Murata Power Solutions

DMS APPLICATION NOTE 11

Using the DMS-EB-RMS Board

General Description

When soldered to a 2V-input, 3½ digit DMS-30 Series meter, the DMS-EB-RMS Application Board enables the meter to display the true rms value of ac voltages up to 750V with a resolution of 1V. When the board is soldered to a 200mV-input DMS-30 meter, ac voltages up to 199.9V can be displayed with 0.1V resolution. The DMS-EB-RMS board will operate with either LED display (DMS- 30PC) or 5V-powered LCD display (DMS-30LCD) meters.

As shown in Figure 2, a 1000:1 voltage divider consisting of resistors R1 (988k), R2 (988k) and R3 (1.98k) is used to attenuate the ac input to a level that U1 can accept. U1 is a precision, integrated circuit, ac-to-rms converter whose dc output is directly applied to the DMS-30's input.

As an example, assume a 120Vrms, 60Hz, ac power-line input is applied to TB1 terminals 1 and 3. This input is divided down to 0.120Vrms and then applied to U1. If the selected DMS-30 meter has a ±2V input range (-1 suffix), the display reading will be "120" (1Vac resolution). If the selected DMS-30 meter has an input range of ±200mV (-0 suffix), the display reading will be "120.0" (decimal point DP3 is enabled by shorting solder gap SG1).

Powering the DMS-EB-RMS

As stated in the DMS-EB-RMS's data sheet, a dedicated, transformer-isolated, +5V power supply must be used to power the DMS-EB-RMS and its meter in order to ensure safe operation when measuring ac power mains input signals. The transformer's breakdown voltage rating must always be higher than the ac input being measured. The DMS-EB-RMS provides no isolation between the ac input signal and the meter's 5V RETURN terminal. Take extreme care when connecting any ac power mains source as an input signal to the DMS-EB-RMS. Never connect the DMS-EBRMS's 5V RETURN terminal to earth (chassis) ground since this could defeat any safety grounding and place the system's +5V power supply, and all its associated circuitry, at dangerously elevated ac-line potentials.

The only time the above precautions may be deviated from is if the input signal is either transformer-coupled or electrically isolated from the ac power line. The output of a current transformer (used for making ac amperage measurements) is an example of an ac signal that normally exceeds the isolation requirements stated earlier. Do not hesitate to consult Murata Power Solutions if you have questions regarding any aspect of your DMS-EB-RMS application.

Modifying the DMS-EB-RMS's Input Circuit

The 1000:1 input divider described above can be altered or removed altogether to suit the user's particular input requirements. However, in all cases, the maximum voltage that can be applied to U1's VIN terminal (pin 2) is 1.0Vac. For example, to display a 0 to 1Vac input with 1mV resolution, a jumper wire (JP1) can be used to effectively short R1 and R2 (see Figure 1). In applications in which R1 and R2 are shorted, R3 should also be removed from the circuit because it may load down the signal source. With this configuration and an input of 1.0Vac, a DMS-30PC-1 meter (±2V input) will display "1.000".

As another example, assume that the input signal range is 0 to 10Vac. A 10Vac input is too high to be applied directly to U1; it must first be divided by a factor of 10 to obtain a level of 1.0Vac at U1 pin 2. This can easily be accomplished by leaving R1 and R2 in the circuit and replacing R3 with a precision, ±0.1%, 221k resistor.

A DMS-30PC-1 meter will now read "10.00" for an input of 10Vac. The appropriate decimal point is enabled via the on-board solder gaps: DP1 in the first example and DP2 in the second example.

Eliminating DC Components

To measure the ac component of a signal that is "riding on top" of a dc voltage, the ac input to the DMS-EB-RMS must be capacitively coupled. The capacitor value chosen should produce negligible capacitive reactance (impedance) at the lowest frequency of interest. A 0.1µF ceramic or film capacitor can be used with 120-220Vac, 50/60Hz inputs. The minimum voltage rating of the coupling capacitor is determined by first finding the sum of the peak ac signal plus its dc component, and then multiplying this sum by a safety factor of 1.5. The coupling capacitor is installed in series with TB1 and the ac input. One capacitor lead is attached directly to TB1 terminal 1 and the other lead soldered to the ac input.

DMS-40 Applications

The DMS-EB-RMS board can be used with 4½ digit DMS- 40PC-1-RS (2V input, LED display) or DMS-40LCD-1/2-5 (2V input, 5V-powered, LCD display) voltmeters by simply cutting the etch between pins 7 and 8 as shown in Figure 1. This removes the short circuit between REF. OUT and REF. IN which is needed for DMS-30 Series meters. SG4, SG1, SG2, and SG3 are used to select decimal points DP4, DP3, DP2 and DP1, respectively.

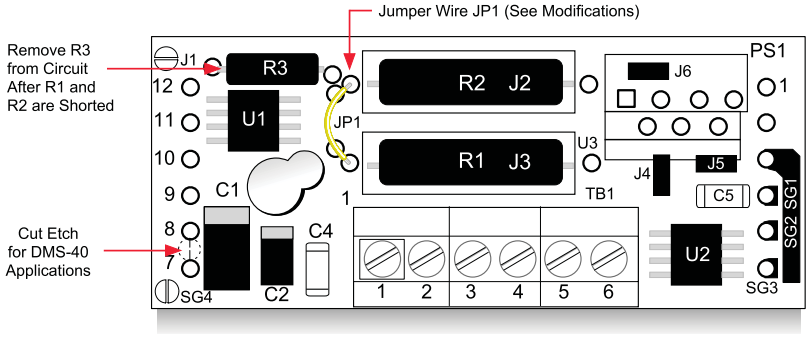

Figure 1. Modifying the DMS-EB-RMS Application Board

Using the DMS-EB-RMS Board

Calibration Access Holes

The DMS-EB-RMS board now has two overlapping holes which provide access to the DMS-30 and DMS-40 meters' rear calibration adjustment potentiometers. In many applications, particularly those involving modifications to the board's 1000:1 input resistor divider, these pots can be adjusted to obtain higher accuracy than the specified ±0.5% in the 0-199.9Vac mode or the ±2% in the 0-750Vac mode.

The mechanical adjustment range of these potentiometers is only ¾ of a turn on DMS-30 meters and 3 turns on DMS-40 meters. DMS-30 pots have fixed end-stops, DMS-40's do not. Therefore, do not use excessive force when making adjustments. Use extreme caution and plastic insulated tools since adjustments have to be made with the DMS-EB-RMS fully energized.

Other DMS-EB-RMS Components

The DMS-EB-RMS board layout was recently updated to include circuitry for many new features: an on-board +5V dc/dc converter (PS1); an LM7805 three-terminal linear regulator (U3); surface mount pads under R1 and R2; solder gap SG4 for decimal point DP4 on DMS-40 meters; and the calibration potentiometer access holes described earlier.

PS1 will support a transformer-isolated, +5V power supply (required when making ac power mains measurements) to be mounted directly on the DMS-EB-RMS itself. U3, the location for an LM7805 regulator, will allow for operation from power sources other than the standard +5Vdc.

Please consult Murata Power Solutions for more information regarding availability and use of any of the new components or features of the DMS-EB-RMS board. Murata Power Solutions' website, www.murata-ps.com/dpm, is an excellent source for obtaining the latest revision of product data sheets and/or applications information.

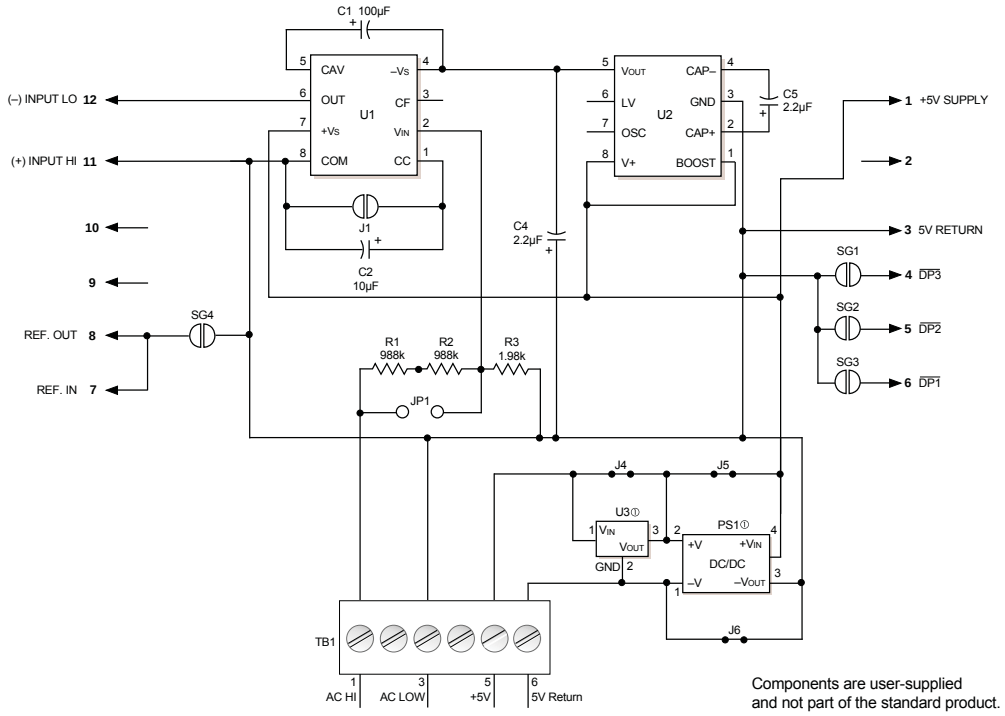

Figure 2. Powering the DMS-EB-RMS

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