KEITHLEY

Firmware Upgrade for Model 2001-M
Release Notes

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Average responding RMS

This firmware upgrade includes an average-responding RMS converter to provide average-responding RMS readings (RMS-Average). This new AC type uses the averaging AC detector, but multiplies the average of the rectified signal by the following correction factor:

$$\frac{\pi}{2\sqrt{2}} = 1.11$$

When used for a sinusoidal signal, the RMS-Average value is the same as the true RMS value. RMS-Average readings for non-sinusoidal signals will not be true RMS.

Sinusoidal signal – For ±10V peak amplitudes, the signal will be read as follows:

Average = Peak × 0.637	RMS = Peak × 0.707	RMS-Average = Average × 1.11
= 10V × 0.637	= 10V × 0.707	= 6.37V × 1.11
= 6.37V	= 7.07V	= 7.07V

As shown above, the RMS reading and RMS-Average reading for a sinusoidal signal is the same.

Half-wave rectified sine wave – For a +10V amplitude, the signal will be read as follows:

Average = Peak × 0.318	RMS = Peak × 0.5	RMS-Average = Average × 1.11
= 10V × 0.318	= 10V × 0.5	= 3.18V × 1.11
= 3.18V	= 5V	= 3.53V

Square wave – For a ±10V amplitude, the signal will be read as follows:

Average = Peak × 1.0	RMS = Peak × 1.0	RMS-Average = Average × 1.11
= 10V × 1.0	= 10V × 1.0	= 10V × 1.11
= 10V	= 10.V	= 11.1V

Rectified square wave – For a +10V amplitude, the signal will be read as follows:

Average = Peak × 0.5	RMS = Peak × 0.5	RMS-Average = Average × 1.11
= 10V × 0.5	= 10V × 0.5	= 5V × 1.11
= 5V	= 5V	= 5.55V

Front panel operation

Perform the following steps to select the RMS-average AC type for volts or current measurements:

1. Press **CONFIG** and then **ACV** or **ACI** to display the menu items.
2. Select **AC-TYPE** to display the menu for AC measurement type names.

NOTE   *Some of the **AC TYPE** names have been abbreviated so they will fit in the display of the Model 2001-M:*

        ***AVERAGE** has been shortened to **AVG**.*
        ***LOW-FREQ-RMS** has been shortened to **LFREQ-RMS**.*

3. Select **RMS-AVG** for average-responding RMS readings.

With the RMS-AVG type selected, the message "RMSA" (RMS average) is displayed along with the reading.

Remote programming

Use the following SCPI commands to select the RMS-average AC type:

Voltage measurements:

```
[SENSe[1]]:VOLTage:AC:DETector[:FUNCtion] RMSAverage
```

Current measurements:

```
[SENSe[1]]:CURRent:AC:DETector[:FUNCtion] RMSAverage
```

Upgrading 2001-M unit for B16 firmware

NOTE   *This firmware upgrade can be performed on Model 2001-M units that have serial number less than 0936521. The serial number can be read from the front panel MAIN MENU as follows:*

    1. Press the MENU key.
    2. Select the GENERAL menu item.
    3. Select the SERIAL# menu item.

    Over the bus, the *IDN? command can be used to read the serial number.

This firmware upgrade kit includes two ROMs that will allow the Model 2001-M to perform average-responding RMS AC measurements (voltage and current). This release covers the new RMS function and explains how to install the new ROMs (firmware upgrade).

Firmware upgrade procedure

The upgrade kit contains two new ROMs that are to be installed in the unit. Perform the following steps to install the ROMs:

WARNING   **The following procedure is to be performed by qualified service personnel only.**

CAUTION **Static electricity could damage the ROMs or other components on the PC board of the Model 2001-M. Avoid touching the connector pins of the ROMs and other circuitry on the PC board. It is recommended that service personnel use a grounded wrist strap when handling and installing the ROMs.**

WARNING **To prevent electrical shock, turn off the Model 2001-M and remove the power line cord. Also, remove all test leads from the unit.**

1. Remove the line cord and remove any test leads.
2. Remove the rear panel bezel. It is secured to the rear panel by two screws.
3. Turn the unit upside down, and remove the one screw from the bottom of the unit. It is located at the rear of the cover.
4. Slide the cover towards the rear and remove it.
5. Locate U637 and U638 on the digital board (on the bottom of the unit). These ROMs are labeled on the board.
6. Using a flat-bladed screwdriver, carefully pry the two ROMs out of their sockets.
7. The two new ROMS are labeled "U637" and "U638":
   - The ROM labeled "U637" is part number 2001M-803-xxx.
   - The ROM labeled "U638" is part number 2001M-804-xxx.
     Where: xxx is the firmware revision (e.g., B15).

   Install the two ROMs in the sockets using the following guidelines:
   - The ROM marked "U637" belongs in the socket labeled "U637".
   - The ROM marked "U638" belongs in the socket labeled "U638".
   - Make sure to align the notched end of ROM with the notch in the socket.
   - Make sure all the pins are lined up with the holes before pressing them firmly into the sockets.
8. Make sure no pins are bent, and then reinstall the cover. Make sure the front legs of the unit (if installed) line up with the slots in the cover.
9. Reinstall the bottom screw for the cover, and reinstall the rear bezel.
10. Connect the power line cord and turn the unit on. During power-up, the message "Model 2001M" should be displayed briefly.

    NOTE *If the unit instead displays "NO COMM LINK", there is a communication problem with the ROMS. Turn off the unit, disconnect the line cord, and repeat steps 1 through 4 to gain access to the ROMs. Double-check that the notched end of each ROM is aligned with the notch in the socket. Also, make sure that all ROM pins are properly engaged into the sockets.*

11. Re-calibrate the Model 2001-M as explained in the Model 2001 Calibration Manual.