# MSTB 009:
# Analog Termination Board

## Analog Accelerator Series
## Microstar Laboratories, Inc.

**Version 1.4**

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Part Number MSAMTB009-0897-01

# Contents

# MSTB 009: Analog Termination Board

The Microstar Laboratories Analog Termination Board, part number MSTB 009, is a 48-point quick-connect termination board for analog signals. It provides access to all connections on the Data Acquisition Processor analog I/O connector.

MSTB 009 provides 16 analog input channels and two analog output channels. Each input/output connection has a corresponding ground connection, allowing easy connection to discrete devices.

Several models of Analog Termination Boards currently are available from Microstar Laboratories. There are MSTB 009 models for stand-alone use and for use in single-board enclosures. Contact your Microstar Laboratories product supplier for more information about available options and for information about Analog Termination Boards that are compatible with analog backplanes and industrial enclosures.

## Hardware Configuration

The Analog Termination Board is connected to a Data Acquisition Processor using a 68-line cable, part number MSCBL 040-01 or MSCBL 041-01. These cables connect the analog I/O connector of a Data Acquisition Processor to connector `J1` of the Analog Termination Board. Figure 1 shows the connector locations of MSTB 009.

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**Warning:** If the Data Acquisition Processor does not have fault-protected input multiplexers, signals must not be applied to the termination board when power is not applied to the Data Acquisition Processor.

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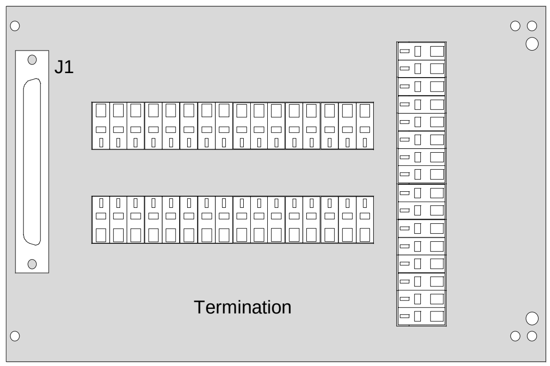


***Figure 1. MSTB 009 Connector Locations***

The input signal connections on the Analog Termination Board are labeled `S0`, `S1`, etc. The input ground connections are labeled `G0`, `G1`, etc. All input connections are labeled with the pin name. Pin mapping is discussed in the connector chapter of the Data Acquisition Processor manual.

The Analog Termination Board is factory configured for voltage input. It also can be configured for current input or for input voltages that exceed Data Acquisition Processor specifications. The Analog Termination Board also has an area for wire wrapping custom circuits. The Analog Termination Board accepts wire sizes from 14 to 26 AWG.

The Analog Termination Board also can be used for differential inputs. A differential input is used to measure the difference between two voltages. The negative terminal voltage is subtracted from the positive terminal voltage. When a differential voltage is measured, a ground sense line must be connected between the Analog Termination Board and the signal source. Table 1 shows the correspondence between differential and single-ended inputs.

*Table 1. Differential Input Connections*

| Single-Ended Input | Differential Input |
|---|---|
| S0 | D0- |
| S1 | D0+ |
| S2 | D1- |
| S3 | D1+ |
| S4 | D2- |
| S5 | D2+ |
| S6 | D3- |
| S7 | D3+ |
| S8 | D4- |
| S9 | D4+ |
| S10 | D5- |
| S11 | D5+ |
| S12 | D6- |
| S13 | D6+ |
| S14 | D7- |
| S15 | D7+ |

Two Data Acquisition Processor digital-to-analog converter outputs are available on the Analog Termination Board, labeled `DAC0` and `DAC1`. Each has an associated ground return, labeled `DAC0G` and `DAC1G`.

The output current from each digital-to-analog converter output is rated at ±5 milliamps; however, Microstar Laboratories recommends that this current not exceed ±1 milliamp. The digital-to-analog converter outputs are voltage outputs.

The Data Acquisition Processor has ±18 volt supply voltages that are available on the Analog Termination Board. The maximum current drain from these supplies is 20 milliamps each. If more current than this is required, an external power supply is necessary.

## Current Input Configuration

To configure the Analog Termination Board for a current input, place a resistor in the location on the termination board corresponding to the input pin being reconfigured. Figure 3 and Table 2 show resistor placement. The appropriate size for this resistor can be calculated using Ohm’s Law, given the maximum input current and the input voltage range of the Data Acquisition Processor.

```
Ohm’s Law: Resistance = Voltage/Current
```

The following configuration assumes that the Data Acquisition Processor is configured for the ±5-volt range, which is the standard factory setting. The accuracy of the measurements made in this configuration depends on the precision of the resistors used; this should be taken into consideration when selecting the resistors. Microstar Laboratories recommends using resistors with a 1% or better tolerance.

Excess power dissipated in the resistor causes heating, which changes the resistance value and decreases the accuracy of measurements. The recommended maximum power dissipation is 0.1 watt.

```
Power Calculation: Power = current² *
resistance
```

For current input, a current source is connected to the `Sx` terminal and the ground return is connected to the `Gx` terminal. To convert voltage input `S0` into a current input that generates 1 to 5 volts with an input current of 4 to 20 milliamps, a 250 ohm resistor is inserted in the `R1` location. In this case, the maximum power dissipated in the resistor is 0.1 watt at +5 volts; this is the maximum recommended power dissipation. Figure 2 illustrates the connections for this example.

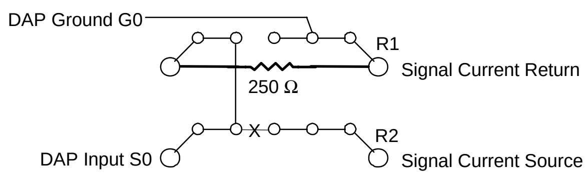


***Figure 2. Resistor Connection for Current Input***

## Voltage Divider Installation

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**Warning:** Be careful to avoid applying an input voltage to the Data Acquisition Processor that exceeds specifications.

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The Analog Termination Board can be configured for applications requiring input voltages greater than that allowed by the Data Acquisition Processor. This is accomplished by soldering a resistive voltage divider in the location provided on the termination board. Before this is done, a trace on the termination board must be cut. Above each even-numbered resistor there is a row of five small holes. Between two of the holes there is a white “X”. The trace must be cut at the “X”.

**Danger:** If the trace on the termination board is not cut, the high-voltage input is connected directly to the Data Acquisition Processor input; this may destroy the Data Acquisition Processor.

Once the trace is cut, the resistors for the voltage divider are soldered into place. The resistor on the ground side of the divider is placed in an odd-numbered resistor location and the resistor on the input signal side of the divider is placed in an even-numbered resistor location. Figure 3 and Table 2 illustrate resistor placement for each input.

After both resistors are soldered into place, signals may be connected between the `Sx` and `Gx` terminals. Test the voltage divider circuit before connecting the circuit to the Data Acquisition Processor.

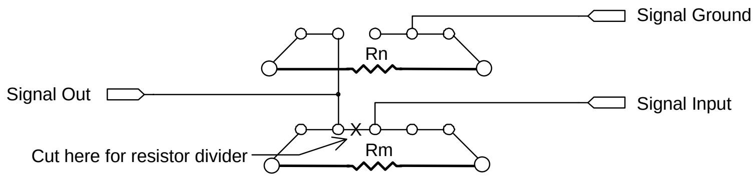


*Figure 3. Resistor Placement*

**Note:** To avoid exceeding Data Acquisition Processor input voltage specifications, make sure both resistors are securely soldered in the correct locations and the trace beneath the X is completely cut before using the circuit.

*Table 2. Resistor Placement*

| Terminal | Current Input Resistor * | Voltage Divider Resistors |
|---|---|---|
| S0, G0 | R1 | R1, R2 |
| S1, G1 | R3 | R3, R4 |
| S2, G2 | R5 | R5, R6 |
| S3, G3 | R7 | R7, R8 |
| S4, G4 | R9 | R9, R10 |
| S5, G5 | R11 | R11, R12 |
| S6, G6 | R13 | R13, R14 |
| S7, G7 | R15 | R15, R16 |
| S8, G8 | R17 | R17, R18 |
| S9, G9 | R19 | R19, R20 |
| S10, G10 | R21 | R21, R22 |
| S11, G11 | R23 | R23, R24 |
| S12, G12 | R25 | R25, R26 |
| S13, G13 | R27 | R27, R28 |
| S14, G14 | R29 | R29, R30 |
| S15, G15 | R31 | R31, R32 |

* The current input resistor is placed in the Rn location shown in Figure 3.

** The first resistor is on the ground side of the voltage divider (Rn), the second is on the input signal side (Rm), as shown in Figure 3. For example, R1 is Rn and R2 is Rm. Figure 4 shows the resistor placement for this example.

Figure 3 and Table 2 can be used to locate the appropriate resistors when using either the current input or voltage division configuration. Figure 3 shows schematically how the inputs and grounds on the termination board are connected. For example, to configure input `S0` so that an input range of 0 to 20 volts is scaled down to a range of 0 to 5 volts, a resistor ratio of 3:1 is needed.

Voltage Divider Equation: $V_{out} = V_{in} * R1/(R1+R2)$

Resistance values of 1500 ohms and 500 ohms may be used. The trace beneath the X above R2 is cut. Then the 500 ohm resistor is placed in the R1 position and the 1500 ohm resistor is placed in the R2 position. Since 500 ohm resistors are not commonly available, a 510 ohm resistor would typically be used instead, resulting in a small error in the division ratio. This error is linear and can be corrected by multiplying by a constant in DAPL. Figure 4 illustrates the circuit for this example.

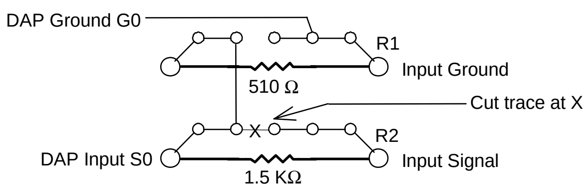


***Figure 4. Resistor Circuit for S0***

## External Clocking and Triggering Connections

External clocking and triggering signals can be connected to the Analog Termination Board to provide hardware triggering and clocking. See the Data Acquisition Processor manual for more information about hardware clocking and triggering.

External clock and trigger signals connected to the Analog Termination Board must be in the standard TTL range of 0 to 5 volts.

The external clocking and triggering labels on the Analog Termination Board are defined as follows:

- `IXCIN` = External Input Clock – Input
- `IXTIN` = External Input Trigger
- `INCLK` = Internal Input Clock – Output
- `OXCIN` = External Output Clock – Input
- `OXTIN` = External Output Trigger
- `OUTCLK` = Internal Output Clock – Output

## Cold Junction Reference

MSTB 009 has a cold junction temperature reference circuit. This circuit is used to measure the temperature of the “cold junction” at the termination board when using thermocouples. Since the cold junction temperature is the same for all thermocouples connected to a termination board, only one cold junction reference circuit is needed for any number of thermocouples.

The cold junction reference circuit generates a voltage that is temperature dependent. The output of this circuit is connected to input `S8` of the termination board. The Data Acquisition Processor samples this voltage and the resultant information is used in the `THERMO` command for cold junction compensation.

To use the cold junction reference circuit, both shunts must be installed on `J6` and `J7`.

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**Note:** When the cold junction reference circuit is used, no other inputs may be connected to the `S8` terminal, as it is connected to the cold junction reference circuit.

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The cold junction reference circuit consists of a Linear Technology LT1025A integrated circuit. The LT1025A has a linear voltage output which is directly proportional to the temperature in degrees Celsius. The LT1025A outputs 0 Volts at 0° Celsius and 10 millivolts for every degree above zero. At 25° Celsius, the LT1025A will output 250 millivolts. The cold junction reference circuit will not operate at temperatures below 0° Celsius. MSTB 009 may not function properly at temperatures above 50° Celsius.

## Optional External Enclosure

The MSTB 009 Analog Termination Board is available with a single-board external enclosure option. The external enclosure provides shielding and is compliant with the European Community directive 89/336/EEC.

The single-board enclosure has two standard end panels: blank and BNC connectors. A blank end panel allows the user to create custom connection points. A BNC end panel provides direct connections to the Analog Termination Board.

### BNC End-Panel Connections

Each BNC connector can be wired to any termination point on the Analog Termination Board. In the standard configuration, the BNC connectors map to the Analog Termination Board as follows:

`S0-S15`...................... analog input channels `S0-S15`
`DAC0`, `DAC1`................ not connected
`AG` .............................. not connected
`G`................................. signal ground `G0`

All signal grounds should be connected to `G`.