

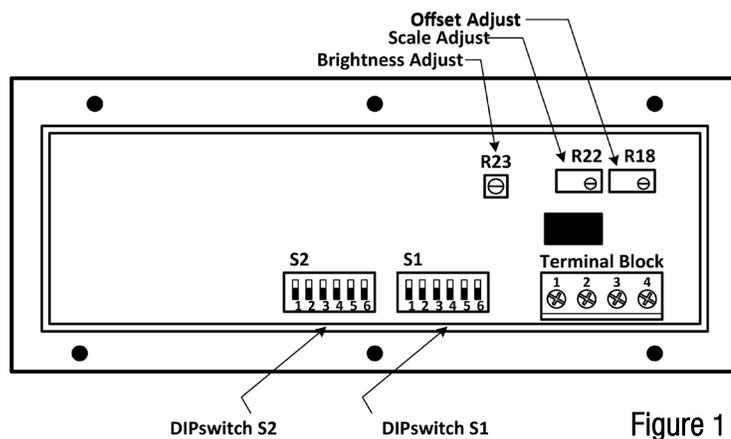


Application note ACAN-25 provides supplemental information for connecting, configuring and calibrating the DMS01 series panel meters. Practical examples with illustrations describe the recommended settings for the dipswitches, potentiometers and how to use the calibration features for maximum effectiveness across a wide range of applications. For additional details such as specifications, limits and mechanical details, refer to meter's datasheet.

APPLICABLE PANEL METER MODELS

Model Number	Measurement Type	Input Range	Measurement / Display range	Link to Datasheet
DMS01-VM1-RS12-C	DC Voltmeter	± 2 V or ± 200 mV	± 2 V or ± 200 mV	view datasheet
DMS01-AM-RS12-C	DC Shunt Ammeter	50 mV and 100 mV	± 1 A to ± 1200 A	view datasheet
DMS01-CL-RS12-C	Current Loop Process Meter	4-20 mA or 0-20 mA	0 to 20000 or 0 to ± 9500	view datasheet
DMS01-VP-RS12-C	Voltage Process Meter	0-5 V or 0-10 V	0 to 20000 or 0 to ± 9500	view datasheet

REAR PANEL LAYOUT



User Interface Features Map

TERMINAL BLOCK:

Position #	Name	Connection Function
1	-VS	Power Supply terminals (12Vdc)
2	+VS	
3	-IN	Measurement Input Terminals
4	+IN	

R18, R22, R23 TRIM POTS:

Adjust to control display brightness and calibration

S1, S2 DIP switches:

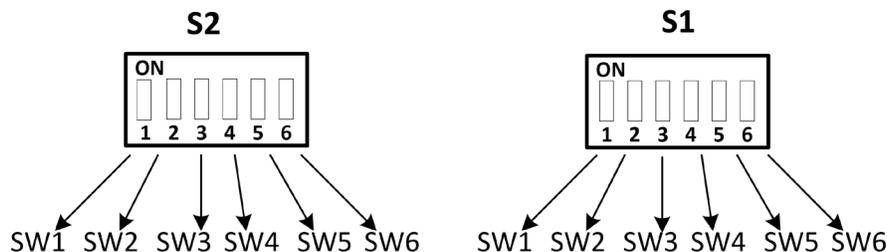
Use to set input range, display/span range, decimal place, digital filter, trim enable and unipolar/bipolar mode.

Note: "S2" deleted / not used on DMS01-VM1-RS12-C

Dipswitch layout

DIP switches S1 and S2 each consist of six (6) individual switches referred throughout this ACAN as follows:

1 = SW1, 2 = SW2, 3=SW3....6=SW6 as shown below.



CONFIGURABLE FEATURES COMMON TO ALL DMS501 METERS

Dipswitches and trim potentiometers are used to configure settings:

Input range

Sets the input voltage or input current range the meter is going to measure. For example, the input range of the voltmeter can be set to either $\pm 2V$ or ± 200 mV.

Decimal place

Can either be set to auto decimal or a fixed decimal place, with the exception of the current meter which is permanently set to auto decimal place.

Digital filter

Can be set to ON or OFF. In the OFF position, the filter is disabled and the meter's readings are updated, without filtering, at maximum speed. In the ON position, the filter is enabled, and the measurements are passed through a digital low pass filter. The result is a stable reading but a slower response. For all examples in this application note, the digital filter will be turned off or disabled for ease of explanation. However, the digital filter can be enabled at any time depending on your application's requirements.

Trim enable

Use to calibrate or adjust the meter. In the OFF position, the meter runs from factory calibration. In the ON position, the trim is enabled and this allows the user to calibrate or adjust the meter. When the trim is enabled, "Offset Adjust" or R18 (a 12 turn potentiometer) is used to adjust the meter's offset and "Scale Adjust" or R22 (a 12 turn potentiometer) is used to adjust the meter's scale.

Display brightness

Display brightness can be adjusted by setting the potentiometer R23

Span / Display range

Only used with the DMS01-CL current loop meter, DMS01-VP voltage process meter and DMS01-AM ammeter (as *current range*). These meters measure either an input current or input voltage and can be set to display a specific range. For example, the voltage process meter can be set to measure an input voltage of 0-10 volts and set to display from "0.000" to "6.500" as the output.

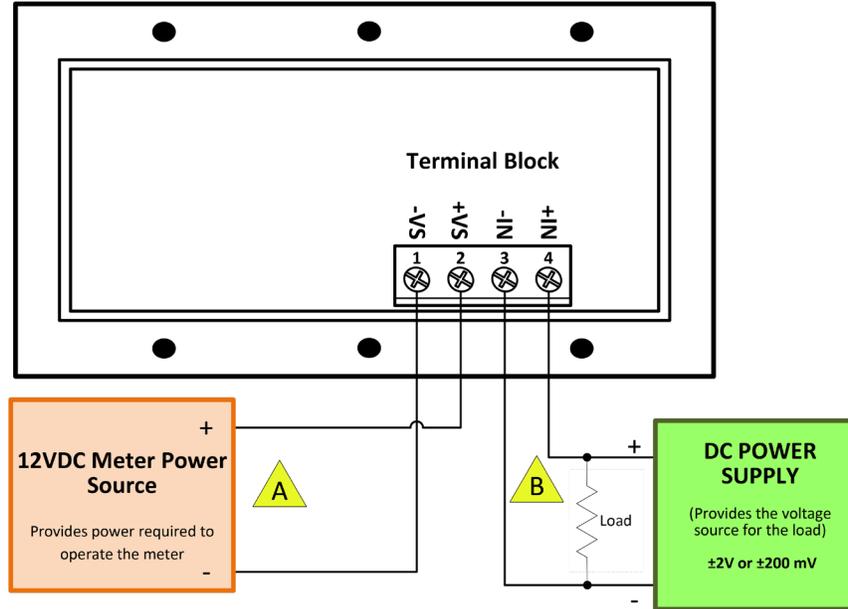
Unipolar / bipolar modes

Used only with the current loop and voltage process meters. In the unipolar mode, the meter will display only positive readings, for example, 0 to 20000. In the bipolar mode, the meter will display negative and positive readings, for example, -9500 to ± 9500 .

DMS01-VM1-RS12-C SETTINGS & OPERATION, DC VOLTMETER

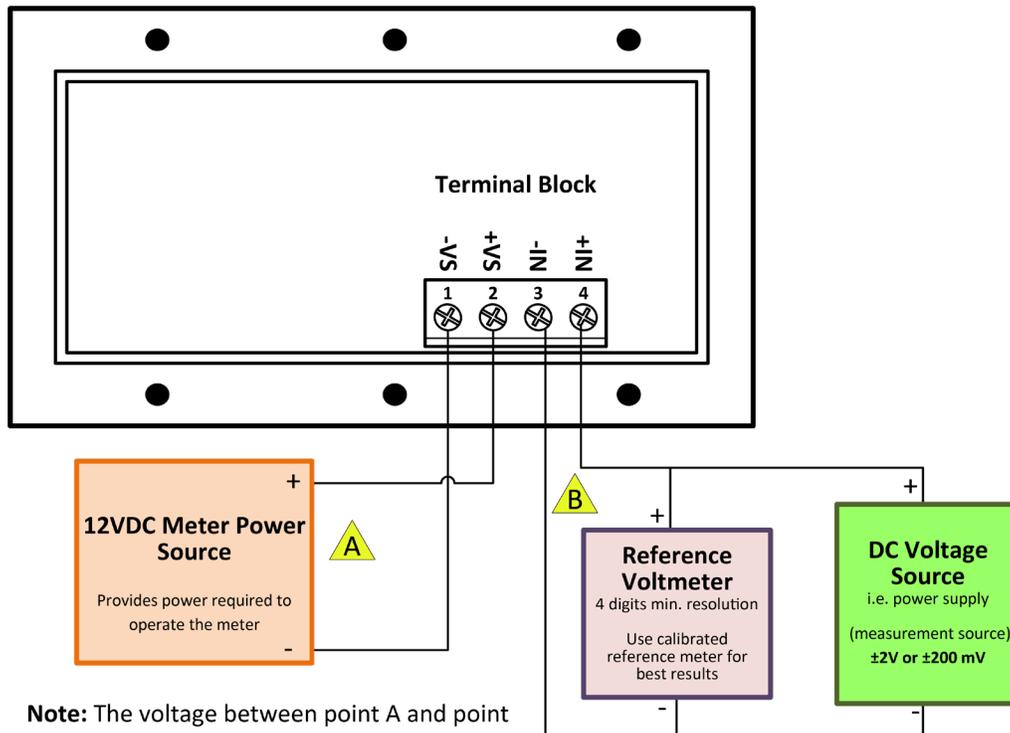
Connection Diagrams

Figure 2A: Typical connection for measurement, DMS01-VM1-RS12-C



Note: The voltage between point A and point B must be within +/- 48V

Figure 2B: Calibration Connections, DMS01-VM1-RS12-C



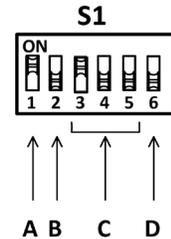
Note: The voltage between point A and point B must be within +/- 48V

DC VOLTMETER, CONTINUED

Measurement Example, DMS01-VM1-RS12-C

Step 1: Set S1 Dipswitch for a measurement range of ± 2.000 V (refer to [figure 1](#), pg. 1 for location of S1) as follows

- | |
|---|
| A. set SW1 ON \rightarrow for the ± 2 V input range |
| B. set SW2 OFF \rightarrow to disable the meter's digital filter |
| C. set SW3 ON, SW4 OFF, SW5 OFF \rightarrow to set the decimal place as "0.000" |
| D. set SW6 OFF \rightarrow to disable the trim & run the meter from factory calibration |



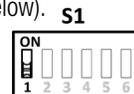
Step 2: Connect and Measure, DMS01-VM1-RS12-C

Connect the meter per [Figure 2A](#) using a ± 2 V power supply to provide the measurement voltage. The meter is now ready to measure from -2.000V to +2.000V to within $\pm 0.2\%$. The display brightness can be changed by varying the potentiometer R23.

Try the following test measurements:

- 1) Set the power supply voltage to 0.000 V. The meter's display should read between "-0.004" and "0.004" (0.000 +/- 0.2% Full Scale)
- 2) Set the power supply voltage to 2.000V. The meter's display should read between "1.996" and "2.004" (2.000 +/- 0.2%)
- 3) Finally, set the power supply to -2.000V. The meter's display should read between "1.996" and "2.004" (-2.000 +/- 0.2%)

Figure 2A showed the simplest connection using this voltmeter. Nevertheless, this meter can be connected as required by your application. Similarly, this voltmeter can be set to measure ± 200 millivolts by setting the SW1 switch to the OFF position (see below).

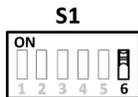


The decimal place, digital filter and trim enable can be set as in shown above or can be changed according to your application's requirement.

Calibration Procedure, DMS01-VM1-RS12-C

This meter is factory calibrated and can be adjusted if required, following these steps:

- 1) Connect as shown in [Figure 2B](#). For the purpose of this example, use a ± 2 V power supply to calibrate for a voltage range of ± 2.000 volts (the same procedure applies if using a ± 200.0 mV power supply)
- 2) Set S1: SW6 ON \rightarrow to enable the trim as shown:

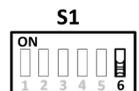


Enabling the trim allows the use of the potentiometers R18 (Offset Adjust) and R22 (Scale Adjust) to calibrate/adjust the meter

- 3) Set the calibrated power supply to 0.000V and adjust R18 so that the display and reference voltmeter read "0.000"
- 4) Set the power supply to 2.000V and adjust R22 so the display and reference voltmeter read "2.000"
- 5) Set the power supply to -2.000V and the display and reference voltmeter should read "-2.000"
- 6) Repeat steps 4 to 6 to ensure the adjustments do not affect one another

After completing this process the DMS01-VM1-RS12-C is capable of measuring from -2.000V to +2.000V to within $\pm 0.2\%$ and the meter can be connected per [Figure 2A](#), or as required by your application.

This meter can be returned to the original factory calibration settings by disabling the trim or setting the S1 SW6 to the OFF position:



DMS01-AM-RS12-C SETTINGS & OPERATION, DC AMMETER

Connection Diagrams:

Figure 3A: Typical connection for measurement, DMS01-AM-RS12-C

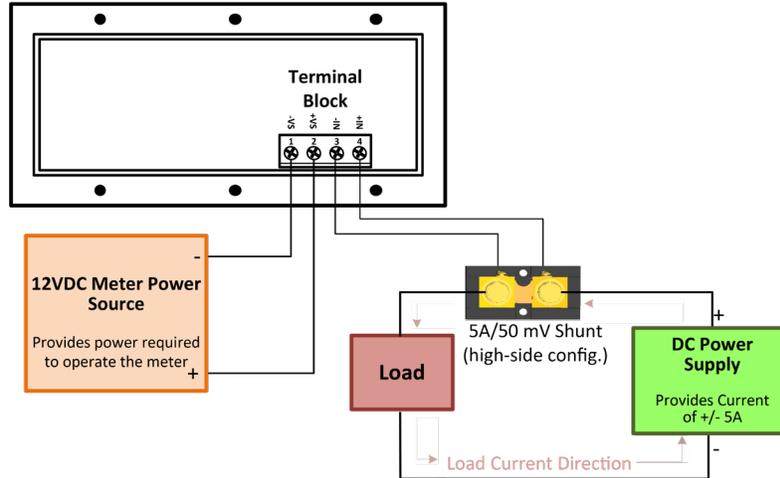
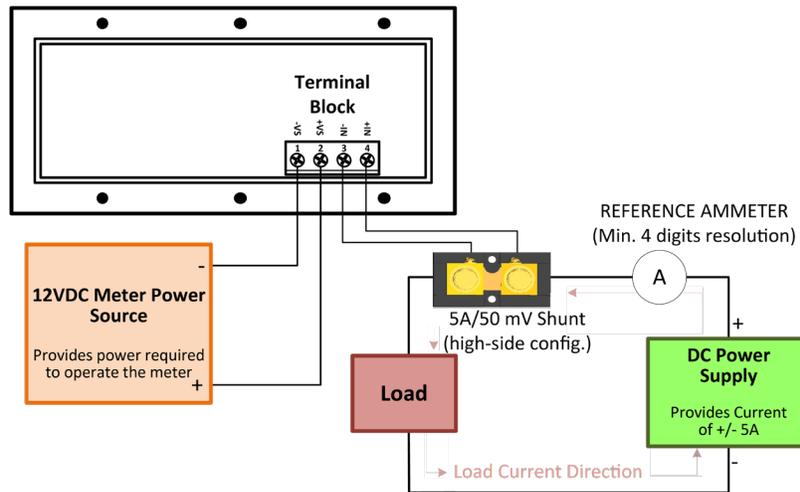
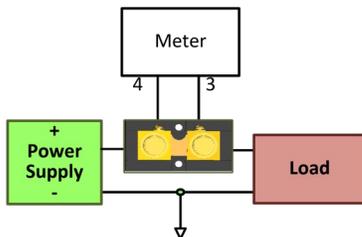


Figure 3B: Calibration Connections, DMS01-AM-RS12-C

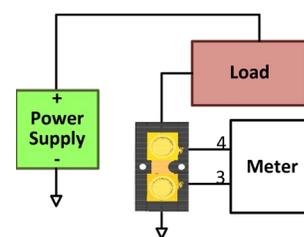


High-side & Low-side shunt configurations

high-side :



Low-Lower-side:

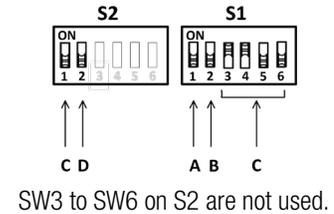


DC AMMETER, CONTINUED

Measurement Example, DMS01-AM-RS12-C

Step 1 Set dipswitches for DC Current measurement range of ± 5 A with a 5A/50mV shunt. Refer to [Figure 1](#) for location of S1, and S2.

- | | |
|----|--|
| A. | S1: set SW1 OFF \rightarrow for the ± 50 mV input range |
| B. | S1: set SW2 OFF \rightarrow to disable the meter's digital filter |
| C. | S2: set SW1 OFF & on S1: set SW3 ON, SW4 ON, SW5 OFF, SW6 OFF \rightarrow this sets the meter for a current range of ± 5.000 A -- see current range table in datasheet |
| D. | S2: set SW2 OFF \rightarrow to disable the trim and run the meter from factory calibration |



Notes: The ammeter features "auto-decimal place" and cannot be changed by end user.

Step 2: Connect and Measure, DMS01-AM-RS12-C

Connect per [Figure 3A](#) to measure currents from -5.000 A to +5.000 A to within $\pm 0.45\%$. The display brightness can be changed by varying the potentiometer R23.

Try the following measurements:

- 1) Set the power supply to 0.000 A, the meter's display should read between "-0.023" and "0.023" (0.000 \pm 0.45 % Full Scale)
- 2) Set the power supply to 5.000A, the meter's display should read between "4.977" and "5.023" (5.000 \pm 0.45%)
- 3) Set the power supply to -5.000A, the display should read between "-4.977" and "-5.023" (-5.000 \pm 0.45%)

Using this meter for additional current ranges:

This meter can be configured to measure a wide range of current by selecting a shunt resistor value and setting the corresponding dipswitches.

For example, to measure a current range of ± 100 A using a 100A/100mV shunt resistor, the corresponding dipswitch settings would be as follows:

- \triangleright S1: set SW1 ON \rightarrow to set the input range for ± 100 mV
- \triangleright S2: set SW1 OFF & on S1: set SW3 & SW4 ON, SW5 OFF, SW6 ON \rightarrow to set the current range

Refer to the [datasheet](#) for this and additional current range options and settings.

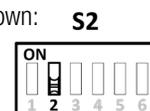
Note: The digital filter and trim enable can be set as in above example, or can be changed to support your application.

Calibration Procedure, DMS01-AM-RS12-C

This meter is factory calibrated and can be adjusted if required by following these steps:

- 1) Connect as shown in [Figure 3B](#). For the purpose of this example, both a calibrated reference ammeter and a non-calibrated ± 5 A power supply / current source is connected. If the power supply / current source is calibrated the ammeter is not needed. Ensure the power supply / current source and or the reference ammeter is calibrated and has at least four digits of resolution for best results. In the example, the meter will be calibrated for a current range of ± 5.000 A and the same procedure can be used for the current range between ± 1 A to ± 1200 A.
- 2) Keep the dipswitches set per step one, as this example is using the same ± 5 A range (follow same process for other current ranges).
- 3) Set S2: SW2 ON \rightarrow to enable the trim
- 4) Set the 5A power supply to 0.000A and adjust R18 so the display and reference ammeter read "0.000"
- 5) Set the power supply to 5.000A and adjust R22 so the display and reference ammeter read "5.000"
- 6) Set the power supply to -5.000A and the display and reference ammeter should read "-5.000"

Repeat these steps to ensure adjustments do not affect one another. After completing this process the DMS01-AM-RS12-C is capable of measuring from -5.000A to +5.000A to within $\pm 0.45\%$ and the meter can be connected per [Figure 3A](#), or as required by your application. The meter can be reset to factory calibration by disabling the trim by setting S2 SW2 to the OFF position as shown:



DMS01-CL-RS12-C SETTINGS & OPERATION, CURRENT-LOOP PROCESS METER

DMS01-CL-RS12-C measures a DC current in the range of 0-20 mA or 4-20 mA and displays measured current in one of two modes, Unipolar, 0 to 20000 counts or bipolar, 0 to ± 9500 counts.

Connection Diagrams:

Figure 4A: Typical connection for measurement, DMS01-CL-RS12-C

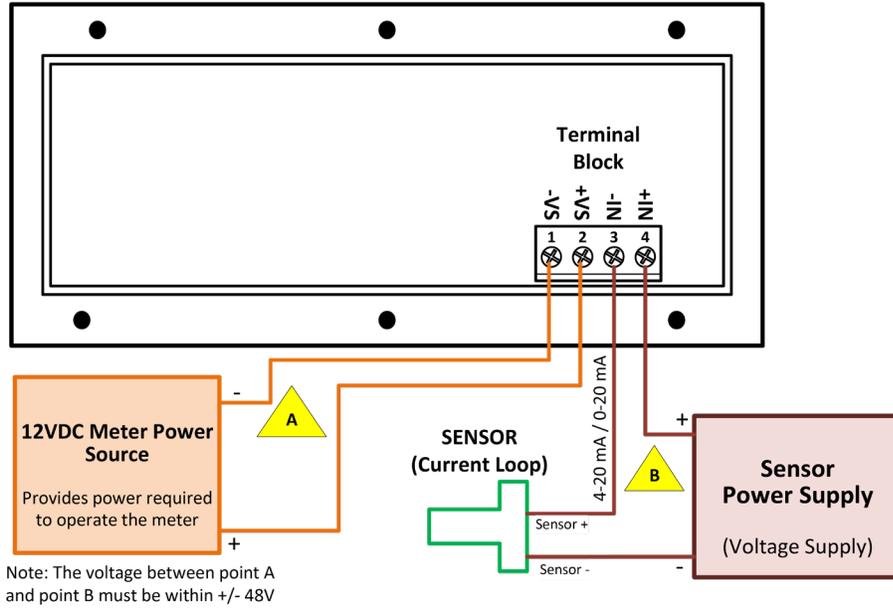
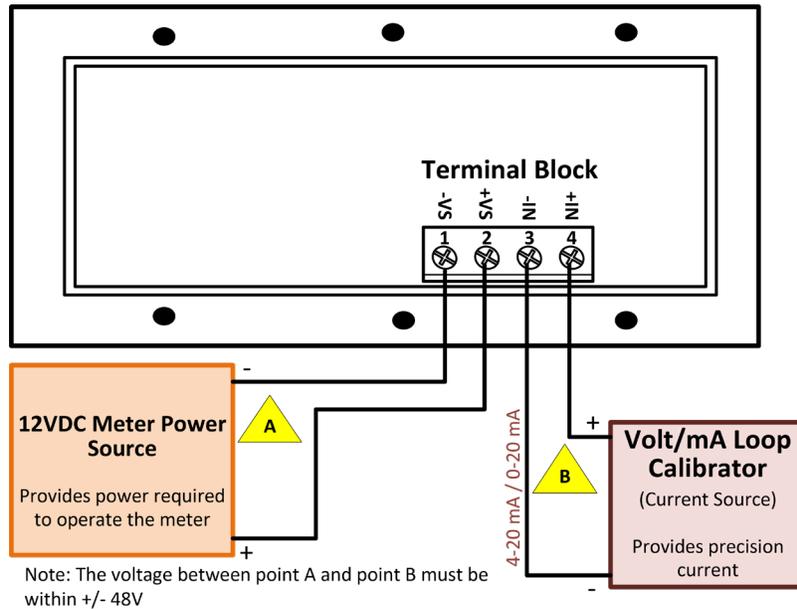


Figure 4B: Calibration Connections, DMS01-CL-RS12-C

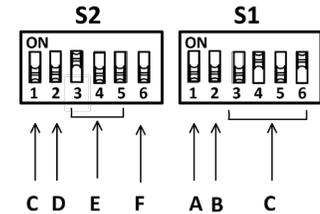


CURRENT LOOP PROCESS METER, CONTINUED

Measurement Example 1: measure an input current of 4-20mA and display from 0.000 to 6.500 or 4 mA="0.000" and 20 mA="6.500", $\pm 0.1\%$

Step 1 Set dipswitches as follows. Refer to [Figure 1](#) for location of S1, and S2.

- | |
|---|
| A. S1: set SW1 OFF \rightarrow for the 4-20 mA input current range |
| B. S1: set SW2 OFF \rightarrow to disable the meter's digital filter |
| C. S2: set SW1 OFF & on S1: SW3 OFF, SW4 ON, SW5 OFF, SW6 ON \rightarrow for a range of 6500 (see span range table in datasheet) |
| D. S2: set SW2 OFF \rightarrow for unipolar readings |
| E. S2: set SW3 ON, SW4 OFF, SW5 OFF \rightarrow for decimal place as "0.000" |
| F. S2: set SW6 OFF \rightarrow to disable the trim & run the meter from factory calibration |



Step 2: Connect and Measure, DMS01-CL-RS12-C

Connect per [Figure 4A](#) ; The display brightness can be changed by varying the potentiometer R23.

With the above configuration:

- 1) When the Sensor outputs 4.0 mA, the display should read between "-0.007" and "0.007" (0.000 +/- 0.1% Full Scale)
- 2) When the Sensor outputs 20.0 mA, the display should between "6.493" and "6.506" (6.500 +/- 0.1%)

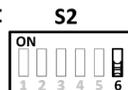
Calibration Procedure, DMS01-CL-RS12-C

This meter is factory calibrated and can be adjusted if required by following these steps. After these steps, the meter will be calibrated for an input current range of 4-20mA and span range of 0 to 6.500. Note that the same procedure can be used for an input current range of 0-20 mA and a span range of 0 to ± 20000 .

- 1) Connect as shown in [Figure 4B](#)
- 2) Keep the dipswitches set per step one above
- 3) Set S2: SW6 ON \rightarrow to enable the trim
- 4) Set the volt/mA loop calibrator (or calibrated current source) to 4.0 mA and adjust R18 so the display reads "0.000"
- 5) Set the volt/mA loop calibrator (or calibrated current source) to 20.0 mA and adjust R22 so the display reads "6.500"

Repeat these steps to ensure adjustments do not affect one another. You can now use this calibrated current loop process meter to measure input currents of 4-20 mA and display from 0.000 to 6.500 to within $\pm 0.1\%$. Reconnect the circuit as shown in [Figure 4A](#) or as required by your application. The meter can be returned to factory calibration by disabling the trim as follows:

Set S2: SW6 to OFF position as shown:



Similarly, this current loop meter can also be set to measure input currents in the 0-20 mA range by setting S1 SW1 to the ON position. **S1**

In this case, you will need to use a 0.0 mA input current as a calibration point instead of 4 mA. As shown:

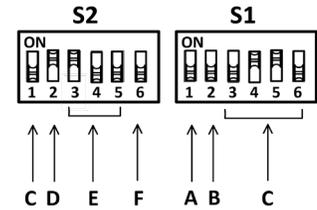


CURRENT LOOP PROCESS METER, CONTINUED

Measurement Example 2: measure an input current of 4-20mA and display from -4.500 to 4.500 or 4 mA=" -4.500", 12 mA="0.000" and 20 mA="4.500"

Step 1 Set dipswitches as follows. Refer to [Figure 1](#) for location of S1, and S2.

- | | |
|----|--|
| A. | S1: set SW1 OFF → for the 4-20 mA input current range |
| B. | S1: set SW2 OFF → to disable the meter's digital filter |
| C. | S2: set SW1 OFF & S1: SW3 OFF, SW4 ON, SW5 ON SW6 OFF → for a range of 4500 (see span range table in datasheet) |
| D. | S2: set SW2 ON → for bipolar mode or to display ±4500 |
| E. | S2: set SW3 ON, SW4 OFF, SW5 OFF → to set decimal place as "0.000" |
| F. | S2: set SW6 OFF → to disable the trim & run the meter from factory calibration |



Step 2: Connect and Measure, DMS01-CL-RS12-C

Connect per [Figure 4A](#) to measure currents from -5.000 A to +5.000 A to within ±0.45%. The display brightness can be changed by varying the potentiometer R23.

With the above configuration:

- When Sensor+ outputs 4.0 mA, the display should read between "-4.495" and "-4.504" (-4.500 V +/- 0.1%)
- When Sensor+ outputs 12.0 mA, the display should read between "-0.005" and "0.005" (0.000 +/- 0.1% Full Scale)
- When Sensor+ outputs 20.0 mA, the display should read between "4.495" and "4.505" (4.500 V +/- 0.1%)

Calibration Procedure, DMS01-CL-RS12-C

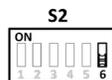
This meter is factory calibrated and can be adjusted if required by following these steps. After these steps, the meter will be calibrated for an input current range of 4-20mA and span range of 0 to ±4.500. Note that the same procedure can be used for an input current range of 0-20 mA and a span range of 0 to ±9500.

- Connect as shown in [Figure 4B](#).
- Keep the dipswitches set per step one above.
- Set S2: SW6 Set ON → to enable the trim
- Set the volt/mA loop calibrator (or calibrated current source) to 12.0 mA input and adjust R18 so the display reads "0.000"
- Set the volt/mA loop calibrator (or calibrated current source) to 20.0 mA and adjust R22 so the display reads "4.500"
- Set the volt/mA loop calibrator to 4.0 mA and the meter should display "-4.500"

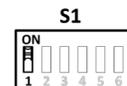
Repeat these steps to ensure adjustments do not affect one another. You can now use this meter to measure input currents of 4-20 mA and display from "-4.500" to "4.500" to within 0.1%. Reconnect the circuit as shown in [Figure 4A](#) or as required by your application.

The meter can be returned to factory calibration by disabling the trim as follows:

Set S2: SW6 OFF as shown:



Similarly, this current loop meter can also be set to measure input currents in the 0-20 mA range by setting S1 SW1 to the ON position as shown:



DMS01-VP-RS12-C SETTINGS & OPERATION, VOLTAGE PROCESS METER

DMS01-VP-RS12-C voltage process meter measures DC voltage in the range of 0-5 volts or 0-10 volts while displaying voltage in the range of 0 to 20000 counts, unipolar mode or from 0 to ± 9500 counts, bipolar mode.

Connection Diagrams:

Figure 5A: Typical connection for measurement, DMS01-VP-RS12-C

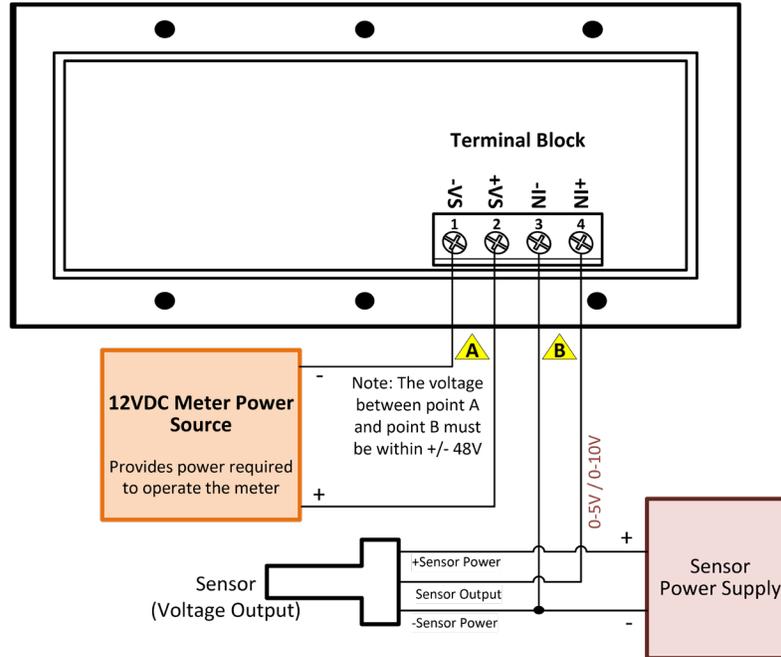
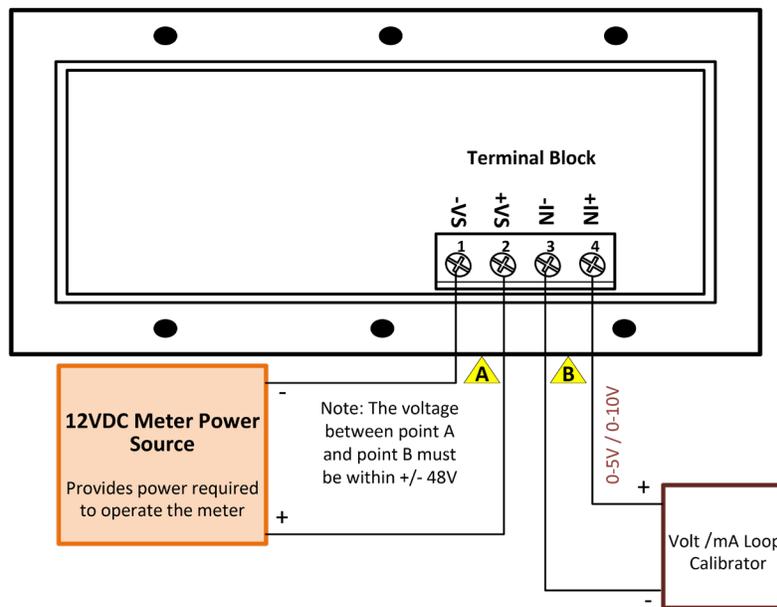


Figure 5B: Calibration Connections, DMS01-VP-RS12-C

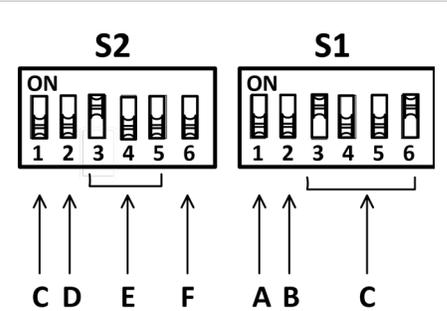


VOLTAGE PROCESS METER CONTINUED

Measurement Example 1: measure an input voltage of 0-5 V and display from 0.000 to 6.000 or 0.000V="0.000" and 5.000V="6.000"

Step 1 Set dipswitches as follows. Refer to [Figure 1](#) for location of S1, and S2.

- | |
|--|
| A. S1: set SW1 OFF → for the 0-5V input voltage range |
| B. S1: set SW2 OFF → to disable the meter's digital filter |
| C. S2: set SW1 OFF & on S1 SW3 to ON, SW4 to OFF, SW5 to OFF & SW6 to ON → for a span range of 6000 -see span range table in datasheet |
| D. S2: set SW2 OFF → for unipolar readings |
| E. S2: set SW3 ON, SW4 → to OFF & SW5 to OFF to set decimal place as "0.000" |
| F. S2: set SW6 OFF → to disable the trim & run meter from factory calibration |



Step 2: Connect and Measure, DMS01-VP-RS12-C

Connect per [Figure 5A](#) ; The display brightness can be changed by varying the potentiometer R23.

With the above configuration:

1. When sensor outputs 0.000V, the display should read between "-0.006" and "0.006" (0.000 +/- 0.1% Full Scale)
2. When sensor outputs 5.000V, the display should read between "5.994" and "6.006". (6.000 +/- 0.1%)

Calibration Procedure, DMS01-VP-RS12-C

This meter is factory calibrated and can be adjusted if required by following these steps. After these steps, the meter will be calibrated for voltage process meter to measure input voltages of 0-5V and display from "0.000" to "6.000" to within ±0.1%. Note that the same procedure can be used for an input current range of 0-10V and a span range of 0 to 20000

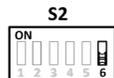
Connect as shown in [Figure 5B](#).

1. Keep the dipswitches set per step one above
2. Set S2: SW6 ON → to enable the trim
3. Set the volt/mA loop calibrator to 0.000V and adjust R18 so the display reads "0.000"
4. Set the volt/mA loop calibrator to 5.000V and adjust R22 so the display reads "6.000"

Repeat these steps to ensure adjustments do not affect one another. Reconnect the circuit as shown in [Figure 5A](#) or as required by your application.

The meter can be returned to factory calibration by disabling the trim as follows:

Set S2: SW6 OFF as shown:

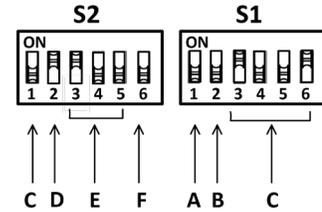


VOLTAGE PROCESS METER CONTINUED

Measurement Example 2: measure input voltages of 0-5V and display from “-6.000” to “6.000” to within $\pm 0.1\%$.

Step 1 Set dipswitches as follows. Refer to [Figure 1](#) for location of S1, and S2.

- | | |
|----|--|
| A. | S1: set SW1 OFF \rightarrow for the 0-5V input voltage range |
| B. | S1: set SW2 OFF \rightarrow to disable the meter’s digital filter |
| C. | S2: set SW1 OFF & on S1: SW3 ON, SW4 OFF, SW5 OFF & SW6 ON \rightarrow for a span range of 6000. See span range table in the datasheet |
| D. | S2: set SW2 ON \rightarrow for bipolar mode or to display ± 6.000 |
| E. | S2: set SW3 ON, SW4 OFF, SW5 OFF \rightarrow to set decimal point as “0.000” |
| F. | S2: set SW6 OFF \rightarrow to disable the trim and run the meter from factory calibration |



Step 2: Connect and Measure, DMS01-VP-RS12-C

Connect per [Figure 5A](#) ; The display brightness can be changed by varying the potentiometer R23.

With the above configuration:

- When sensor outputs 0.000V, the display should read between “-5.994” and “-6.006” (0.000 +/- 0.1% Full Scale)
- When sensor outputs 2.500V, the display should read between “-0.006” and “0.006” (0.000 +/- 0.1% Full Scale)
- When sensor outputs 5.000V, the display should read between “5.994” and “6.006” (6.000 +/- 0.1%)

Calibration Procedure, DMS01-VP-RS12-C

This meter is factory calibrated and can be adjusted if required by following these steps. After these steps, the meter will be calibrated for measuring input voltages of 0-5V and display from “-6.000” to “6.000” to within +/- 0.1%. Note that the same procedure can be used for an input current range of 0-10V and a span range of 0 to +/-9500.

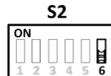
Connect as shown in [Figure 5B](#).

- Keep the dipswitches set per step one above.
- S2, SW6 ON \rightarrow to enable the trim
- Set the volt/mA loop calibrator to 2.500V and adjust R18 so the display reads “0.000”
- Set the volt/mA loop calibrator to 5.000V and adjust R22 so the display reads “6.000”
- Set volt/mA loop calibrator to 0.000V and the display should read “-6.000”

Repeat these steps to ensure adjustments do not affect one another. Reconnect the circuit as shown in [Figure 5A](#) or as required by your application.

The meter can be returned to factory calibration by disabling the trim as follows:

Set S2: SW6 OFF as shown:



Similarly, this voltage process meter can also be set to measure input voltages in the 0-10V range. To measure input voltages in the 0-10V range, set the S1 SW1 to the ON position as shown:

