MICROLINK 305x

Analogue Inputs

User Manual

Biodata Limited

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Multi-Channel Analogue Inputs

The 305x range provides analogue input to the computer. There are facilities for voltage inputs with resistance, bridge and rms options. An auxiliary channel is provided which is reserved for special inputs such as cold junction measurement.

The input signals are conditioned by the 305x module and then passed to a 304x module which digitises the signal.

7.1 3050/2/3/4—Analogue Inputs

The 3050 accepts up to 16 differential voltage inputs.

The 3052 enables strain gauge measurements to be placed under computer control. Sixteen strain gauge bridges can be monitored by any one module. It can accept full, half or quarter bridge configurations with programmable gain and balance.

The 3053 is equivalent to a 3050 with an rms converter to convert analogue voltage signals to their root mean squares. The readings will therefore always be positive voltages. You can disable the rms option and use the 3053 exactly like a 3050.

The 3054 is similar to the 3050 but provides 32 differential analogue inputs instead of 16. It has only 1 auxiliary channel, so thermocouples, for example, could only be connected to the left hand connector, i.e. to channels 0–15. B, E, J, K, N, R, S and T type thermocouples are supported.

7.1.1 Connection Notes

Although these modules have various functional capabilities, they share a common input configuration.

Differential Inputs

All the inputs are differential. This means that the amplifier measures the difference between its positive and negative inputs. It is important to remember that the voltages at both inputs must be within the amplifier operating range. A classic error is to connect a battery between positive and negative inputs with no other connection. Although the difference between the inputs is well defined, the actual voltage at each input could be anything. Connecting one end of the battery to Microlink 0 V, either direct or via a resistor, would solve the problem.

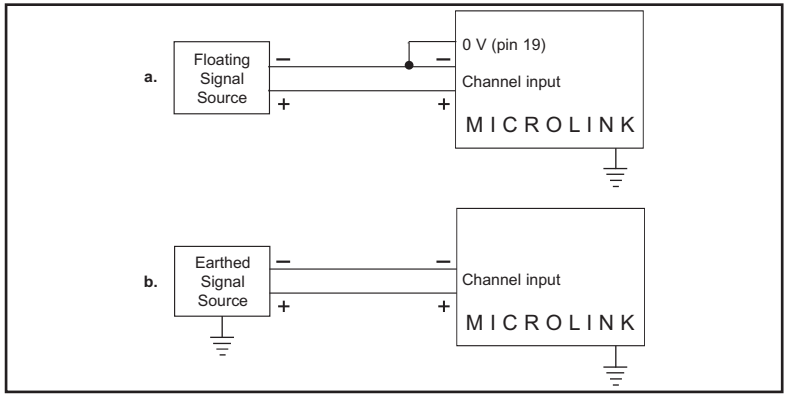

Figure 7.1 For floating signals you need to connect one end of the signal to the 0 V input on pin 19

Since the 0V of the Microlink is itself connected to mains earth, when making your connections you should follow this policy.

- If your signal source is “floating”, ie has no reference to mains earth, then you must provide a reference by connecting one end of it to Microlink 0 V, either direct or via a resistor. The resistor could have any value up to several MΩ. However large values could cause 50 Hz problems if your signal source has much leakage to earth.

- If your signal source is itself earthed then you should connect only positive and negative inputs. You should make no connection to Microlink earth.

To use a differential input in single-ended mode short one of the signal wires (usually the – input) directly to ground.

Input Voltage Range

The 305x modules will operate correctly with input voltages in the range ±11 V. The inputs will reject voltages that are common to both positive and negative inputs. These common mode voltages could be as big as 10 V. The amplifier must be capable of handling both the common mode voltage and the amplified signal. The maximum permissible common mode voltage for any given input signal is defined by the following formula:

$$11 = V_{cm} + V_{diff} \times G/2$$

where V_{cm} is the common mode voltage
V_{diff} is the differential voltage between the 2 inputs
G is the input amplifier gain
(1 for voltage ranges 10, 5, 2)
(10 for voltage ranges 1, 0.5, 0.2)
(100 for voltage ranges 0.1, 0.05, 0.02, 0.01)

Maximum Input Voltage

The input multiplexers are protected to 20 Volts beyond the power supply. This means ±35 V if the Microlink is switched on, ±20 V if it is switched off. When a voltage above the power supply is applied to the unit its protection mechanism comes into action and this draws some current from the signal source. This effect can be a problem when the Microlink is switched off. It now draws current from any signal. If this is a problem the current can be limited by series resistors. These could be conveniently housed on the 3900 Screw Terminal module. Such resistors will also protect the unit from much higher voltages. There is of course a price to pay for such resistors. This is higher noise, slower maximum multiplex rates, and dc errors caused by the amplifier input currents flowing through the resistors.

Unconnected Inputs

You can leave unused inputs unconnected, however if you attempt to read from unconnected inputs do not expect to get 0 V! They could be any value. If another connected channel has recently been read, the unconnected input will return a similar value. This is not crosstalk. It occurs because the input capacitance of the amplifier is charged to the

voltage of the previous channel and has little incentive to change when connected to an open circuit.

High Impedance Signals

A similar effect to that described above can occur with high impedance signal sources. When the source is selected it must supply current to charge the amplifier input capacitance. A high impedance signal source may take some time to do this so slowing the maximum multiplex rate.

Auxiliary Input

This input has all the facilities of the other sixteen. It can indeed be used as a 17th input if required. In Windmill software it is reserved for measuring cold junction temperatures with thermocouples or excitation voltage in bridge circuits. If you are using a 3902 thermocouple input card, or a 3904 bridge input card, the auxiliary input is automatically connected as required by the software.

Use with 3902/3903 Thermocouple Input Units

When used with these units the auxiliary input is automatically connected to the cold junction sensor. This is an RTD with 1 milliampere flowing through it. Its resistance is thus 1 ohm per measured millivolt.

If inputs are unconnected the thermocouple break detection circuitry will cause them to read positive full scale.

Use with 3904 Bridge Input Unit

When used with this unit the auxiliary input automatically measures the excitation voltage connected to the 3904. On a 3052 module this voltage is used to produce the programmable balance function. This means that the bridge remains balanced even if your excitation voltage changes.

Table 7.1 3050/2/3/4 - Analogue Inputs
Pin Connections for Left Hand 37-Way D Plug (Wiring View)

		19	0V
+15V	37		
		18	–15V
+ Auxiliary	36		
		17	Auxiliary –
+ Input 15	35		
		16	– Input 15
+ Input 14	34		
		15	– Input 14
+ Input 13	33		
		14	– Input 13
+ Input 12	30		
		13	– Input 12
+ Input 11	31		
		12	– Input 11
+ Input 10	30		
		11	– Input 10
+ Input 9	29		
		10	– Input 9
+ Input 8	28		
		9	– Input 8
+ Input 7	27		
		8	– Input 7
+ Input 6	26		
		7	– Input 6
+ Input 5	25		
		6	– Input 5
+ Input 4	24		
		5	– Input 4
+ Input 3	23		
		4	– Input 3
+ Input 2	22		
		3	– Input 2
+ Input 1	21		
		2	– Input 1
+ Input 0	20		
		1	– Input 0

Please read the Connection Notes on the previous pages before making your connections.

Table 7.2 3054 - 32 Analogue Inputs
Pin Connections for Right Hand 37-Way D Plug (Wiring View)

		19	0 V
+15 V	37		
		18	– 15 V
unused	36		
		17	unused
+ Input 31	35		
		16	– Input 31
+ Input 30	34		
		15	– Input 30
+ Input 29	33		
		14	– Input 29
+ Input 28	32		
		13	– Input 28
+ Input 27	31		
		12	– Input 27
+ Input 26	30		
		11	– Input 26
+ Input 25	29		
		10	– Input 25
+ Input 24	28		
		9	– Input 24
+ Input 23	27		
		8	– Input 23
+ Input 22	26		
		7	– Input 22
+ Input 21	25		
		6	– Input 21
+ Input 20	24		
		5	– Input 20
+ Input 19	23		
		4	– Input 19
+ Input 18	22		
		3	– Input 18
+ Input 17	21		
		2	– Input 17
+ Input 16	20		
		1	– Input 16

Please read the Connection Notes on the previous pages before making your connections.

7.2 3051—Resistance Measurement

The 3051 is essentially a 3050 with additional features to permit the measurement of resistance rather than voltage. It is therefore appropriate for the monitoring of temperatures using Resistance Temperature Devices (RTDs or Pt100) or thermistors. Other variable resistance transducers can also be monitored with the 3051.

The inputs accept up to 16 resistance devices in 2, 3 or 4 wire form. Each channel has + and – inputs to measure voltage across the resistors, plus a current source and compensation amplifier. You can choose whether or not to use the resistance option on the 3051. If the current source is not connected and the compensation input is earthed then the 3051 behaves as a 3050 measuring voltage.

7.2.1 Connection Notes

The 3051 is a variant of the 3050 module. All the comments made in the 3050 connection notes apply to this module. You should read the 3050 notes first, especially if you intend to use the 3051 to measure voltage signals. The 3051 uses 4 connections per channel to measure resistance. The connections for channels 0–7 are on the left hand connector whilst 8–15 are on the right hand connector.

7.2.2 Lead Arrangements

2 Wire

In this configuration lead resistance is an additive error but can be tolerated in those applications which do not require high absolute accuracy.

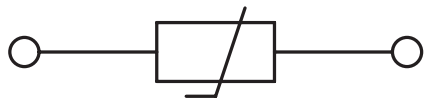

Figure 7.2 2 Wire RTD Arrangement

3 Wire

This is probably the most widely used configuration. The resistance of 1 lead is measured and used to perform a compensation for the resistances in the other leads to the RTD.

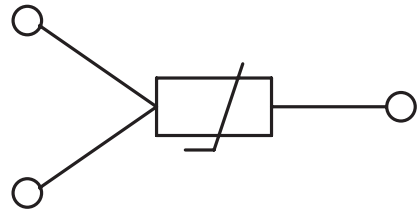

Figure 7.3 3 Wire RTD Arrangement

4 Wire

This is the configuration that gives the most accurate measurement. The measuring current is applied via 2 of the leads, and the voltage drop across the RTD is measured with a high input impedance device using the other 2 leads.

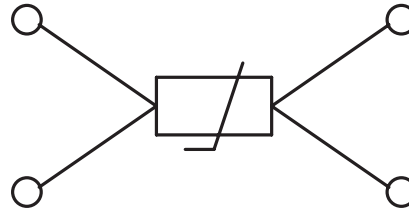

Figure 7.4 4 Wire RTD Arrangement

4 Wire Compensated

In this configuration the resistance across the dummy leads is measured and used as compensation.

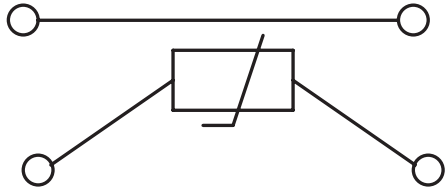

Figure 7.5 4 Wire Compensated RTD Arrangement

7.2.3 3051 Measurement Techniques

The 3051 can cope with any of the above lead arrangements, for up to eight RTD devices. It uses the following technique to measure resistance:

1. A programmable constant current source of 1 mA.

2. A high input impedance instrumentation amplifier for measuring the voltage drop across the RTD.

3. A compensation amplifier for measuring lead resistance which can then be subtracted from the measured RTD resistance.

Figures 7.6 to 7.9 show how the RTD devices are connected to the measuring circuit for each of the different lead arrangements.

2 Wire

With the two wire arrangement, the constant current flows through the RTD to earth. The voltage across the RTD is measured by the instrumentation amplifier. The compensation amplifier is not used, so its input is tied to earth.

3 Wire

The constant current flows through the RTD to earth causing error voltage drops in the resistances of the B and C leads. Only negligible current flows down the A lead. Thus the instrumentation amplifier measures the voltage across the RTD plus the voltage developed in the B lead, while the compensation amplifier measures the voltage developed in the C lead. The subtraction then produces the RTD voltage assuming the lead resistances are equal.

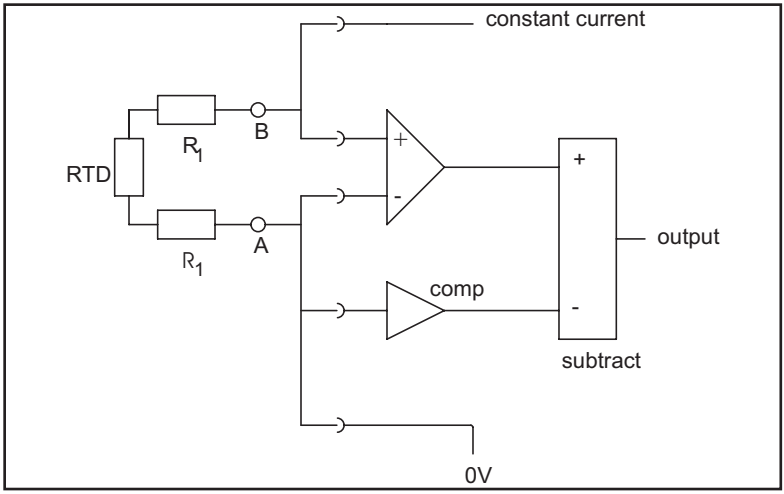

Figure 7.6 Connections for 2 Wire RTDs

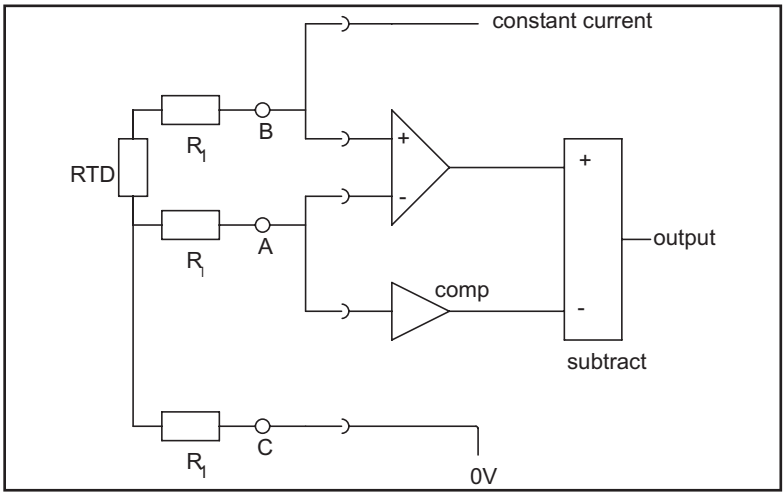

Figure 7.7 Connections for 3 Wire RTDs

4 Wire

The constant current flows down the D and C leads. Only a negligible current flows in the B and A leads, so the instrumentation amplifier directly measures the RTD voltage. The compensation amplifier is not used and is connected to earth.

4 Wire Compensated

The constant current flows through all leads. The instrumentation amplifier measures the voltage drop across the RTD and the drops in the leads to A and B. The compensation amplifier measures the voltage in the C and D leads. The subtraction leaves the RTD voltage drop, assuming the lead resistances to be equal.

Voltage Measurement

You can use the + and – inputs to measure voltage just as in a 3050. You must connect the compensation input for that channel to 0 V although you don't need to make a connection to the current terminal of that channel.

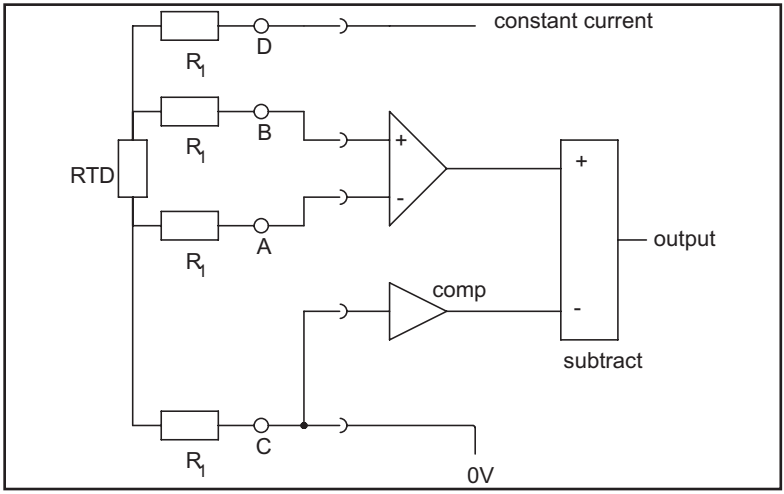

Figure 7.8 Connections for 4 Wire RTDs

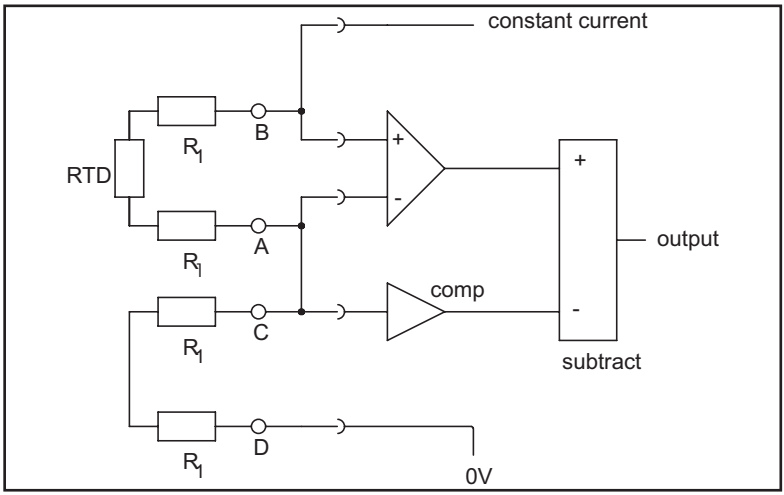

Figure 7.9 Connections for 4 Wire Compensated RTDs

Table 7.4 3051 - Resistance Measurement
Pin Connections for Left Hand 37-Way D Plug (Wiring View)

		19	0V
+15V	37		
		18	–15V
+ Auxiliary	36		
		17	Auxiliary –
Current 7	35		
		16	Comp 7
Current 6	34		
		15	Comp 6
Current 5	33		
		14	Comp 5
Current 4	32		
		13	Comp 4
Current 3	31		
		12	Comp 3
Current 2	30		
		11	Comp 2
Current 1	29		
		10	Comp 1
Current 0	28		
		9	Comp 0
+ Input 7	27		
		8	– Input 7
+ Input 6	26		
		7	– Input 6
+ Input 5	25		
		6	– Input 5
+ Input 4	24		
		5	– Input 4
+ Input 3	23		
		4	– Input 3
+ Input 2	22		
		3	– Input 2
+ Input 1	21		
		2	– Input 1
+ Input 0	20		
		1	– Input 0

Please read the Connection Notes on the previous pages before making your connections.

Table 7.5 3051 Resistance Measurement
Pin Connections for Right Hand 37-Way D Plug (Wiring View)

		19	0 V
+15 V	37		
		18	–15 V
unused	36		
		17	unused
Current 15	35		
		16	Comp 15
Current 14	34		
		15	Comp 14
Current 13	33		
		14	Comp 13
Current 12	32		
		13	Comp 12
Current 11	31		
		12	Comp 11
Current 10	30		
		11	Comp 10
Current 9	29		
		10	Comp 9
Current 8	28		
		9	Comp 8
+ Input 15	27		
		8	– Input 15
+ Input 14	26		
		7	– Input 14
+ Input 13	25		
		6	– Input 13
+ Input 12	24		
		5	–Input 12
+ Input 11	23		
		4	–Input 11
+ Input 10	22		
		3	– Input 10
+ Input 9	21		
		2	–Input 9
+ Input 8	20		
		1	–Input 8

Please read the Connection Notes on the previous pages before making your connections.

7.3 3055—Low Thermal Reed Relay Input

The 3055 is essentially a 3050 with the input signal multiplexers replaced by low thermal offset reed relays. The relays are specified to introduce offsets of less than 1 microvolt into the input signals. This compares with about ten microvolts for the semiconductor multiplexers of 3050. The major use of such low level capability is in high resolution thermocouple measurement. Because of this the standard 3055 is configured for such measurements.

Input Configuration

All the inputs are differential. This means that the amplifier measures the difference between the positive and negative inputs. The inputs are fitted with thermocouple break circuitry. This consists of a 1 MΩ resistor tying the negative input to 0 V, plus a 1 MΩ resistor tying the positive input to a voltage of about 300 millivolts. When a thermocouple is connected a current of about 150 nanoamperes flows through it. This produces negligible error with a normal, low impedance, thermocouple. If the thermocouple should become open circuit then a maximum temperature reading will be obtained. If you wish to use the unit for non-thermocouple measurements then it may be advisable to disable all or part of this circuitry. You can remove R5 from the 3055B board to disable this facility. You may also wish to remove R4 which provides the zero reference.

Input Voltage Range

These units will operate correctly with input voltages in the range ±12 V. The inputs will reject voltages that are common to both positive and negative inputs. These common mode voltages could be as big as 10 V. The amplifier must be capable of handling both the common mode voltage and the amplified signal. The maximum permissible common mode voltage for any given input signal is defined by the following formula.

$$12 = V_{cm} + V_{diff} * G/2$$

where V_{cm} is the common mode voltage
V_{diff} is the differential voltage between the 2 inputs
G is the input amplifier gain
(1 for voltage ranges 10, 5, 2)
(10 for voltage ranges 1, 0.5, 0.2)
(100 for voltage ranges 0.1, 0.05, 0.02, 0.01)

Maximum Input Voltage

The inputs are protected to ±35V for continuous voltages. Transient voltages much higher than this will cause no damage. Since all relays are off when the unit is switched off, it will not load its inputs.

Connections

Two rows of 18 screw terminals provide the input connections. The isothermal plate on which they are fitted is engraved with channel numbers 0 to 15, positive and negative. The top 2 terminals of each row are connected to 0 V.

Auxiliary Input

The 3055 is fitted with a cold junction sensor. This is the circuitry at the front of the screw terminals. It consists of an 0.01% 100 ohm RTD excited by a 1 milliampere constant current. Its resistance is thus 1 ohm per measured millivolt.

7.4 305x Specifications

7.4.1 3050 Specifications

Number of inputs	16 + 1 auxiliary
Type of measurement	voltage, cold junction
Input Multiplexer	
On resistance	~400 Ω
Switch off leakage	<2 nA
Analogue voltage range	+11, –15 V
Max safe input voltage:	
Power supply ON	±35 V
Power supply OFF	±20 V
Break before make delay	1 μsec
Crosstalk	75 dB
Input impedance	100 MΩ
Amplifier	
Offset voltage drift (gain=100)	1 μV/°C
Input bias current	±30 nA
Common mode rejection	105 dB (gain=1000)
Common mode range	±10 V
Frequency response	50 kHz
Settling time to 0.01%	15 μsec
Relative accuracy of gain ranges	0.02%
Initial accuracy of gain and offset	±1 LSB
Input noise voltage	2 μV rms

7.4.2 3051 Specifications

Current sources	10, 100, 1000 μA
Accuracy 10, 100 μA	0.2%
Accuracy 1000 μA	0.02%

Other specifications as 3050

7.4.3 3052 Specifications

Max balance range	10% bridge imbalance

Other specifications as 3050

7.4.4 3053 Specifications

Accuracy for 50 Hz signal	±0.5%
Settling time for channel switching	200 msec
Other specifications as 3050	

7.4.5 3054 Specifications

Number of channels	32
Number of auxiliary channels	1
Other specifications as 3050	

7.4.6 3055 Specifications

Relay thermal offset	1 μV
Relay switching time	1 msec
Other specifications as 3050	