Off the power supply of the SmartBox.
Step-2: Open the SmartBox cover for gaining access to the PCB.
Step-3: Locate the Jumper JP1 in the PCB.

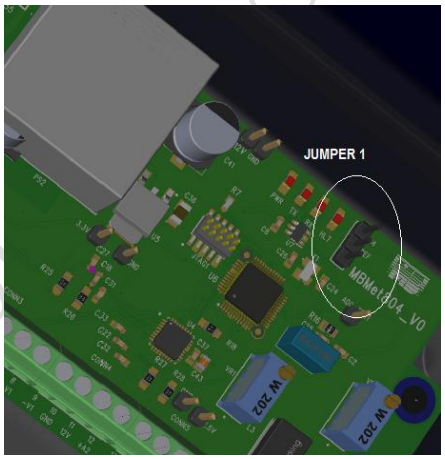

Fig – 7.2: Position of Jumper-1 in board

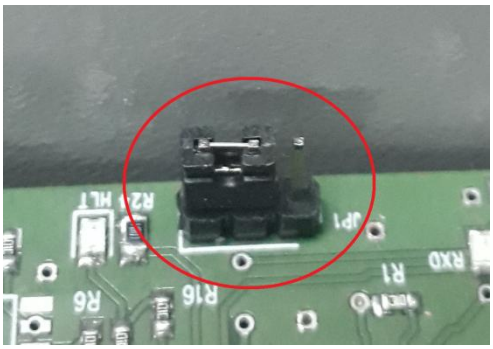
Fig – 7.3: Jumper position (factory setting)

Step-4: Change the jumper position from Fig 7.1 to Fig 7.3

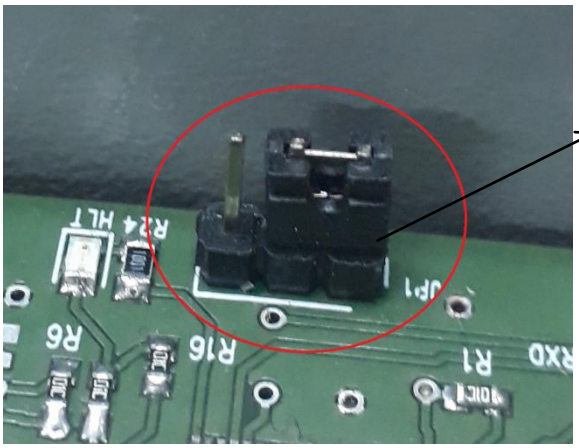

Fig – 7.4: Jumper position (for factory resetting)

Step-5: Switch On power supply, wait for 30 sec and switch off the power supply
Step-6: Reconnect the jumper in the original factory position as in Fig 7.2
Step-7: Close the transducer cover securely

The transducer is reset to it's factory settings. It can now be reconfigured according to requirement.

8. Configuration – SmartBox Analog Channels

Configuration details for analog channels of SmartBox are provided here.

MODBUS Register Address	Parameter	Length (bits)	Register Type	Parameters Type
Analog input Channel-1				
120	Signal input Type 0= 4-20mA 1= Differential 20 mV 2= Differential 50 mV 3= Differential 100 mV 4= Differential 1000 mV	16	Read/Write	Unsigned Integer
121	Averaging Time (seconds) 1- 600 seconds (v)	16	Read/Write	Unsigned Integer
122	Signal low scaling range	16	Read/Write	Signed Integer
123	Signal high range	16	Read/Write	Signed Integer
124	Enable Calibration constant	16	Read/Write	Unsigned Integer
125	Calibration constant * 100 (i)	16	Read/Write	Unsigned Integer
126	Save AI-1 configuration (Write 1)	16	Write Only	Unsigned Integer
Analog input Channel-2				

127	Signal input Type 0= 4-20mA 1= Differential 20 mV 2= Differential 50 mV 3= Differential 100 mV 4= Differential 1000 mV	16	Read/Write	Unsigned Integer
128	Averaging Time (seconds) 1- 600 seconds (v)	16	Read/Write	Unsigned Integer
129	Signal low scaling range	16	Read/Write	Signed Integer
130	Signal high range	16	Read/Write	Signed Integer
131	Enable Calibration constant	16	Read/Write	Unsigned Integer
132	Calibration constant *100 (i)	16	Read/Write	Unsigned Integer
133	Save AI-2 configuration (Write 1)	16	Write Only	Unsigned Integer
RTD Channel				
134	Temperature Unit 0 = ^{o}C 1 = ^{o}K 2 = ^{o}F	16	Read/Write	Unsigned Integer
135	Averaging Time (seconds) 1- 600 seconds (v)	16	Read/Write	Unsigned Integer
136	Save RTD configuration parameters	16	Write only	Unsigned Integer

Table No: 8.1 – Analog input channel configuration

Note:

i) Calibration constant is user defined and shall be used for calculation if the same is enabled. Calibration constant is 16 bits unsigned integer with range 1.00 to 655.34. If calibration constant is enabled, range parameters for the channel are not used. Calculation is then done as shown below in (ii).

ii) Calculated value = mv input*1000/calibration constant. Applicable only for mV channels.

iii) Care should be taken that input mv and calibration constant do not result in overflow in calculated integer value (16 bits signed value). If this happens – calculated values should be read using float registers.

iv) To save the configuration parameters, write 1 in register 118 else the settings will not be saved.

v) Measured values will be averaged for configured time in seconds. Averaged valued will available via MODBUS slave registers.

9. SmartBox Hardware Information

Hardware details of SmartBox can be read via MODBUS registers as per details provided below.

MODBUS Register Address	Parameter	Length (bits)	Register Type	Parameters Type
110	Device Model No AC PS and PT100 - 14480 AC PS and PT1000 - 14481 DC PS and PT100 - 14482 DC PS and PT1000 - 14483	16	Read only	Unsigned Integer
111	Hardware Version	16	Read only	Unsigned Integer
112	Software Version	16	Read only	Unsigned Integer
113	Manufacture Year	16	Read only	Unsigned Integer
114	Device Serial number	16	Read only	Unsigned Integer

Table No: 9.1 – SmartBox hardware details read registers