GOODBURN

SIGMA DATA ACQUISITION SYSTEM INSTALLATION MANUAL

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1 SIGMA 300 PRODUCT DESCRIPTION

The Sigma 300 series are a family of measurement and control modules developed for industrial and scientific data acquisition applications. A number of module types are available to offer a variety of analogue and digital measurements. The modules communicate with a host computer using the RS485 and RS232 data transmission standards. Up to 99 modules can be connected to a screened twisted pair cable.

The analogue modules contain a high precision auto-ranging integrating A-D converter and precision signal conditioning circuitry. The converter can be programmed to integrate input signals to be measured over one complete mains cycle period. This can be set up for 50 or 60 Hz. This allows the measurement process to reject large amounts of mains borne interference superimposed on microvolt signals. Measurement conversion resolutions of 13 to 19/20 bits are supported.

A local serial interface port on each module can be used for installation, configuration and troubleshooting purposes. Sigma 300 modules do not use configuration switches or internal manual calibration adjustments. All the module's programmed configuration including network address, communication baud rates, measurement types, alarm levels and calibration parameters may be set remotely.

All set up and data acquisition operations are controlled by IDAS data acquisition software running under Windows. Programmed configuration and calibration parameters are stored in non-volatile EEPROM so that all programmed parameters are retained in the event of a power failure.

Generally calibration is only required at 3 year intervals in applications where specified accuracy is important. Calibration can be achieved by connecting a calibrator to the first channel on the module and then sending a simple sequence of commands. No internal access is required.

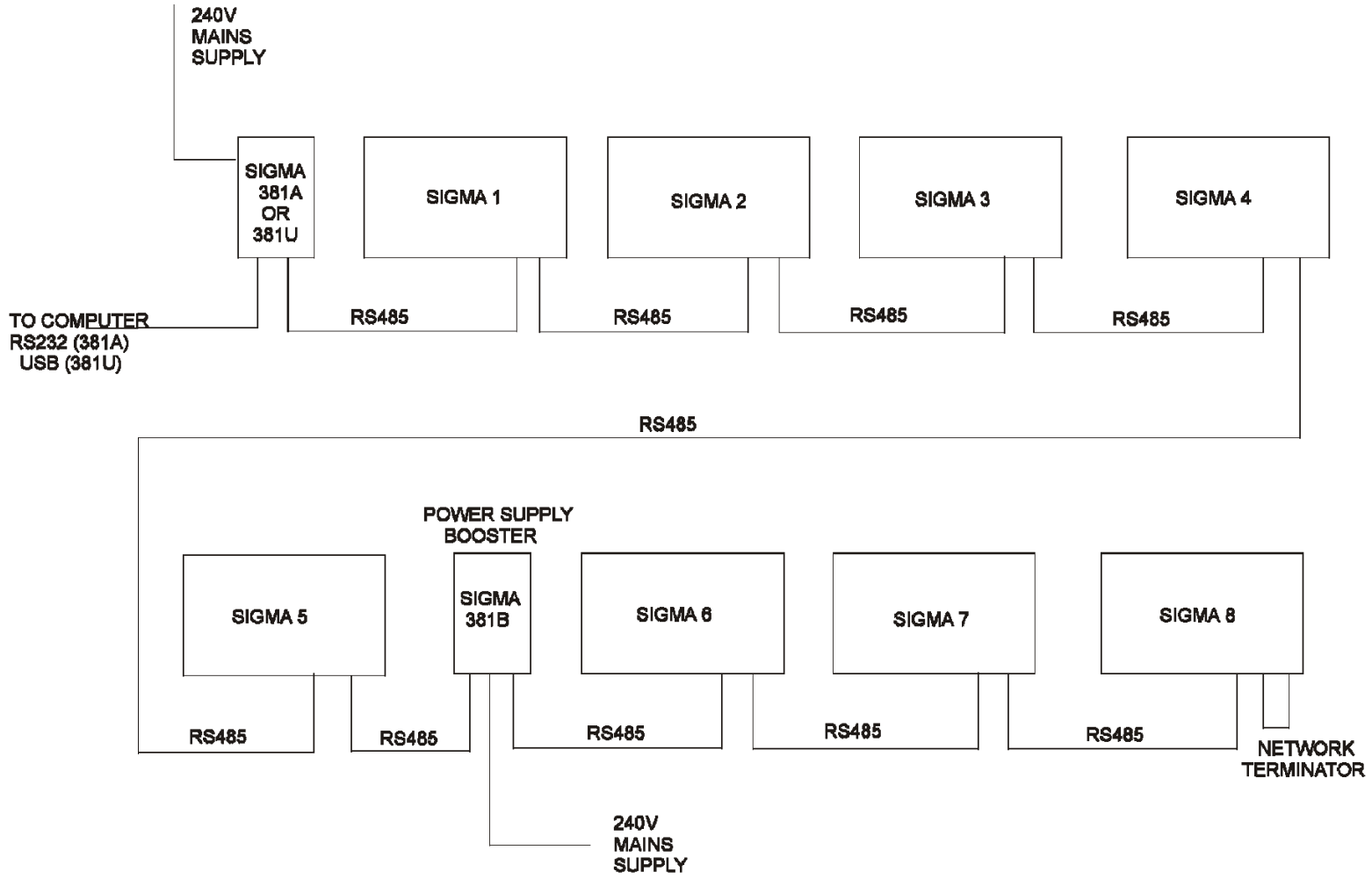
1.1 SYSTEM REQUIREMENTS

The following list gives an overview of the hardware required to set-up a typical Alpha 300 system for use with a PC compatible host. In addition to the Sigma modules themselves:

1. A desktop or laptop PC running Windows 2000, XP or NT, with an unused RS232 COM port, with IDAS and Hyperterminal software installed.
2. A Sigma 381a network power supply/RS485-RS232 converter
3. A sigma 381b slave power supply for systems with more than 5 Sigma modules connected.

The sigma modules should be connected as in figure 1.

FIGURE 1 - SIGMA MODULE CONNECTION DETAILS



2 *INSTALLATION*

2.1 Module network address

Before installing a Sigma 300 module or connecting it an existing network, the module should be programmed with a unique network address. Network addresses should be in the range 01 to 99. A unit's network address can be set via the local RS232 connection using Hyperterminal software that is usually available within Windows, or by using IDAS software.

2.1.1 Setting network address with Hyperterminal

To set the network address using the local RS232 connection :-

1. Connect the Sigma module to the Sigma 381A or 381U power supply unit using a Sigma network cable.
2. Connect the local RS232 socket on the Sigma module to a spare RS232 input on the PC.
3. Plug in and switch on the mains power to the Sigma 381 module. The Power LED on the Sigma module should light up.
4. On the PC, select START – All programs – accessories – communications – HYPERTERMINAL
5. Select FILE – Properties
6. Set the COM port to the computers RS232 port number (COM1, COM2 etc)
7. Click on the CONFIGURE box
8. Set Bits per second to 9600
9. Set Data bits to 8
10. Set Parity to EVEN
11. Set Stop Bits to 1
12. Set Flow Control to NONE
13. Click on OK
14. Select FILE – SAVE and save these settings (e.g. name SIGMASETUP)
15. Click on the CALL logo to connect with the Sigma module.

You are now connected to the Sigma module through its local RS232 interface. To set the module's network address :-

1. Type ADxx (where xx is the required 2 digit network address.)
2. Type SA

This changes the network address of the module and saves it to EEPROM memory. The network address can be recorded in the square provided on the module label.

To disconnect from the RS232 interface, just click on the DISCONNECT icon.

2.1.2 Local Serial Interface specification:

The local serial interface is not strictly RS232 standard as it operates on 5 volt rails. It is however compatible with the RS232 port of standard PCs and terminals.

Signals	Rx Tx Gnd
Signal levels	+-4.5V
Baud rates	9K6 (default) 19K2, 38K4
Character format	Asynchronous 8 bits , even parity , one stop bit.
Connector	High quality cage clamp two part screw terminal
Maximum cable length	10m
Recommended cable type	Not critical

2.1.3 Setting network address with IDAS

To set a module's network address using IDAS :-

1. Connect the Sigma module to the Sigma 381A or 381U power supply unit using a Sigma network cable.
2. Connect the RS232 cable between the Sigma 381A module and the PC or connect the 381U USB cable to the PC.
3. Plug in and switch on the mains power to the Sigma 381 module. The Power LED on the Sigma module should light up.
4. Run IDAS on the PC.
5. Select DEVICES – SIGMA
6. Double click on the first line of the resulting table (SA1-20)
7. Click on the MODULE TYPE box and sent this to suit the Sigma module being addressed.
8. Click on the SET box next to ADDRESS
9. Enter the serial number of the Sigma module being addressed (the serial number is printed on a silver label on the unit).
10. Tick the AUTO SET MODULE ADDRESS box
11. Enter the required network address in the relevant box
12. Click SET NOW and IDAS will change the sigma modules network address as requested.

2.2 Installing modules.

The Sigma 300 modules should be placed as close to the sensors as is practical. This will keep cabling lengths to a minimum which is beneficial for reducing the effects of electrical interference as well as keeping installation costs to a minimum.

For each module the channel connections are shown on the module label. They are colour coded against the type of sensor to be connected. In the section on each module a connection list is given to aid the documentation of plant wiring and to clarify the label legend. The terminal numbers are embossed in the case.

2.2.1 Environmental Considerations

The following environmental conditions should be observed:

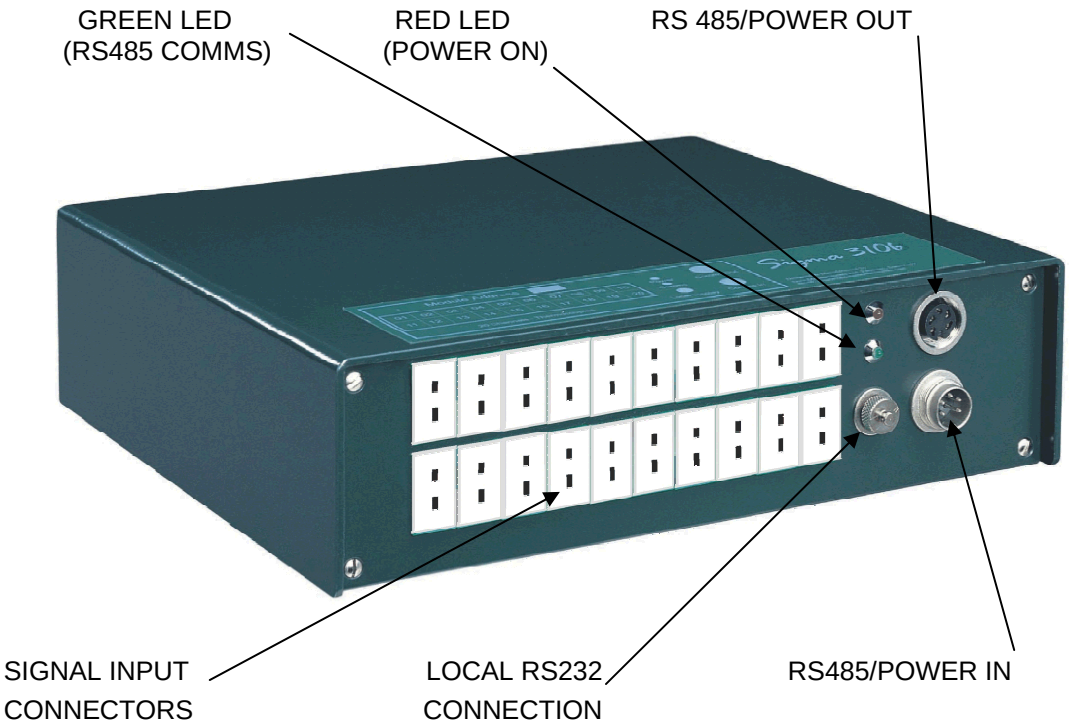
Operating temperature range	-20 to 60'C
Relative humidity	<90% 0-40'C
Vibration	3g 0-400 Hz in three planes

The Sigma modules are housed in a robust Aluminium case. High quality cage clamp two part screw terminations are used for most user connections except on thermocouples. The Sigma 310 module has connectors designed for thermocouple termination with integral cold junction compensation. These are not two part for maximum accuracy.

2.2.3 EMC Considerations

Where the application is at a location with the possibility of large Electromagnetic fields, radiated or conducted interference, channel input connections to sensors may require screened cable in cases where conducted common mode interference exceeds 2 volts peak to peak on channel wiring at the channel input connectors. In this case the screen should be connected to the enclosure metalwork as close to the point of entry as is practical. If the sensor is isolated the screen should be also connected to the -ve signal line at the sensor.

FIGURE 2 : SIGMA MODULE CONNECTIONS



2.3 Wiring and termination

The Sigma modules should be set up as shown in figure 1. Connections between modules use an RS485 network and these cables also carry the module power supply. Connections between modules are made using the front panel connectors shown in Figure 2. The RS485 network can extend to a total length of 1.2Km.

Any cable can be used for the RS485/power supply connection that has 2 twisted pairs of signal conductors within an overall screen. The characteristic impedance should be 100 Ohm. Low loss cable is recommended for use at higher baud rates over large distances. Belden cable type 9207 is recommended for networks over 300m Belden type 8761 (UL2092) is suitable for up to 300m runs. The total maximum length of the cable connected to all modules should be less than 1.2Km

Up to 99 modules can be connected to the network each of which must be first programmed with a unique network address (see section 2.1) unless the default addresses as shipped are satisfactory for the application.

APPENDIX 1 : SIGMA 310 THERMOCOUPLE MODULE

This module provides 20 channels of screw terminal connected voltage and thermocouple measurement. It is fitted with specialised thermocouple terminals with integral cold junction compensation, which will allow an accuracy of 0.5'C to be achieved on the higher output thermocouple types. Thermocouples supported include most popular types used in the industry.

Thermocouple health monitoring is a standard feature and errors can be reported when a thermocouple breaks or deteriorates. Thermocouple measurements may be referenced to an external cold junction if required.

The Sigma 310 is also available with pre wired connectors for common thermocouple types and for DC voltage measurements, for example :

Sigma 310A : 20 connector inputs for type K thermocouple
Sigma 310B : 20 connector inputs for DC voltage measurement

Specification

Number of channels / module	20
Connector type input channels	Isothermal screw terminal
Measurement Modes	uV DC mV DC Thermocouple Ambient temperature Thermocouple Sensor Health
Thermocouple Types	K, J, T, R, S, E, B, N
Thermocouple compensation	Dual sensors
Thermocouple condition detection	By resistance measurement

A-D Converter and Voltage Specification

Refer to appendix 5 for specifications.

Thermocouple measurement accuracy with internal CJC

Type	Range 'C	Accuracy 'C	Type	Range 'C	Accuracy 'C
K	-100 to 500	0.5	R	0 to 1600	2.0
	+500 to 1200	0.8			
	1200 to 1600	4.0	S	0 to 1700	2.2
J	-50 to 360	0.5	E	-50 to 290	0.7
	360 to 800	0.8		290 to 1000	1.0
T	-150 to 400	0.5	B	200 to 1600	4.5
			N	-200 to -100	1.3
				-100 to 580	1.1
				580 to 1300	1.3

Displayed Sensitivity 0.1'C

Ambient temperature measurement

Range	0-60'C
Accuracy	1.5'C
Resolution	0.1'C

Status LEDS

Function	Red : Power Green : Communication RS485

Thermocouple Health Monitoring

The resistance of thermocouples can be monitored in the background automatically by this module. This is enabled by issuing the CI command directed at the channels requiring this function. The CR command will discontinue this function. An error message 107 will be returned in the result field of any channel that has an unacceptably high resistance indicating a deteriorating thermocouple.

Module channel connections

The following list is provided for plant wiring documentation. The terminal numbers are embossed in the plastic case.

Terminal	Function	Terminal	Function
1 - CHANNEL 1	'+' INPUT	31 - CHANNEL 11	'-' INPUT
2 - CHANNEL 1	'-' INPUT	32 - CHANNEL 11	'+' INPUT
3 - CHANNEL 2	'+' INPUT	33 - CHANNEL 12	'-' INPUT
4 - CHANNEL 2	'-' INPUT	34 - CHANNEL 12	'+' INPUT
5 - CHANNEL 3	'+' INPUT	35 - CHANNEL 13	'-' INPUT
6 - CHANNEL 3	'-' INPUT	36 - CHANNEL 13	‘+' INPUT
7 - CHANNEL 4	'+' INPUT	37 - CHANNEL 14	'-' INPUT
8 - CHANNEL 4	'-' INPUT	38 - CHANNEL 14	'+' INPUT
9 - CHANNEL 5	'+' INPUT	39 - CHANNEL 15	'-' INPUT
10 - CHANNEL 5	'-' INPUT	40 - CHANNEL 15	'+' INPUT
11 - CHANNEL 6	'+' INPUT	41 - CHANNEL 16	'-' INPUT
12 - CHANNEL 6	'-' INPUT	42 - CHANNEL 16	'+' INPUT
13 - CHANNEL 7	'+' INPUT	43 - CHANNEL 17	'-' INPUT
14 - CHANNEL 7	'-' INPUT	44 - CHANNEL 17	‘+' INPUT
15 - CHANNEL 8	'+' INPUT	45 - CHANNEL 18	'-' INPUT
16 - CHANNEL 8	'-' INPUT	46 - CHANNEL 18	'+' INPUT
17 - CHANNEL 9	'+' INPUT	47 - CHANNEL 19	'-' INPUT
18 - CHANNEL 9	'-' INPUT	48 - CHANNEL 19	'+' INPUT
19 - CHANNEL 10	'+' INPUT	49 - CHANNEL 20	'-' INPUT
20 - CHANNEL 10	'-' INPUT	50 - CHANNEL 20	'+' INPUT

General wiring considerations:

Refer to section 2 for installation information.

APPENDIX 2 : SIGMA 311 VOLTAGE AND CURRENT INPUT MODULE

The Sigma 311 provides 20 screw terminal connected channels for voltage and current measurement. Internal current shunts can be connected across the inputs for measuring 4-20mA current loops. The number of channels committed to current measurement using these internal shunts is normally determined when the module is built and shipped. External current shunts can be used but accuracy is dependent on integrity of connection and shunt used. To display correctly scaled current measurements the value of these shunts should be 62R.

The Sigma 311 is also available with pre wired connectors for DC Current and DC voltage measurements, for example :

Sigma 311A : 20 connector inputs for DC current measurement
Sigma 311B : 20 connector inputs for DC voltage measurement

Specification

Number of channels / module	20
Connector type input channels	Two part rising cage clamp screw terminal.
Measurement Modes	uV DC mV DC 4-20 mA

A-D Converter and Voltage Specification

Refer to appendix 5 for specifications.

Current measurement

Ranges	4-20 mA (0-100%) 0-20 mA
Accuracy	+-0.13% (using internal shunts)
Resolution	0.3 uA

Status LEDS

Function	Red : Power Green : Communication RS485

Connection details

The following list is provided for plant wiring documentation. The terminal numbers are embossed in the plastic case.

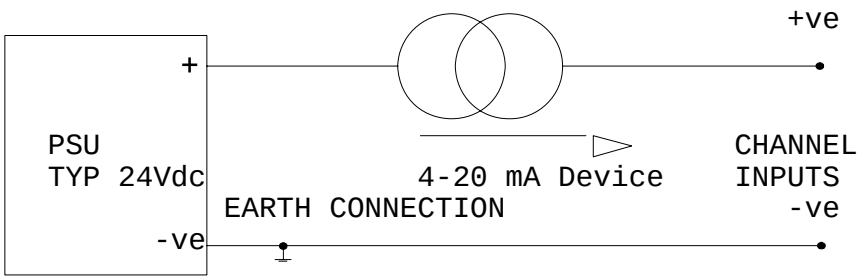
Terminal	Function	Terminal	Function
1 - CHANNEL 1	'+' INPUT	31 - CHANNEL 11	'-' INPUT
2 - CHANNEL 1	'-' INPUT	32 - CHANNEL 11	'+' INPUT
3 - CHANNEL 2	'+' INPUT	33 - CHANNEL 12	'-' INPUT
4 - CHANNEL 2	'-' INPUT	34 - CHANNEL 12	'+' INPUT
5 - CHANNEL 3	'+' INPUT	35 - CHANNEL 13	'-' INPUT
6 - CHANNEL 3	'-' INPUT	36 - CHANNEL 13	'+' INPUT
7 - CHANNEL 4	'+' INPUT	37 - CHANNEL 14	'-' INPUT
8 - CHANNEL 4	'-' INPUT	38 - CHANNEL 14	'+' INPUT
9 - CHANNEL 5	'+' INPUT	39 - CHANNEL 15	'-' INPUT
10 - CHANNEL 5	'-' INPUT	40 - CHANNEL 15	'+' INPUT
11 - CHANNEL 6	'+' INPUT	41 - CHANNEL 16	'-' INPUT
12 - CHANNEL 6	'-' INPUT	42 - CHANNEL 16	'+' INPUT
13 - CHANNEL 7	'+' INPUT	43 - CHANNEL 17	'-' INPUT
14 - CHANNEL 7	'-' INPUT	44 - CHANNEL 17	'+' INPUT
15 - CHANNEL 8	'+' INPUT	45 - CHANNEL 18	'-' INPUT
16 - CHANNEL 8	'-' INPUT	46 - CHANNEL 18	'+' INPUT
17 - CHANNEL 9	'+' INPUT	47 - CHANNEL 19	'-' INPUT
18 - CHANNEL 9	'-' INPUT	48 - CHANNEL 19	'+' INPUT
19 - CHANNEL 10	'+' INPUT	49 - CHANNEL 20	'-' INPUT
20 - CHANNEL 10	'-' INPUT	50 - CHANNEL 20	'+' INPUT

General wiring considerations

Refer to section 2 for installation information.

Input connections for 4-20mA devices

Recommended current loop arrangement:



It is advisable to connect the -ve of the PSU to ground potential to avoid the possibility of the input terminal voltage ratings being exceeded either by the loop supply voltage or by capacitively coupled AC common mode voltages.

APPENDIX 3 : SIGMA 312 RTD, RESISTANCE AND VOLTAGE INPUT MODULE

The Sigma 312 provides 10 channels of RTD, resistance, full bridge strain or voltage measurement and can be used to measure standard Platinum RTD in 2, 3 or 4 wire configurations. The resistance mode can also be used for thermistors and other resistive transducers. The energising current for resistance and strain gauge measurements is pulsed therefore reducing errors due to heating effects of the sensors.

The Sigma 312A is also available with pre wired connectors for all the above measurements as well as an internal 24Vdc power supply for loop powered 4-20mA sensors.

Specification

Number of channels / module	10
No of poles / channel	4
Connector type input channels	Two part ,high quality cage clamp screw terminal.
Measurement Modes	uV DC mV DC Resistance 2 terminal Resistance 4 terminal PT 100 3 terminal PT 100 4 terminal Full bridge strain (120 or 350R bridges)

A-D Converter and Voltage Specification

Refer to appendix 5 for specifications that are common to other module types.

Resistance measurement

Measurement ranges	2 KOhm 256 Ohm 32 Ohm
Sensing current	<0.75 mA (switched)
Accuracy	0.03% rdg +0.015% rng +3 mOHM

RTD Measurement PT100

Accuracy	-50 to 400'C +/-0.2'C -150 to 600'C +/-0.4'C

Full bridge strain measurement

350 OHM Bridges	
Accuracy full bridge (repeatability)	10 uE
Sensitivity	0.4 uE (1 active gauge factor = 2)
Energisation	5 mA pulsed
120 OHM Bridges	
Accuracy full bridge(repeatability)	20 uE
Sensitivity	1.2 uE (1 active gauge factor =2)
Energisation	5 mA pulsed

Status LEDS

Function	Red : Power Green : Communication RS485

Connection details

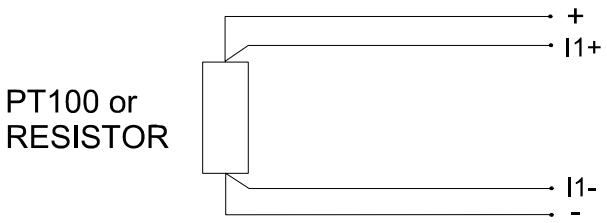
The following list is provided for plant wiring documentation. The terminal numbers are embossed in the plastic case. The termination function is shown for each type of measurement.

Terminal		Voltage	PRT 4-wire	PRT 3-wire	Strain
1 -	CHANNEL 1	'+' INPUT	'+' INPUT	'+' INPUT	'+' INPUT
2 -	CHANNEL 1	'-' INPUT	I1+	I1+	I3+
3 -	CHANNEL 1	N/C	I1-	I1-/I2-	'-' INPUT
4 -	CHANNEL 1	N/C	'-' INPUT,	'-'INPUT/I2+	I3-
5 -8	CHANNEL 2	AS CHANNEL 1 ABOVE			
9-12	CHANNEL 3	AS CHANNEL 1 ABOVE			
13-16	CHANNEL 4	AS CHANNEL 1 ABOVE			
17-20	CHANNEL 5	AS CHANNEL 1 ABOVE			
21 -	CHANNEL 6	N/C	'-' INPUT	'-' INPUT	I3-
22 -	CHANNEL 6	N/C	I1-	I1-/I2-	'-' INPUT
23 -	CHANNEL 6	'-' INPUT	I1+	I1+	I3+
24 -	CHANNEL 6	'+' INPUT	'+' INPUT,	'+' INPUT	'+' INPUT
25-28	CHANNEL 7	AS CHANNEL 6 ABOVE			
29-32	CHANNEL 8	AS CHANNEL 6 ABOVE			
33-36	CHANNEL 9	AS CHANNEL 6 ABOVE			
37-40	CHANNEL 10	AS CHANNEL 6 ABOVE			

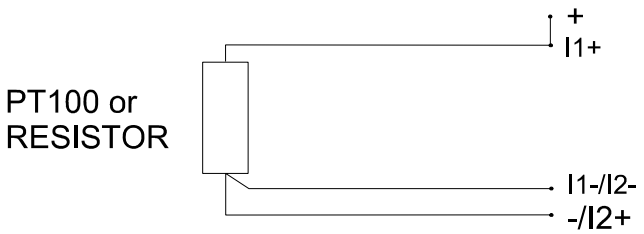
General wiring considerations

Refer to section 2 for installation information.

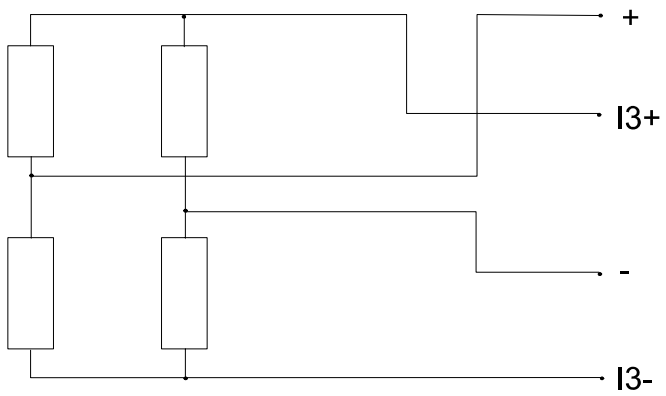
4 Wire PRTConnection



3 Wire PRTConnection



Full Bridge Strain Gauge Connection



Full Bridge Strain measurement

The strain is calculated from the resistive change of the active arm. The energising current is 5mA. One active arm and a gauge factor of 2 is assumed. The channel scale function can be used to allow for the actual gauge factor and also for additional active gauges in the bridge.

APPENDIX 4: SIGMA 314 VOLTAGE AND STRAIN GAUGE INPUT MODULE

The 314 module provides 16 three-pole channels, which can be used for voltage or current measurement at up to 19 bit resolution and 1uV integrity. Pairs of these channels can be combined to make strain gauge measurements with six poles. Full, half and quarter bridge strain measurements on 359 ohm or 120 ohm bridges are supported. The measurement resolution of a 350 bridge with two active gauges can be as high as 0.1uE. Strain gauge bridge excitation is constant voltage with full remote sensing to eliminate lead and connector resistance errors. The bridge supply is directly derived from the A-D reference so that the effect of drift in these circuits does not affect measurement accuracy. Initial bridge unbalance can be compensated for. The bridge voltage for strain gauge measurements is pulsed therefore reducing errors due to heating effects of the sensors. It is also applied symmetrically about the bridge so that the measurement leads across the bridge are kept close to 0V and do not have to charge up to make a measurement. This improves the performance and eliminates cable dielectric secondary storage effects which can otherwise cause measurement errors.

Specification

Number of channels / module	16
Number of 6 pole channels	up to 8
Number of 3 pole channels	up to 16
Connector type input channels	Two part screw terminal. High quality cage clamp.
Measurement modes	uV DC mV DC ¼ bridge strain ½ bridge strain full bridge strain

A-D Converter

Five measurement resolutions are supported:	19 bits at 10 measurements per second 18 bits at 20 measurements/s 17 bits at 40 measurements/s 15 bits at 100 measurements/s 13 bits at 200 measurements/s

In addition a channel filter function can be applied to any channel.

Voltage measurement

Input voltage ranges	+10V >-10V +1.5V >-1.5V +180mV >-180mV +23mV >-23mV

Automatic range selection is supported.

DC measurement accuracy +/- 0.015% of reading + 0.01% of range + 6uV

Temperature coefficients DC voltage	25ppm rdg + 0.1uV/^{o}C
Measurement sensitivity	<0.25uV on +23mV>-23mV range at 18 bits

(Note: displayed sensitivity depends on reporting format)

Additional error at 200/sec mode	0.05% of range

Strain measurement

Bridge Configurations	Full 120R Half 120R Full >=350R Half >=350R Quarter External Dummy
Bridge supply	Voltage remote sensed
Bridge voltage	1.7V to 5.0V depending on mode

Accuracy	350R Full	0.05%rdg+3uE	
	350R Half	0.05%rdg+5uE	
	120R Full	0.05%rdg+6uE	
	120R Half	0.05%rdg+5uE	
Measurement repeatability 24Hrs		2uE	
Sensitivity	350R Half, Full, 120R half	0-7000uE	0.1uE
		7000-12000uE	0.8uE
	120R full bridge	0-10000uE	0.2uE

Temperature coefficient	350R Full	0.003%rdg/ ºC
	350R Half	0.003%rdg+2uE/ ºC
	120R Half	0.003%rdg+2uE/ ºC
	120R Full	0.003%rdg/ 'C

(Accuracies are stated for gauge factor 2, 2 active gauges, 18 bit ADC,at 23'C for 1Yr)

Interference rejection

AC Common mode rejection ratio channel group	<0.1uV/V
AC Single channel common mode rejection ratio	<1uV/V
DC channel common mode rejection ratio	<5uV.V
AC series mode rejection ratio 50 or 60 Hz +/- 0.05% Applies to 17,18,19 bit measurements	<1mV/V

Maximum voltages operating:	
Maximum voltage between any (+) and all (-) inputs	12V
Maximum voltage between any two (-) input terminals	11V
Maximum Voltage between any two terminals	22v

Overload protection

Channel overload protection	Passive 50V continuous 150V for short periods

Isolation

Isolation test voltage between channel group and power supply or RS485	Tested at 1500V.
Input current of instrumentation amplifier	5nA
Input impedance of operating	>10m 0-12V

Status LEDS

Function	Red : Power Green : Communication RS485

Connection details

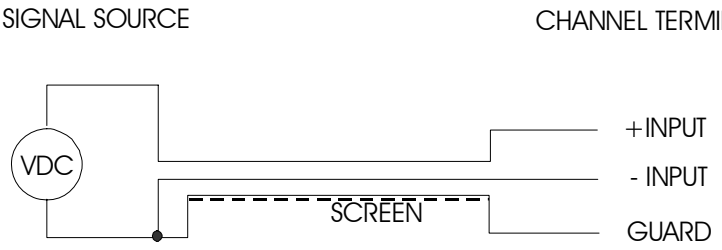
The following list is provided for plant wiring documentation. The terminal numbers are embossed in the plastic case.

				MEASUREMENT TYPE	
				VOLTAGE	**STRAIN**
		(V)	**(S)**		
TERMINAL 1	CHANNEL	1	1	+ INPUT	+ INPUT
TERMINAL 2	CHANNEL	1	1	- INPUT	+ SENSE
TERMINAL 3	CHANNEL	1	1	GUARD	+ ENERGISATION
TERMINAL 4	CHANNEL	2	1	+ INPUT	- INPUT
TERMINAL 5	CHANNEL	2	1	- INPUT	- SENSE
TERMINAL 6	CHANNEL	2	1	GUARD	- ENERGISATION
TERMINAL 7	CHANNEL	3	3	+ INPUT	+ INPUT
TERMINAL 8	CHANNEL	3	3	- INPUT	+ SENSE
TERMINAL 9	CHANNEL	3	3	GUARD	+ ENERGISATION
TERMINAL 10	CHANNEL	4	3	+ INPUT	- INPUT
TERMINAL 11	CHANNEL	4	3	- INPUT	- SENSE
TERMINAL 12	CHANNEL	4	3	GUARD	- ENERGISATION
TERMINAL 13	CHANNEL	5	5	+ INPUT	+ INPUT
TERMINAL 14	CHANNEL	5	5	- INPUT	+ SENSE
TERMINAL 15	CHANNEL	5	5	GUARD	+ ENERGISATION
TERMINAL 16	CHANNEL	6	5	+ INPUT	- INPUT
TERMINAL 17	CHANNEL	6	5	- INPUT	- SENSE
TERMINAL 18	CHANNEL	6	5	GUARD	- ENERGISATION
TERMINAL 19	CHANNEL	7	7	+ INPUT	+ INPUT
TERMINAL 20	CHANNEL	7	7	- INPUT	+ SENSE
TERMINAL 21	CHANNEL	7	7	GUARD	+ ENERGISATION
TERMINAL 22	CHANNEL	8	7	+ INPUT	- INPUT
TERMINAL 23	CHANNEL	8	7	- INPUT	- SENSE
TERMINAL 24	CHANNEL	8	7	GUARD	- ENERGISATION
TERMINAL 31	CHANNEL	9	9	+ INPUT	+ INPUT
TERMINAL 32	CHANNEL	9	9	- INPUT	+ SENSE
TERMINAL 33	CHANNEL	9	9	GUARD	+ ENERGISATION
TERMINAL 34	CHANNEL	10	9	+ INPUT	- INPUT
TERMINAL 35	CHANNEL	10	9	- INPUT	- SENSE
TERMINAL 36	CHANNEL	10	9	GUARD	- ENERGISATION
TERMINAL 37	CHANNEL	11	11	+ INPUT	+ INPUT
TERMINAL 38	CHANNEL	11	11	- INPUT	+ SENSE
TERMINAL 39	CHANNEL	11	11	GUARD	+ ENERGISATION
TERMINAL 40	CHANNEL	12	11	+ INPUT	- INPUT
TERMINAL 41	CHANNEL	12	11	- INPUT	- SENSE
TERMINAL 42	CHANNEL	12	11	GUARD	- ENERGISATION
TERMINAL 43	CHANNEL	13	13	+ INPUT	+ INPUT
TERMINAL 44	CHANNEL	13	13	- INPUT	+ SENSE
TERMINAL 45	CHANNEL	13	13	GUARD	+ ENERGISATION
TERMINAL 46	CHANNEL	14	13	+ INPUT	- INPUT
TERMINAL 47	CHANNEL	14	13	- INPUT	- SENSE
TERMINAL 48	CHANNEL	14	13	GUARD	- ENERGISATION
TERMINAL 49	CHANNEL	15	15	+ INPUT	+ INPUT
TERMINAL 50	CHANNEL	15	15	- INPUT	+ SENSE
TERMINAL 51	CHANNEL	15	15	GUARD	+ ENERGISATION
TERMINAL 52	CHANNEL	16	15	+ INPUT	- INPUT
TERMINAL 53	CHANNEL	16	15	- INPUT	- SENSE
TERMINAL 54	CHANNEL	16	15	GUARD	- ENERGISATION

Connection Diagrams

Voltage input connection

For measurement of microvolt signals in the presence of common mode interference, the following connection scheme is recommended.

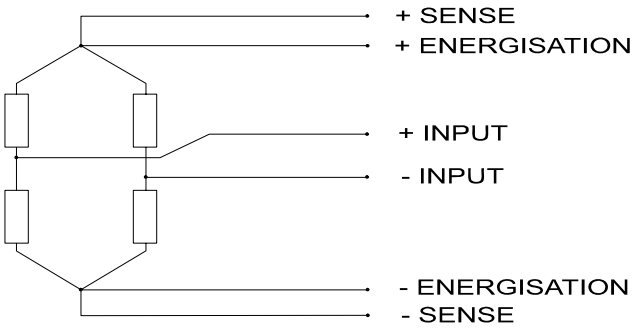


Note the –INPUT is linked to the GUARD channel terminal preferably at the sensor. If screened cable is to be used then the screen is connected to the GUARD channel terminal and again linked to the –INPUT at the sensor. Any induced common mode interference is then carried by the screen conductor alone.

Alternatively, where excessive noise is not a problem or the measured voltages are larger, then the GUARD and –INPUT channel terminals can be linked locally at the module and simple two core cable used.

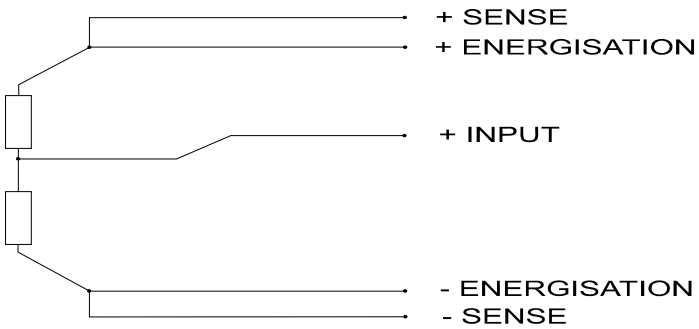
Full Bridge Strain Gauge Connection

The voltage supply to the bridge is sensed at the strain gauges for maximum accuracy. This eliminates the effect of lead and connector resistance on the measured strain. The constant voltage energisation is set by the measurement mode selected and is 1.7V for 120R full bridges and 3V for half bridge and 350R full bridge modes. The firmware assumes one active gauge. Often 2 or even 4 gauges are active in full bridge applications. This double or quadruples the sensitivity and improves accuracy. This can be allowed for using the CB command described below.



Half Bridge Strain Gauge Connection

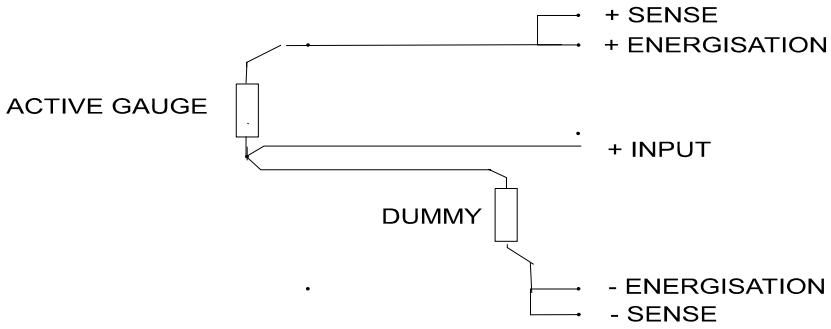
The voltage supply to the half bridge is sensed at the strain gauges for maximum accuracy. This eliminates the effect of lead and connector resistance on the measured strain. The constant voltage energisation is set by the measurement mode selected and is 3V for the half bridge mode. The bridge completion network is internal to the module.



The bridge is completed within the 314 module. The firmware assumes one active gauge. Typically both gauges are active or one is used for temperature compensation. This doubles the sensitivity and improves accuracy. This can be allowed for using the CB command . (See below)

Quarter Bridge Strain Gauge Connection

This arrangement is similar to the half bridge but with the dummy located locally to the 314 for convenience. A three wire connection is taken to the active gauge. The lead resistance between the dummy and the gauge is cancelled by connecting the positive sense directly to the positive energisation locally at the module. If the connecting wires change their resistance with temperature changes, then an equal effect is produced in the top and bottom arms of the bridge and errors are eliminated. The bridge completion network is internal to the module.



The firmware assumes one active gauge, as this is always the case here.

It is possible to share one common dummy with up to 8 channels on a module. The connections from each gauge to the common dummy are made at the dummy and the –ENERGISATION and –SENSE connections from the dummy are connected in parallel to each channel to be used for this strain mode. As strain gauges are invariably isolated from the structures they are sensing, then the common connection between gauges does not normally cause a problem. This arrangement can reduce the number of components and wiring complexity significantly.

If a similar gauge is used for the dummy, and all the gauges including the dummy at the 314 measurement module are in a similar temperature environment, some degree off temperature compensation for the gauges can be maintained even in this configuration. Cable resistance is approximately cancelled with respect to bridge offset but will still have an effect on overall scaling and may need to be taken into account.

APPENDIX 5 : SIGMA 333 DIGITAL INPUT MODULE

Event mode operation

The Sigma 333 module is designed to accurately record digital input changes as they are detected. The module provides 18 fully isolated inputs for timing measurement. The intended application is for monitoring the sequence of events such as trips and control reaction in industrial plant so that alarm or normal operating sequences can be studied. The main function of the 333 is to record changes of inputs against a real time reference. These events are buffered and available to be read into the host computer without risk of missing subsequent events in the process.

If the number of detected events exceeds the buffer capacity then the event recording would 'freeze' preserving these first events encountered. One event is defined as all input changes within the specified debounce interval. (If several channels changed within a 100mS period for example and the debounce interval was set for 100mS for all these channels then this would be recorded in only one event entry in the module's memory. These will be reported together with the same time reference.

Status, counting, frequency and period modes

Input signals are conditioned. Common problems such as contact bounce can be filtered so that multiple events are not recorded on slow mechanical contacts.

Input status mode is available on all channels. Counting and frequency measurement modes are also available on all channels up to a maximum frequency of 400 Hz. On 4 channels the maximum frequency can be 20000 Hz.

Cycle period and interval measurements can be made on 4 channels for improved resolution on low frequency signals. A number of periods can be measured together to return the total elapsed time.

Input channel grouping:

Channels 1 to 10 are referred to as group A.
Channels 11 to 18 are referred to as group B

Specification

Number of inputs per 933 unit	18
Input isolation	Tested for no breakdown at 1500V
Input threshold	4.0V
Input operational range	4.5-24V (4.5-5.5V for 20 KHz functions)
Input current	2 mA @ 5V
Debounce options	1-200 mS (One setting for channels 1-4 in event mode, channels 5-18 in other modes)

Timing function

Event measurement resolution	1 mS
Event registration between 933 units	1 mS using sync connection
Max. input state change rate	800 changes/sec/channel Subject to aggregate maximum of 4000 changes/sec
Buffer capacity for processed events	250 per module

Counting function

Number of channels	18
Max. count value	65535
Max. count rate	400 pulses /sec channels 5-18 at 1:1 mark-space ratio. Subject to aggregate maximum of 2000 /sec 20000 pulses/sec 1:1 mark-space ratio on channels 1 to 4. (independent of above aggregate limit)

Frequency measurement

Gate time	1 sec, 10 sec
Max. input frequency	400 pulses /sec channels 5-18 at 1:1 mark-space ratio. Subject to aggregate maximum of 2000 Hz 20 KHz on channels 1-4 (independent of above aggregate limit)
Accuracy	0.05% reading +- 1 Hz (1 sec gate) 0.05% reading +- 0.2Hz (10 sec gate)
Resolution (max.)	0.1 cycle/sec

Single Period measurement

Number of channels	4 - channels 5-8
Max. cycle period	60 seconds
Measurement resolution	1 mS
Accuracy	0.05% reading +- 1mS

Multiple period measurements

Number of averaged periods	1-100 (common to channels 1-4)
Duration of multiple period	60 seconds max.
Accuracy	0.05% reading +- 1mS
Effective Period resolution (100 periods)	10 uS

Interval measurement

Number of channels	4 - channels 5-8
Max. Interval duration	60 seconds
Measurement resolution	1 mS

Note: Aggregate limit applies to number of input state changes on all input channels in event mode and channels 5-18 in counting and frequency modes taken together.

Status LEDS:

Function	Red : Power /Fault Green : Communication RS485

Connection details

The following list is provided for plant wiring documentation. The terminal numbers are embossed in the plastic case.

Terminal		Function	Terminal	Function
1 -	CHANNEL 1	'+' INPUT	31 - CHANNEL 11	'-' INPUT
2 -	CHANNEL 1	'-' INPUT	32 - CHANNEL 11	'+' INPUT
3 -	CHANNEL 2	'+' INPUT	33 - CHANNEL 12	'-' INPUT
4 -	CHANNEL 2	'-' INPUT	34 - CHANNEL 12	'+' INPUT
5 -	CHANNEL 3	'+' INPUT	35 - CHANNEL 13	'-' INPUT
6 -	CHANNEL 3	'-' INPUT	36 - CHANNEL 13	'+' INPUT
7 -	CHANNEL 4	'+' INPUT	37 - CHANNEL 14	'-' INPUT
8 -	CHANNEL 4	'-' INPUT	38 - CHANNEL 14	'+' INPUT
9 -	CHANNEL 5	'+' INPUT	39 - CHANNEL 15	'-' INPUT
10 -	CHANNEL 5	'-' INPUT	40 - CHANNEL 15	'+' INPUT
11 -	CHANNEL 6	'+' INPUT	41 - CHANNEL 16	'-' INPUT
12 -	CHANNEL 6	'-' INPUT	42 - CHANNEL 16	'+' INPUT
13 -	CHANNEL 7	'+' INPUT	43 - CHANNEL 17	'-' INPUT
14 -	CHANNEL 7	'-' INPUT	44 - CHANNEL 17	'+' INPUT
15 -	CHANNEL 8	'+' INPUT	45 - CHANNEL 18	'-' INPUT
16 -	CHANNEL 8	'-' INPUT	46 - CHANNEL 18	'+' INPUT
17 -	CHANNEL 9	'+' INPUT		
18 -	CHANNEL 9	'-' INPUT		

General wiring considerations:

Refer to section 2 for installation information.

APPENDIX 6 : STANDARD SPECIFICATIONS

6.1 A-D Converter

These modules contain a high precision auto-ranging integrating A-D converter The converter be programmed to integrate input signals to be measured over one complete mains cycle period. This can be set up for 50 or 60 Hz. This allows the measurement process to reject large amounts of mains borne interference superimposed on microvolt signals.

Measurements are made continuously. Several measurement resolutions are supported

17 bits at 40/50 measurements per second *
13 bits at 200 measurements per second
15 bits at 100 measurements per second
18 bits at 20 measurements per second *
19/20 bits at 9 measurements per second *

In addition to these measurement resolutions a digital filter can be applied to any channels to further reduce signal or measurement noise.

* Resolutions for mains noise rejection

6.2 Voltage measurement mode specification:

Input voltage ranges	+10V > -10V +1.5V > -1.5V +180 mV >-180 mV +23 mV > -23 mV

Automatic range selection is supported.

DC voltage measurement accuracy:	+-0.015% of reading + 0.01% of range + 3 uV
Temperature coefficients DC voltage	25 ppm rdg +0.05 uV/ºC typ
Measurement sensitivity	<0.25 uV on +23 mV>-23 mV range
(Note: displayed sensitivity depends on reporting format)	
Additional error at 200/sec mode	0.06% of range

Interference rejection:

AC Common mode rejection ratio channel group	<0.1 uV/V
AC Single channel common mode rejection ratio	<1 uV/V
DC Channel common mode rejection ratio	<5 uV/V
AC series mode rejection ratio	50 or 60 Hz +-0.05% <1 mV/V

Maximum voltages, operating:

Maximum voltage between any (+) and all(-)inputs	11V
Maximum voltage between any two (-) input terminals	11V
Maximum voltage between any two terminals	22V

6.3 Overload protection

Channel overload protection	Passive 50V continuous (For 912 30V) 150V for short periods <1sec (For 912 100V)

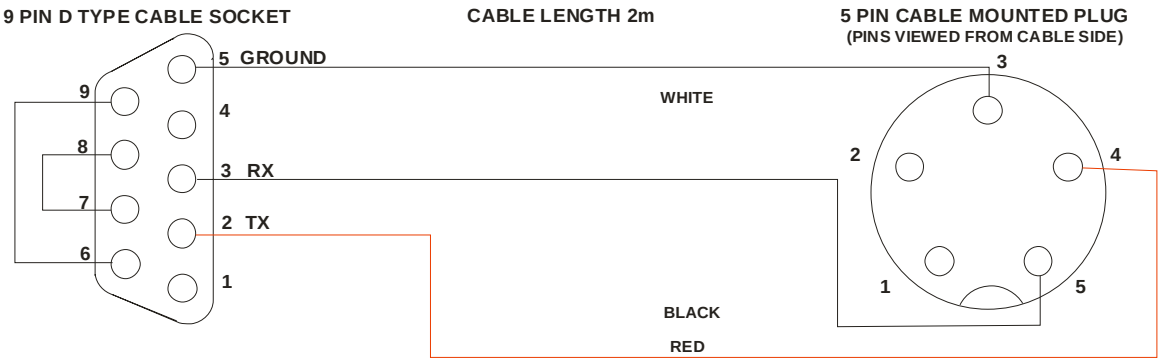
6.4 Isolation

The channel group is isolated from the RS485 and the power supply inputs.

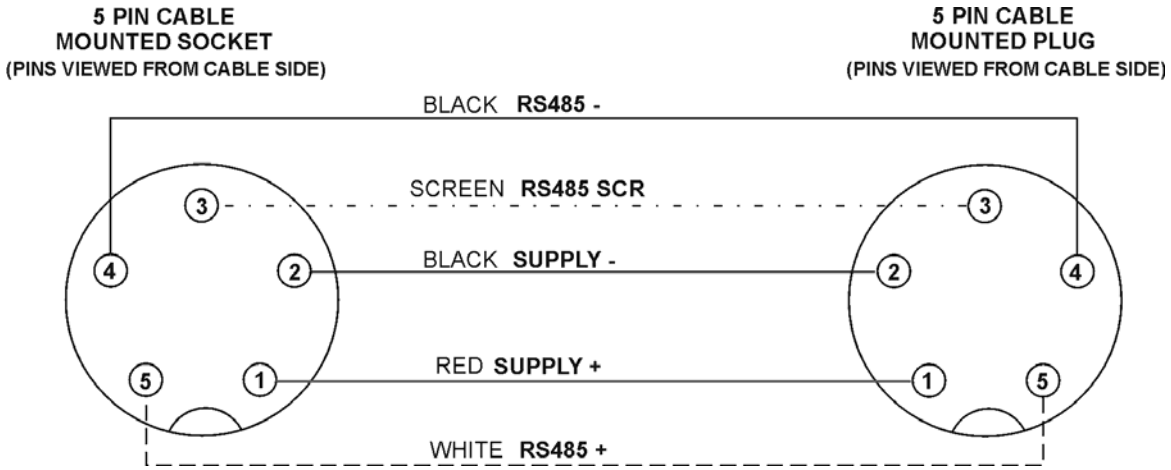
Isolation test voltage between channel group and power supply or RS485 is 1500V.
The test is done at normal temperature and humidity only.

APPENDIX 7 : CONNECTOR WIRING DIAGRAMS

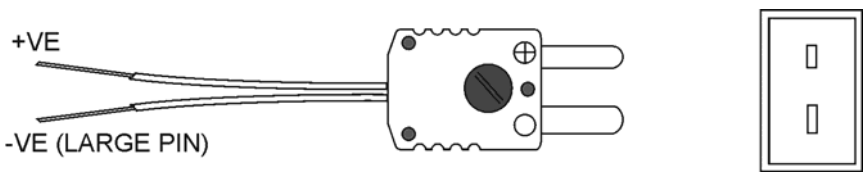
7.1 Local RS232 connection



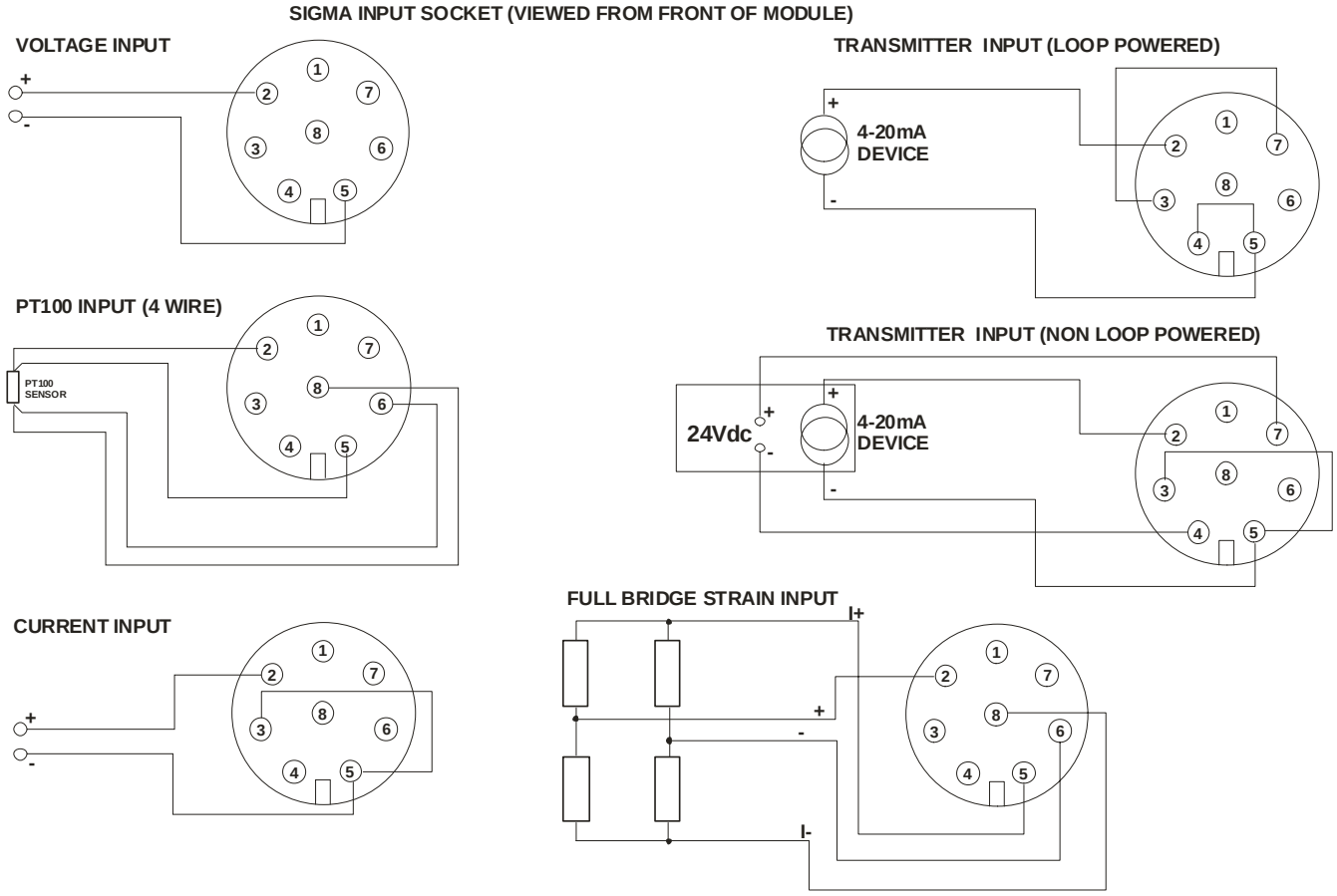
7.2 RS485 Communications/power supply cable



7.3 Sigma 310A, 310B, 311A, 311B connector wiring diagram



7.4 Sigma 312A connector wiring diagram



7.5 Sigma 381U USB wiring diagram