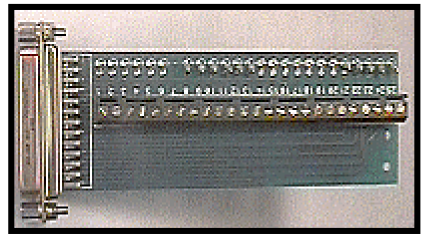
Not Recommended for New Installations.
Please contact Technical Support for more information.

4 to 20ma Adapter Board
Model DTB2520



The DTB2520 converts a 4 to 20 milliamp or 0 to 20 milliamp signal to a voltage range that can be read by B&B Electronics Models 232SDA10, 232SDA12, 485SDA10, and 485SDA12. The DTB2520 connects directly to the I/O port of these modules and provides terminal block access for your current loop signals.

The DTB2520 is designed for use with analog current loop systems. An analog current loop device outputs a current that is proportional to a specific state of the device (or its environment). In a digital current loop, there are only two states: current is flowing (ON) or current is not flowing (OFF). The DTB2520 is not meant to be used with digital current loops.

Using the DTB2520

The 232SDAxx and 485SDAxx offer 11 channels of A/D inputs. Your current loop signals should be connected to the A/D input lines using the terminal blocks provided on the DTB2520. The number of the terminal blocks correspond to the pin numbers of the I/O connector (shown in Table 1). NOTE: the proper connections for A/D Ref. + and A/D Ref. - are required. For information on reading the voltage of the A/D converter and A/D connections refer to your instruction manual.

Table 1 - I/O Connector Pinout

DB-25S Pin #	Function	DB-25S Pin #	Function
1	GND	14	Digital Output #0
2	+12Vdc Output*	15	Digital Output #1
3	Digital Input #0	16	Digital Output #2
4	Digital Input #1	17	+5Vdc Output
5	Digital Input #2	18	A/D Ref. Input +
6	Digital GND	19	A/D Ref. Input -
7	Analog GND	20	No connection
8	A/D Input #0	21	A/D Input #6
9	A/D Input #1	22	A/D Input #7
10	A/D Input #2	23	A/D Input #8
11	A/D Input #3	24	A/D Input #9
12	A/D Input #4	25	A/D Input #10
13	A/D Input #5		

*Actual output is equal to power supply input minus 0.7Vdc

The voltage present on an A/D input can be read through the serial port by issuing the appropriate command to the 232SDAxx or 485SDAxx modules. Once the voltage is determined, your software can determine the value of the current by dividing the voltage by the load (typically 124 Ohms).

$I = VR / RL$

Where "I" is the current, "VR" is the voltage read, and "RL" is load resistance.

Power Supply Considerations

An important part of an analog current loop is calculating the output voltage of the power supply. This voltage must be large enough to supply power to the sensor and for each load in the loop, but must not exceed the maximum voltage specified for the sensor. Figure 1 shows a single load current loop.

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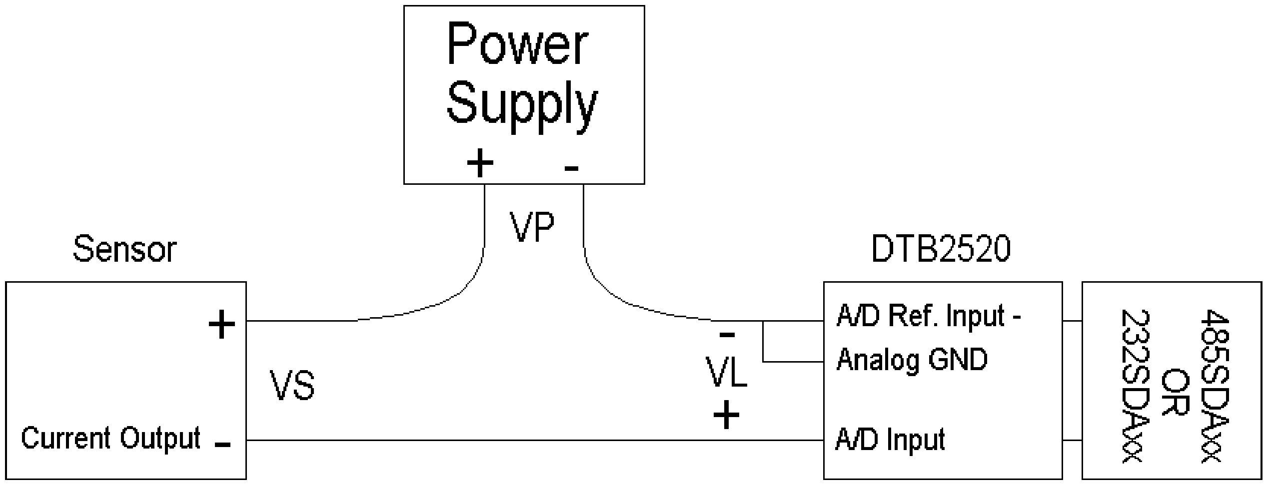

FIGURE 1 - Single Device Loop

For the circuit shown in Figure 1:

VP = VS + VL

Where VP is the power supply voltage and VS is the minimum supply voltage for the sensor. The value of VL for the DTB2520 can be calculated as follows:

VL = IS(max.) * RL

IS(max.) is the maximum current output (20 ma. typ.) of the sensor. RL is typically 124 Ohms.

Example 1: Determine the minimum voltage of the power supply, if the 4 to 20 ma. sensor requires a minimum of 12Vdc.

VL = IS(max.) * RL
VL = 20ma * 124 Ohms
VL = 2.48 Vdc

The voltage drop across the DTB2520 will be 2.48Vdc.

VP = VS + VL
VP = 12Vdc + 2.48Vdc
VP = 14.48Vdc

Therefore, the power supply must be able to supply at least 14.48Vdc.

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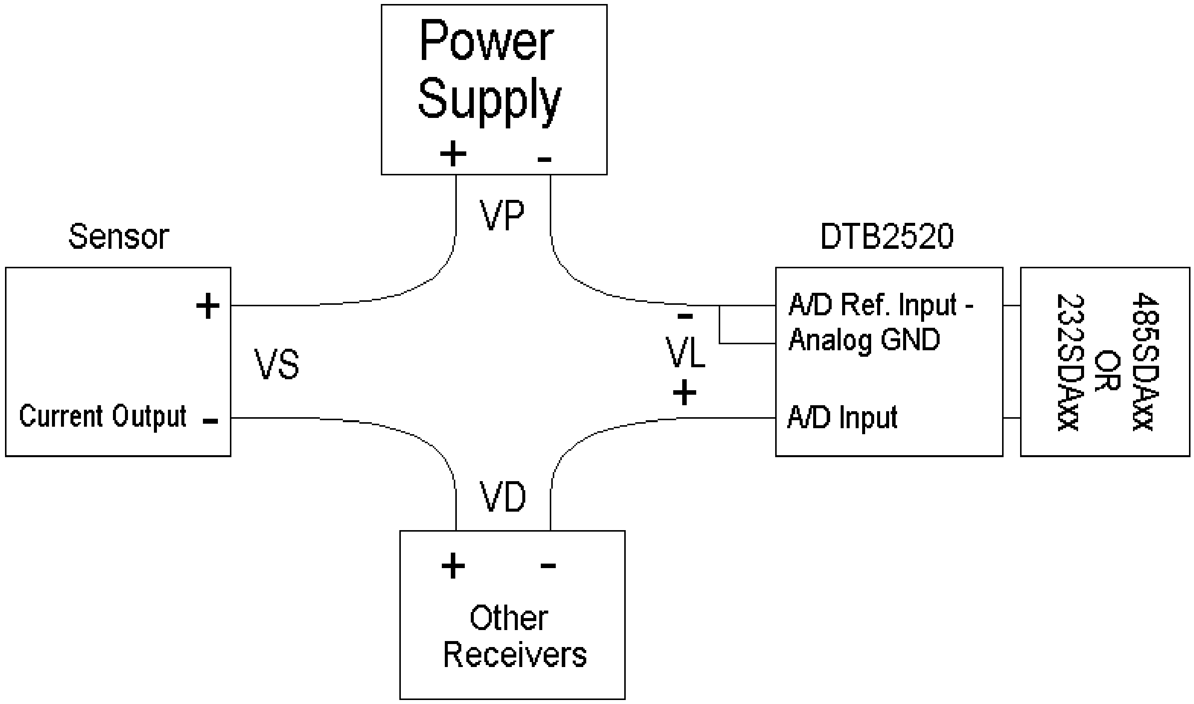

Figure 2 - Multiple Device Loop

For the circuit shown in Figure 2:

VP = VS + VD + VL

Where VP is the power supply voltage and VS is the minimum supply voltage for the sensor. (Calculation for VL remains same). VD is the voltage drop across any additional receivers in the loop. The value of VD can be calculated as follows:

VD = IS(max.) * RD

IS(max.) is the maximum current output (20 ma. typ.) of the sensor. RD is the total load of any additional receivers. These receivers must be wired in series (loads add together). Also, if there are additional receivers in the loop the DTB2520 must be the last device in the loop (no devices between the DTB2520 and power supply common).

Example 2: Determine the minimum voltage of the power supply, if the 4 to 20 ma. sensor requires a minimum of 12Vdc. The other receivers in the loop add a load of 400 Ohms.

VL = IS(max.) * RL
VL = 20ma * 124 Ohms
VL = 2.48 Vdc

The voltage drop across the DTB2520 will be 2.48Vdc.

VD = IS(max.) * RD
VD = 20ma * 400 Ohms
VD = 8.0 Vdc

The total voltage drop across the other receivers will be 8.0Vdc.

VP = VS + VD + VL
VP = 12Vdc + 8.0Vdc + 2.48Vdc
VP = 22.48Vdc

Therefore, the power supply must be able to supply at least 22.48Vdc.

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Calibration Procedure

As with any data acquisition system, there are several sources of error: device output, A/D reference voltage, A/D converter, etc. If you take in account all the errors, the total error can add up to over 2%. This error is twenty times the error of a 10-bit A/D converter. By using one of the calibration methods listed below, the error can be greatly reduced.

METHOD #1

This method will reduce the error to a value approximately equal to the accuracy of your A/D converter. This is the recommended method of calibration since it accounts for most of the error in the system.

Step 1 - Set sensor for minimum current (0 or 4 milliamps).
Step 2 - Take reading from the A/D converter for that channel.
Step 3 - Set sensor for maximum current (20 milliamps).
Step 4 - Take reading from the A/D converter for that channel.
Step 5 - Repeat Steps 1-4 for each device.

Use these values to calculate the current as follows:

device.constant = (Max. - Min.) / (high.reading - low.reading)

Where “Min.” and “Max.” are minimum and maximum output values, “low.reading” is the value from Step 2, and “high.reading” is the value from Step 4. The calibrated current can be determined as follows:

current = [(reading - low.reading) * device.constant] + Min.

Where “reading” is the data returned from the A/D conversion.

Example 3: A 4 to 20ma sensor is connected to channel 0. The output minimum current gives a reading of 100 and the output maximum current gives a reading of 500.

device.constant = (Max. - Min) / (high.reading - low.reading)
device.constant = (20ma -4ma) / (500 - 100)
device.constant = (16ma)/(400) = 0.04 ma

Condition #1: Channel 0 has a reading of 500.

current = [(reading - low.reading) * device.constant] + Min.
current = [(500 - 100) * .04ma] + 4ma = [(400) * .04ma] + 4ma
current = [16ma] + 4ma = 20ma

Condition #2: Channel 0 has a reading of 100.

current = [(reading - low.reading) * device.constant] + Min.
current = [(100 - 100) * .04ma] + 4ma = [(0) * .04ma] + 4ma
current = 4ma

Condition #3: Channel 0 has a reading of 400.

current = [(reading - low.reading) * device.constant] + Min.
current = [(400 - 100) * .04ma] + 4ma = [(300) * .04ma] + 4ma
current = [12ma] + 4ma = 16ma

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METHOD #2

This method can be used to reduce the inaccuracies caused by the voltage reference and input impedance. However, this does not account for any inaccuracies of the device connected to the unit.

Step 1 - Measure the voltage applied to A/D Reference Input +.
Step 2 - Measure the impedance between the input and Analog Ground.
Step 3 - Repeat Step 2 for each input.

Use these values to calculate the current as follows:

input voltage = (reading) * (A/D reference Input +) / (# of steps)

Where “reading” is the data returned from the A/D conversion, “# of steps” is equal to 1023 for a 10-bit A/D and 4095 for a 12-bit A/D, and “A/D Reference Input +) is the voltage measured in Step 1. Once the input voltage is known the current can be determined as follows:

current = input voltage / input impedance

Where “input impedance” is the value measured in Step 2 for the channel being read.

NOTE: The input impedance will vary slightly. Therefore, it is important for your software to keep the input impedance separate for each channel.

Example 4: A 10-bit A/D converter (1023 steps) has A/D Reference Input + voltage of 4.98Vdc. The input impedance of channel 0 is 122.1 ohms.

Condition #1: Channel 0 has a reading of 500.

input voltage = (reading) * (A/D reference Input +) / (# of steps)
input voltage = (500) * (4.98Vdc) / (1023)
input voltage = 2.434Vdc
current = input voltage / input impedance
current = 2.434Vdc / 122.1 Ohms
current = 19.93 milliamps

Condition #2: Channel 0 has a reading of 200.

input voltage = (reading) * (A/D reference Input +) / (# of steps)
input voltage = (200) * (4.98Vdc) / (1023)
input voltage = 0.974Vdc
current = input voltage / input impedance
current = 0.974Vdc / 122.1 Ohms
current = 7.974 milliamps

SPECIFICATIONS

Input Impedance: 124 ohms +/- 1%
Maximum input current: 40 milliamps

0 to 20 milliamp input:

Span accuracy with 2.5V Reference, 10-bit A/D converter: 0.0984% (1015 steps)
Span accuracy with 5.0V Reference, 10-bit A/D converter: 0.197% (507 steps)
Span accuracy with 2.5V Reference, 12-bit A/D converter: 0.0246% (4062 steps)
Span accuracy with 5.0V Reference, 12-bit A/D converter: 0.0492% (2031 steps)

4 to 20 milliamp input:

Span accuracy with 2.5V Reference, 10-bit A/D converter: 0.123% (813 steps)
Span accuracy with 5.0V Reference, 10-bit A/D converter: 0.246% (406 steps)
Span accuracy with 2.5V Reference, 12-bit A/D converter: 0.0308% (3246 steps)
Span accuracy with 5.0V Reference, 12-bit A/D converter: 0.0615% (1626 steps)

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