MeterBuilder™ MB-1
PROGRAMMABLE
RF POWER METER

QUICK-START GUIDE
FOR PRE-ASSEMBLED UNITS

Version 1.02
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Patent and Copyright Notices

Patent Applied For

FCC Notice

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications to this device not expressly approved by the Manufacturer could void the user's authority to operate this equipment.

FIGURES:

1 Introduction

Thank you for purchasing the MeterBuilder MB-1 Power Meter. Your MB-1 has been calibrated at the factory and is ready for operation. This manual provides a brief overview to get your MB-1 up and running quickly. For a complete description of all MB-1 features, see the MB-1 User Manual.

2 Programming your MB-1

Refer to **Figure 1.** A consistent approach is used for configuring all of the MB-1 features. To configure the MB-1, you use the front panel **Up** or **Down** front panel buttons to select the menu of interest, ***which is displayed on line 4 of the LCD***. ***Each menu item on line 4 of the LCD has one to four positional items that can be modified by pressing one of four corresponding menu buttons, M1 through M4. (Positional items in the menu are separated by one or more spaces on line 4 of the LCD.)***

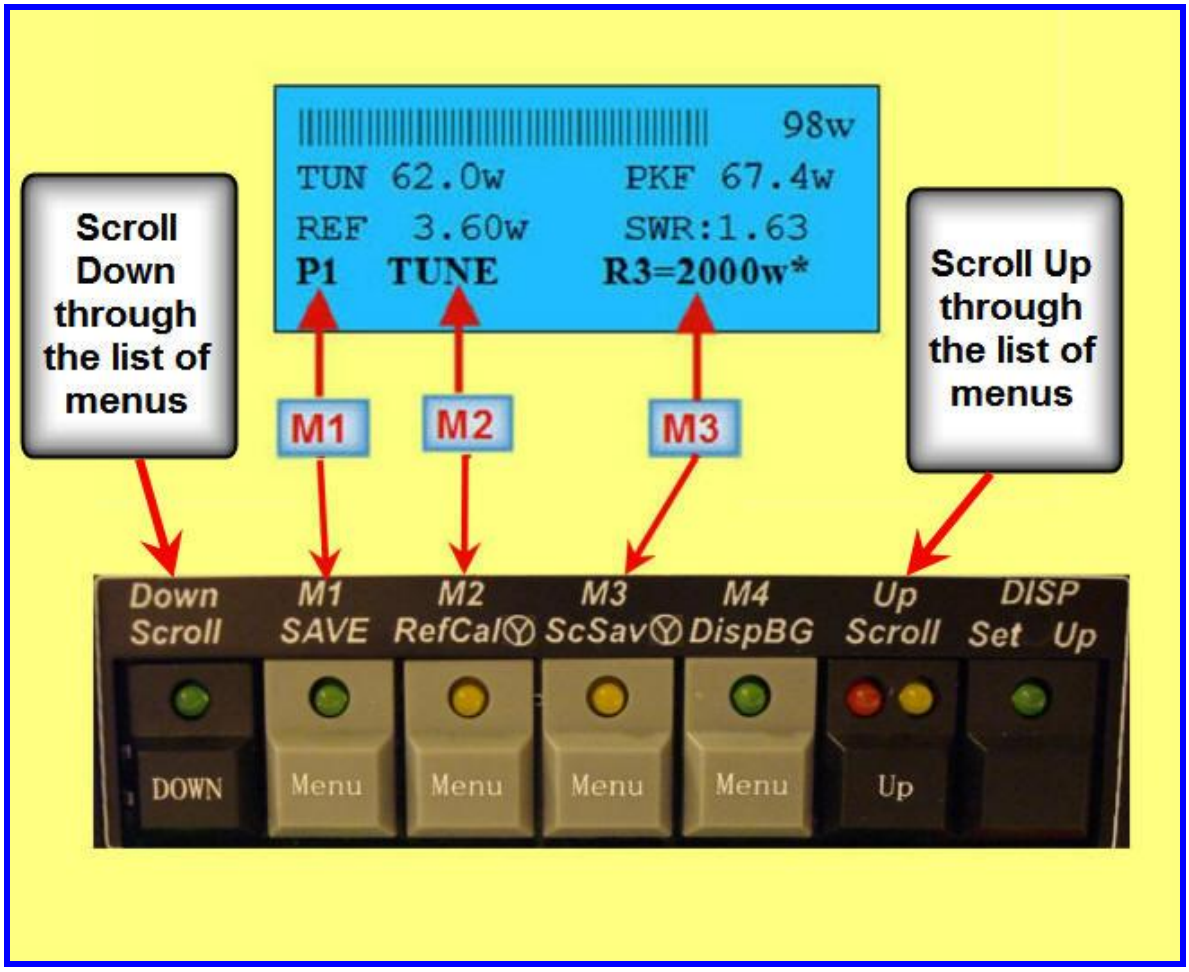
To modify most meter settings, you need to follow two simple steps:

1. First, select the menu for the item you wish to control. Do this by pushing the Menu **Down** Scroll button or Menu **Up** Scroll button shown below. Each of the 19 available menus will scroll in alphabetical order on the bottom line (line 4) of the LCD. Release the scroll button when the desired menu is displayed. A single push of the **Up** or **Down** Scroll button will advance to the next menu, or move back to the previous menu if you overshoot using the **Up** or **Down** scroll buttons.

For quicker access to the most commonly used menus, you can use the bottom row of buttons, referred to as ***shortcut buttons***, to get to a desired menu with the push of a single button. Some examples will be given below.

2. When the desired menu is displayed on line 4 of the LCD as shown below (Panel Meter menu shown in this example in **Figure 1**), press one of the four menu buttons, **M1** through **M4** to modify the first through fourth menu items on line 4, as read from left to right on line 4 of the LCD. ***This will modify the setting associated with that menu button.***

Figure 1 - Example - Configuring the Panel Meter



The example above shows the menu that controls the Analog Panel Meter functions. Menu buttons **M1** - **M3** correspond to the three positional items, as read from left to right, on line 4 of the LCD. (***Menu items are separated on line 4 of the LCD by one or more spaces.)***

Each push of a menu button will select the next available choice for that option.

- In this example, menu button **M1** selects the Panel Meter. (MB-1 supports external analog meters in addition to the built-in crossneedle meter). Panel meter 1 (**P1**), which is the internal crossneedle meter, is selected in the above example. If you have not added any additional external analog meters, **P1** will be your only choice. As you add additional meters, this menu will automatically adapt to allow you to select the additional analog meters you have added.

- **M2** selects the measurement type you want to display on the selected Panel Meter. **TUNE** (instantaneous power) is selected in the above example. Each press of **M2** cycles through the other measurement types that can be displayed on the analog meter (e.g., Peak Power, Average Power, Delivered Power, Min and Max functions, etc.).

- **M3** selects the Panel Meter manual range. In the above example, the third range (**R3**) is currently set at 2000 watts, and is being controlled by the AutoRange function. (***The asterisk indicates that the Panel Meter AutoRange function is on***, and is therefore controlling the range based on the magnitude of the signal being measured). Pressing **M3** will turn the AutoRange function off and will select the lowest range that the panel meter was calibrated at when it was set up during calibration. (The internal Panel Meter comes shipped with three ranges: 20 watts; 200 watts, and 2000 watts.) Subsequent presses of **M3** will select successively higher ranges with wrap-around.

- Since the Panel Meter menu has only three options corresponding to the three fields on the line 4 menu, menu button **M4** is not used with this menu.

If you wish to see a few more examples, see Programming the MB-1.

Note- User feedback indicates that using four grey buttons for the MENU switches (as shown above) and a grey Display/Setup button (top right button, which is shown in black above) provides for the easiest and quickest identification of the switches during operation. Your MB-1 comes with these five grey switches installed, and a red power-on switch installed.

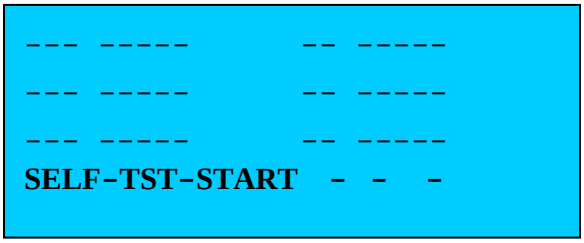
3 Checking your MB-1

Even though your MB-1 was tested prior to shipment, a good way to get acquainted with your meter is to run the built-in diagnostics software, which exercises the various hardware functions of your MB-1. The Self Test menu is shown in **Figure 2** below. To start the self test procedure, first select the self test menu by pressing either the **Down** or **Up** Scroll buttons on the top row of buttons until the self test menu is displayed on line 4 of the LCD, as shown in **Figure 2** . Then tap the left most menu button, **M1** (Menu button 1) to initiate the self test sequence. (This menu only has one choice, and is therefore controlled by menu button **M1**).

The self test procedure is covered in detail in section 3.18 of the MB-1 User Manual. These diagnostics can be run any time to verify the hardware on your MB-1.

The website also has a troubleshooting section. These troubleshooting procedures are intended for use primarily with the solder version of the kit, but you may find them useful as well.

Figure 2 - Self Test Menu



4 Quick Start

Your MB-1 has been calibrated, and the coupler 1 port has been selected as the default. Refer to **Figure 3** and **Figure 4** below.

1. Using the included RCA cable, connect the MB-HF1 coupler to the MB-1 coupler 1 port using the red and white colors to connect to the FWD and REF port respectively.

2. Insert the MB-HF1 coupler in the transmission line to be measured. Connect the TX connector to the transmitter. Connect the LOAD connector the antenna (or dummy load).

3. Plug the 12v DC source into the power connector (center terminal is positive).

4. Turn the meter on by pressing the red power button on the front panel.

Figure 3 – Coupler and Power Connections

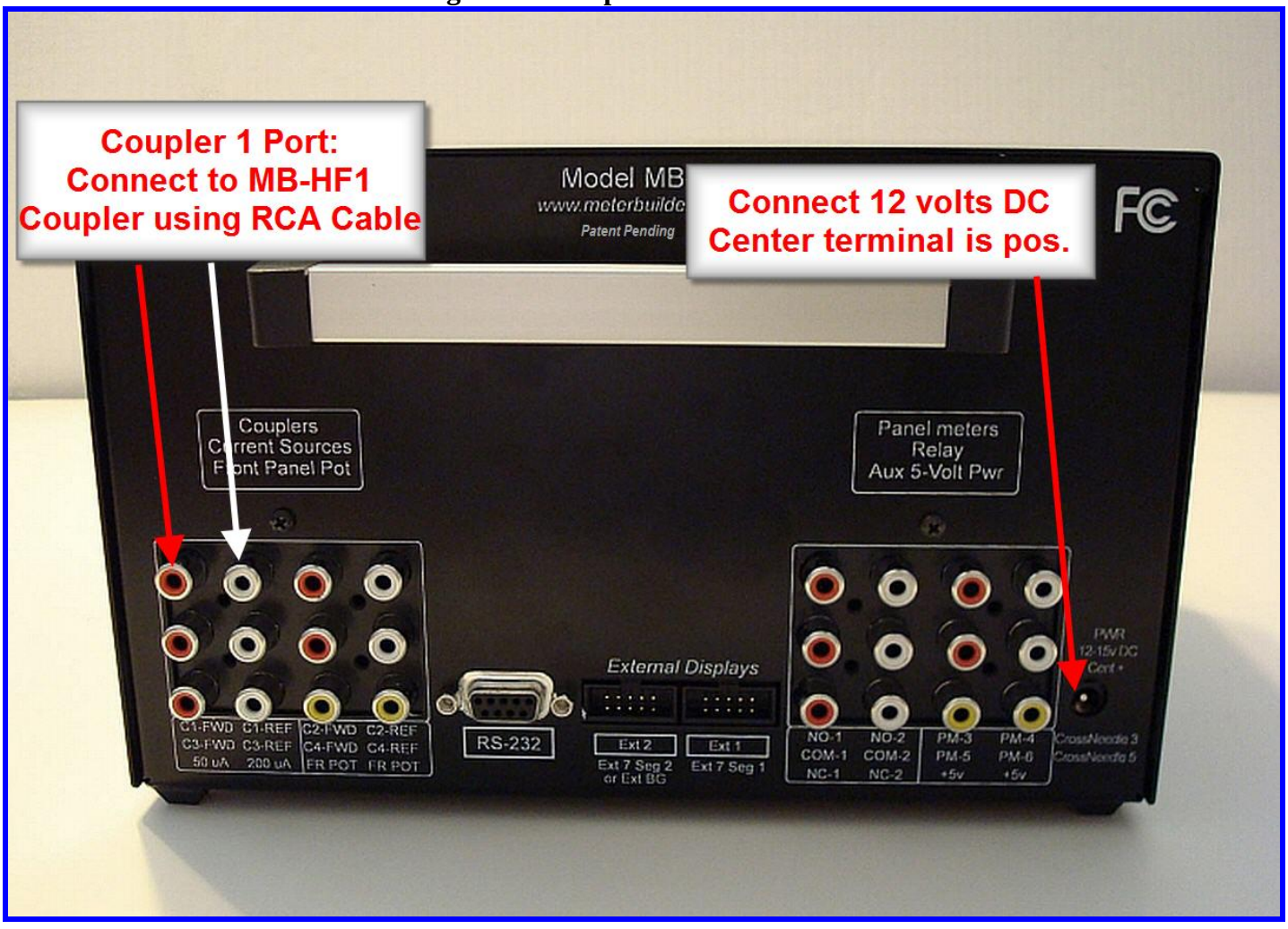


Figure 4 – MB-HF1 Coupler

Your meter is now ready to operate. As shipped, the seven segment LEDs are configured to display instantaneous (TUNE) power on the top left LED (**D1**), and Peak Power on the top right LED (**D2**). The other two 7 segment LEDs are turned off.

The analog meter is set to the 20 watt range.

Keep these settings in mind as you start to use your MB-1. To give you some practice, we will modify them shortly to settings that are more appropriate to most stations. Note, there is no possibility of damaging the analog meter by applying power greater than 20 watts. The ***Soft Overrange*** feature simply drives the meter needles slightly passed the full scale point to let you know when you are in an overrange indication.

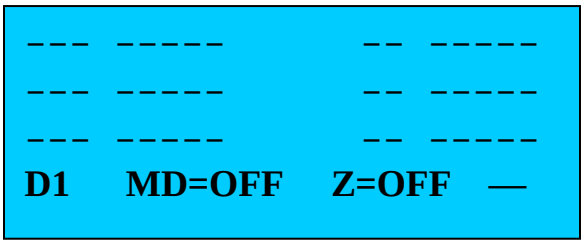
5 Changing some of the Settings and saving them

We will now configure the bottom left 7-segment LED to display SWR (it is currently off). We will also set the Analog Panel Meter range to 200 watts full scale.

5.1 Adding SWR Reading to D3

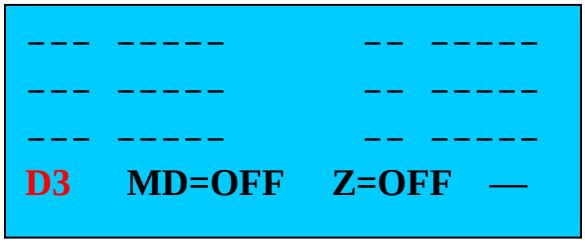
D3 is the bottom left 7-segment LED.
First bring up the 7-segment menu on line 4 of the LCD. This is most easily done by using the 7-segment ***shortcut button***. This button is on the bottom row, second button from left. Tap that button once. The 7-segment menu should now be on line 4 of the LCD as shown below in
Figure 5.

Figure 5 – 7-Segment Menu



With the 7-segment menu displayed on line 4 of the LCD, menu button **M1** is used to select the 7-segment module to be configured (the first field of this menu). Tap **M1** (left most menu button) until **D3** is displayed as shown in **Figure 6** below. If you overshoot, simply keep tapping until **D3** is displayed again. (Again, **D3** is the 7-segment module we want to configure.)

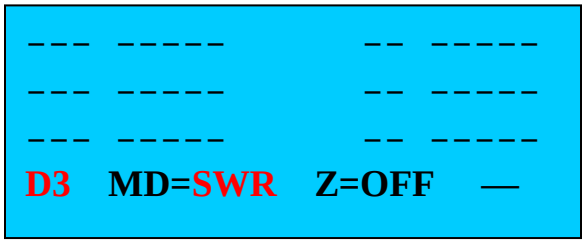
Figure 6 – 7-Segment Menu with Module 3 (D3) selected



Once **D3** is selected, menu button **M2** is used to change the parameter to be displayed on the selected 7-segment module (which is displayed in the second field of this menu). Tap **M2** (second menu button) repeatedly until the second field of the menu is set to **MD=SWR** (mode = SWR) Again, if you overshoot, simply tap **M2** repeatedly until the **SWR** option appears again.

D3, the bottom left 7-segment module, is now set to display SWR as shown in the menu in **Figure 7** below.

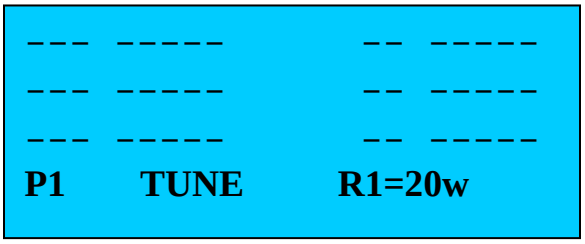
Figure 7 – 7-Segment Menu with Module 3 (D3) set to Display SWR



5.2 Changing the Panel Meter Full Scale Range

As another example, we will now modify the Panel Meter full scale range to 200 watts from its current setting of 20 watts. First bring up the Panel Meter menu. This is most easily done by using the Panel Meter ***shortcut button.*** This is the left-most button on the bottom row of switches. Tap that button once. The Panel Meter menu should now be displayed on line 4 of the LCD as shown below in **Figure 8** below.

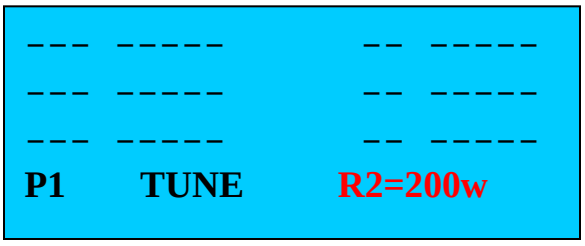
Figure 8 – Panel Meter Menu



With the Panel Meter menu displayed on line 4 of the LCD, menu button **M3** is used to control the full scale range setting (the third field of the menu). Tap **M3** (the third menu button) until the range changes to 200 (watts). If you are using an amplifier, you may want to set this to 2000 watts. Simply tap M3 repeatedly until the desired range is selected. All fields have wrap-around, so if you skip over the option you want, keep tapping the menu button until the desired setting appears again.

The menu line will now appear as shown below in **Figure 9** with the full scale range set to 200 watts. (R2 = 200w indicates that we are on range 2 (**R2**) whose value is 200 watts).

Figure 9 – Panel Meter Menu, Full Scale Range set to 200 watts



5.3 Saving the Changes

The above changes will remain in effect until you change them again with the menus and menu buttons, or until you power down the meter. If you wish to save these settings so that they are automatically restored each time the meter is powered on, ***apply a long press to M1*** (left most menu button). You will get a confirmation that the savings were saved to the Startup set.

5.4 Running the Tutorial in the User Manual

The User Manual has a complete walkthrough of all of MB-1's functions. ***The walkthrough assumes that MB-1 is set to its Default configuration values.*** Therefore, if you decide to go through the walkthrough, you must restore MB-1 to its default settings before proceeding. This is accomplished with a long push of the Backup ***shortcut button***, which is on the button row of buttons, five buttons from the left).

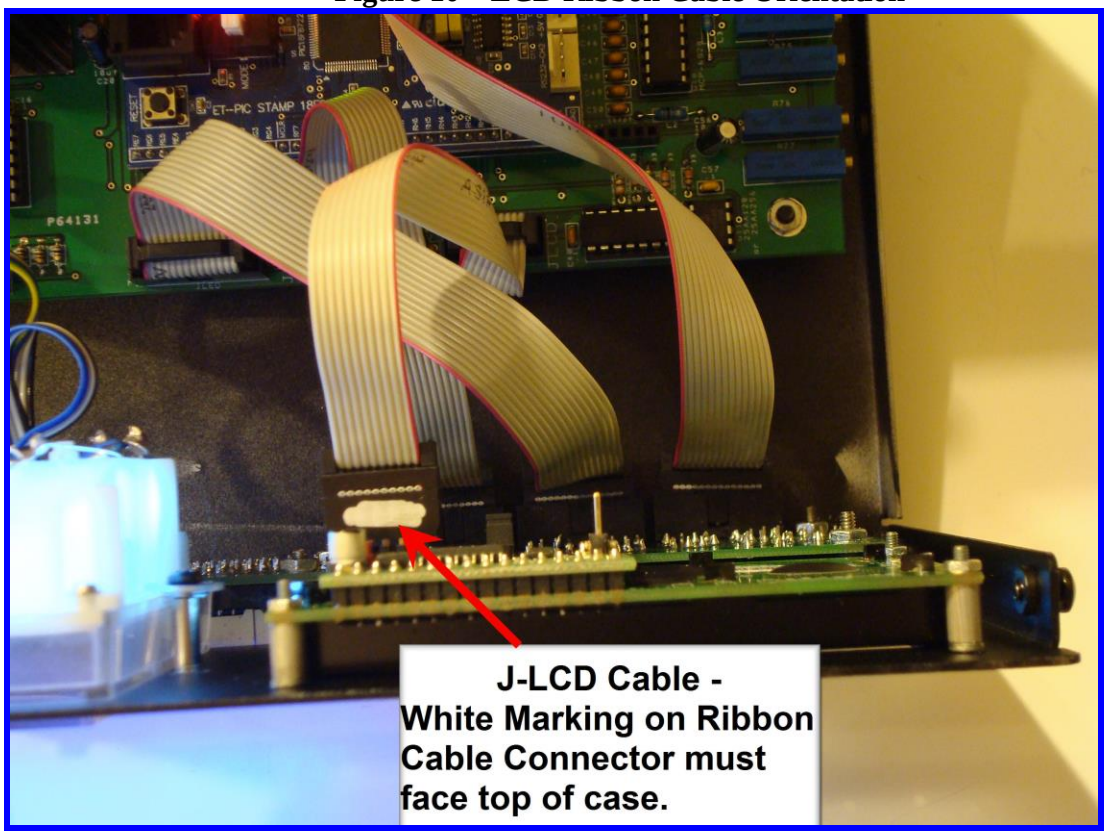
The walkthrough uses MB-1's internal simulator. Therefore you do not need to have your transmitter connected for the walkthrough.

6 Inside your MB-1

Aside from changing the fuse, there is no need to remove the cover of your MB-1. Prior to shipment, your MB-1 was calibrated with the internal panel meter and the MB-HF1 coupler that was shipped with your meter. Furthermore, all adjustments of user provided items, such as additional couplers or external analog meters that you may add in the future, can be done without opening the case. Access holes for the coupler trim pots are located on the right side of the case, and access holes for the panel meter trim pots are located on the left side of the case.

If you decide to remove the case for any reason, simply remove the 10 screw securing the case top. The entire top lifts off. The Assembly Manual shows all of the cable interconnections. If you remove any of the cables, please be careful when reinstalling them, ***especially with the ribbon cable connected to the 4x20 LCD.*** A specially marked ribbon cable with a white marking on one end of the cable is used to connect the main controller board to the 4x20 LCD. Make sure to install the cable as shown in **Figure 10** below with the white marking facing toward the ***top*** of the case.

Figure 10 – LCD Ribbon Cable Orientation



Three ribbon cables interconnect the Switch Display Board to the main controller board. These cables interconnect the **JSW**, **JLED**, and **JPWR** IDC connectors on the two boards. The **JMTRPOT** IDC connector connects to the ribbon cable that is wired to the analog crossneedle meter and 10 turn pot. The **JLCD** ICD connector connects to the 4x20 LCD.

Figure 11 – Display Board – Non-Component Side - IDC Cable Designations

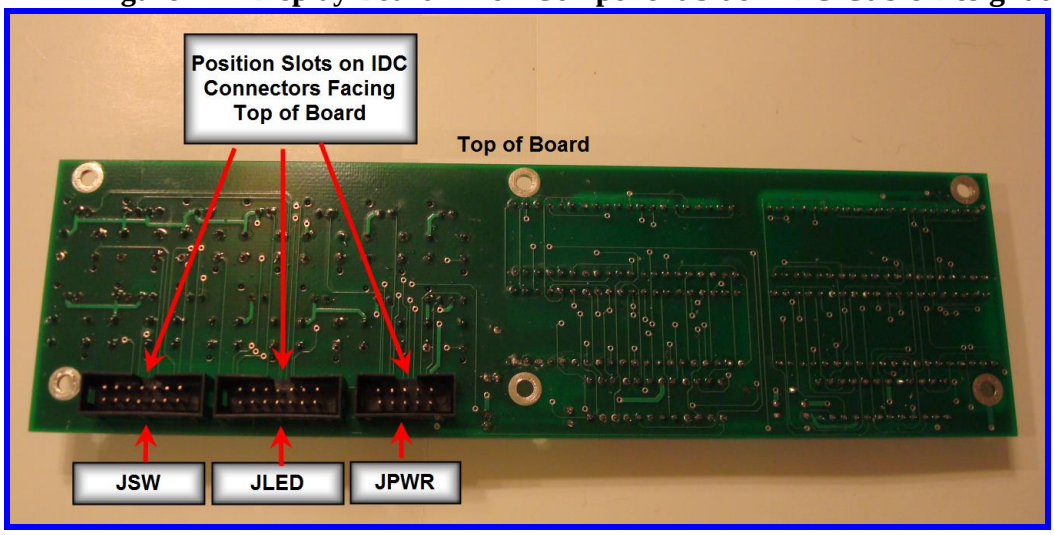
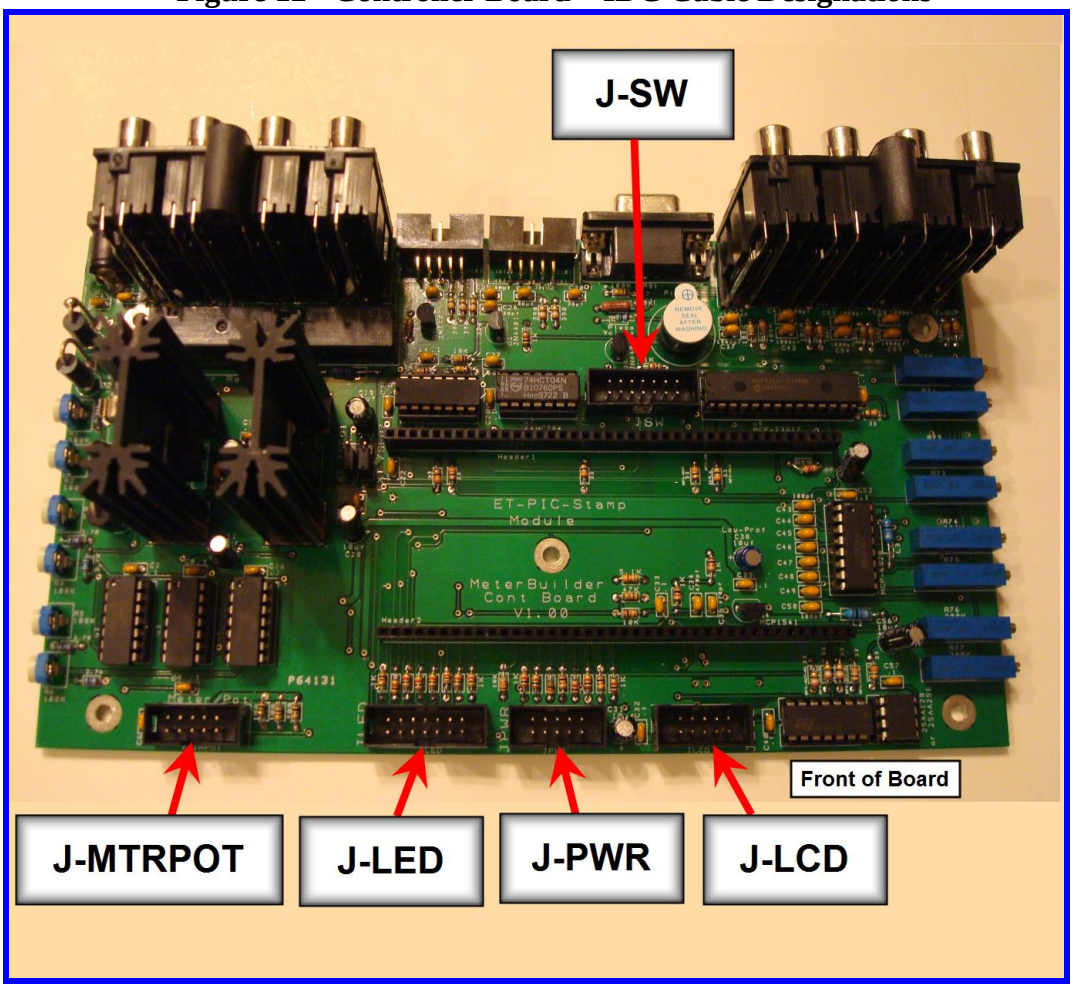


Figure 12 - Controller Board – IDC Cable Designations

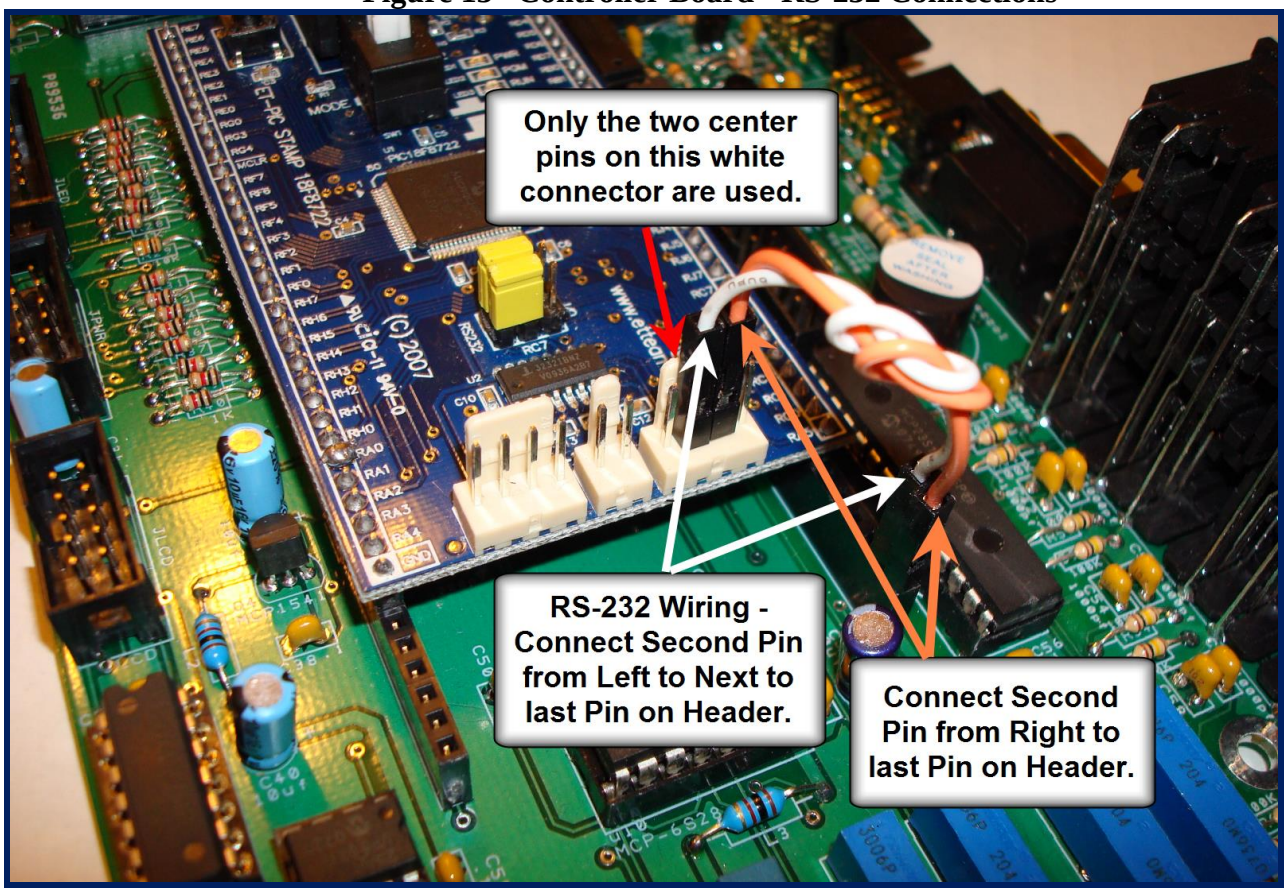


The microcontroller board plugs into the two 40 pin headers as shown in **Figure 13** below. The RS-232 signals are generated on the microcontroller daughter board, and connect to the main controller board with the two jumpers as show below.

Note – if you remove and reinstall the microcontroller board, note the orientation, and note that not all of the pins in the 40 pin headers are used. The microcontroller should be plugged in to the 40 pin headers with 6 empty pins on each 40 pin header as shown below.

Also note that there is a white pushbutton on the microcontroller board. This button must be in the UP position and the white shorting pins on the PIC board must be connected as shown in **Figure 13**.

Figure 13 –Controller Board - RS-232 Connections



7 Expansion Kit Option

The expansion kit option includes a number of accessories. See the MB-1 User Manual for information on configuring and using these accessories. If your meter came with two blank RCA plugs, plug them into the two +5v RCA connectors in the rear of the meter. They will prevent you from inadvertently plugging something into these connectors, which may damage the item being plugged in, or the MB-1 itself. These +5v DC sources are intended primarily for experimenting with analog sensors, which MB-1 can interface to.

8 Spare Components

Your meter is shipped with the following spare components:

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- 1.6 amp Fuse
- Panel Meter Trim Pot
- Coupler Trimmer Pot
- Shorting pin for 3 pin headers
- 2 extra case screws

9 Miscellaneous

The External Seven Segment Display Modules and the External Bar Graph module are packaged with a demo board and a ribbon cable assembly. These demo boards and cable assemblies are not used with your MB-1.

Should the need arise, you can check the External Seven Segment Display Modules and the External Bar Graph module in a stand-alone mode by connecting its demo board to a power source and the external display module. These demo boards connect to the External Seven Segment Display Modules and the External Bar Graph module via ribbon cables. (See the External 7-Segment manual and the External Bar Graph Module manual.)

Note that assembled MB-1 shipped after 5-1-2013 differ slightly in appearance from the above picture. The 7-segment LEDs are blue, and the rightmost top button (used for Setup and Display functions) is grey.

10 Warranty

The original purchaser of MeterBuilder MB-1 is covered by a 12-month, limited warranty from the date of purchase from FullWave, L.L.C. The warranty covers defects in components and materials for one year.

The sole obligation of FullWave, L.L.C. under this warranty is to replace defective components within the one year warranty period. Defects attributable to abuse, misuse, improper installation, or accidental damage are not covered by this warranty.

Any incidental or consequential damages resulting from any defects in this product are excluded, including damage to other equipment used with the MB-1 Meter. This warranty also does not cover damages or inconvenience resulting from changes or availability in the third-party accessories that the MB-1 meter is capable of operating with.

Notes