OPERATION MANUAL
GM-102 SWR & Wattmeter

WA4MCMkits

Don Friend – WA4MCM

Revision History

Revision Number	Date	Description	Notes
1.1	4/18/2023	• Fixed the broken link for downloading the companion application	Special thanks to Craig – WJ6A for alerting me to the broken link.
1.2	7/25/2023	• Modified all sections to accommodate the addition of a third meter face (all digital) with the new firmware version (v1.1.0) • Added a section with instructions for downloading and installing firmware upgrades.	
1.3	12/28/2023	• Corrected the output protocol string definitions for the forward and reflected power scales. • Added new definitions for 4 new settings to the output protocol string – Peak Hold Type (hardware/firmware), Firmware Hold timer, Screen Saver Timeout, and Reflected Power Scale. • Modified the Features section to accommodate firmware update 1.2.1 • Added sections for the 3 new features added by firmware update 1.2.1. • Modified the Remote Control Application section to accommodate the changes prompted by firmware update 1.2.1.	To accommodate Meter firmware version 1.2.1
1.4	4/15/2024	• Fixed a cut and paste error in the Meter Front Panel section for the Needle Meter Face.	
1.5	7/25/2024	• Replaced title page image with one that reflects the new laser engraving of the HF Sensor enclosure.	
1.6	1/23/2025	• Fixed typo on page 18: replaced "richt" with "right". • Modified the Meter's Operation section to accommodate the new screen saver deactivation options added with firmware version 1.2.3. • Modified the Remote Control Application section to accommodate the changes prompted by firmware update 1.2.3. • Added a new definition for the screen saver deactivate options to the output protocol string prompted by firmware update 1.2.3.	Thanks to James – NO0B for his sharp eyes!

CONTENTS

INTRODUCTION

Thank you for purchasing this SWR & Wattmeter kit. Every effort has been made to design a product that will provide years of service and will enhance your ability to monitor your output power as well VSWR.

I made this a kit in an effort to bring back some of the kit building nostalgia that was prevalent in the early days of Amateur Radio as well as add to the growing Maker Movement. A decision was made to use all through-hole components on the circuit boards to make the kit attractive to beginners.

73's,

Don – WA4MCM

FEATURES

- **Easy to Operate** – The GM-102 requires no special skills or knowledge to operate once it has been properly installed according to the instructions provided in this document.

- **Covers 160-6 Meters** – Covers the range from 1.8MHz through 54MHz.

- **Handles Full Legal Power** – Top range is 2KW full scale.

- **Graphical Touch Display** – The meter uses a 3.5" TFT display with an integrated resistive touch panel. All user controls are accessed via the touch panel.

- **Peak Hold Capability** – The meter comes with a user-selectable peak hold function that will smooth out the wild fluctuations when using SSB or CW and display your true peak power output.

- **User Selectable Meter Faces** – The user has a choice of three different meter faces: traditional needle, bar graphs, and a full screen digital display. The needle face can be changed from displaying the forward power to displaying reflected power. The bar graphs and full screen displays show both forward and reflected power on the same meter face. *Please note: the full screen digital meter face is only available with firmware version 1.1.x or later.*

- **Three Independent Power Scales** – The meter provides three power scales in two, user-selectable sets: 10 Watts full scale, 100 Watts full scale, and 1000 Watts full scale **-OR-** 20 Watts full scale, 200 Watts full scale, and 2000 Watts full scale. The forward and reflected power scales can be selected independently of each other. *Please note: the two selectable sets are only available with firmware version 1.2.x or later – otherwise, only one set (20W/200W/2000W) is available.*

- **Always On Digital Display** – With the needle and bar graph meter faces, the forward and reflected power as well as the VSWR is constantly shown at the bottom of the meter's display screen in large numerals for quick, easy viewing.

- **Remote Sensor Unit** – The actual sensor unit is remotely connected to the meter via an inexpensive stereo cable with 3.5mm plugs on each end. This allows for its placement in-line without the need to reroute your feedline to the meter's operating location.

- **Computer Interface** – Comes equipped with a USB interface and companion Windows application for viewing the meter on your computer screen as well as remotely controlling all of the meter's functions. The communications protocol is published so that the user can create their own application, or integrate the meter into other 3rd party solutions such as Node Red.

SPECIFICATIONS

- Operating Voltage: 9V – 15V DC @ 150mA (a 12VDC 1A wall adapter is provided)

- Max Power Reading: 2000 Watts

- Full Scale Settings: 20 Watts; 0.1 W digital display resolution
200 Watts; 1 W digital display resolution
2000 Watts; 1 W digital display resolution

   -OR- (selectable with firmware 1.2.x, or later)

   10 Watts; 0.1 W digital display resolution
100 Watts; 1 W digital display resolution
1000 Watts; 1 W digital display resolution

- Power Reading Modes: Normal and Peak

- Accuracy: ± 10% of Full Scale

- Display: 3.5" TFT w/Resistive Touch Panel

- Computer Interface: Standard USB – Drivers available for most operating systems

- Meter Dimensions: 4 1/2" W x 3 7/16" D x 3 3/4" H

- Sensor Unit Dimensions: 3 1/4" W x 2 1/4" D x 1 5/8" H

OVERVIEW

The GM-102 SWR & Wattmeter has been designed for ease of use as well as flexibility. Once features and settings have been selected, no other user input is needed to constantly monitor forward and reflected power as well as VSWR.

Three different meter faces are available based on the user's preference. The traditional needle face displays either forward or reflected power and is easily switched from one to the other. The bar graph meter face displays both forward and reflected power at the same time. For units that have been upgraded to firmware version 1.1.x or later, a full screen digital display is also available. Full scale power settings can be selected independently for each power type (forward or reflected).

Regardless of which of the first two meter faces selected, the digital power and VSWR readings are always displayed along the bottom of the screen.

The meter comes with circuitry that can be selected to provide a peak hold function. This will allow the meter to display true peak power when using transmit modes where the power output varies widely during a transmission (e.g., SSB or CW). A new, firmware-based peak hold function has been added with firmware version 1.2.x or later. This gives the user flexibility in choosing the type of peak hold experience they receive.

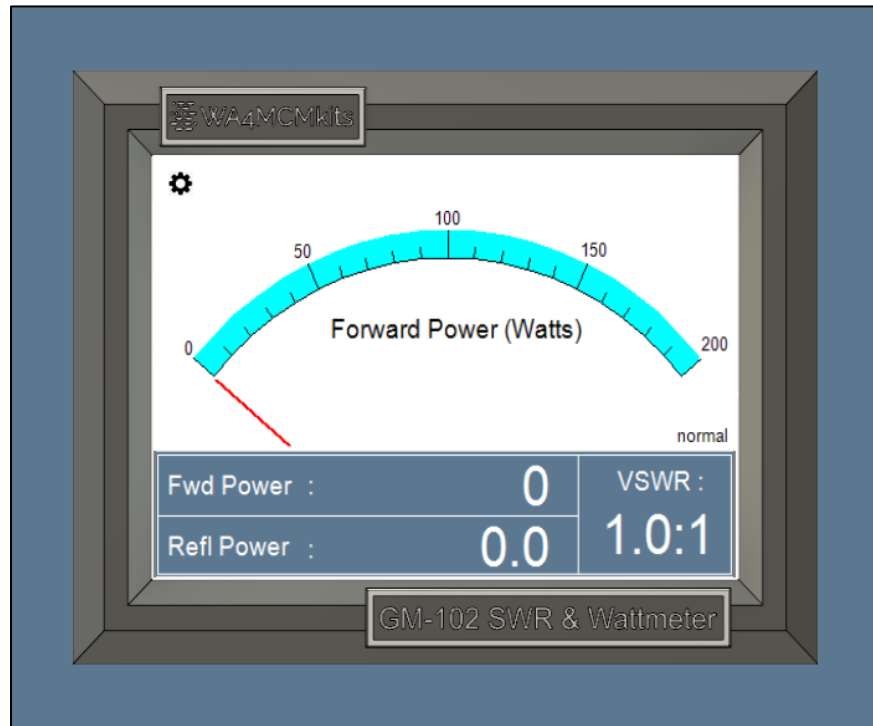Finally, the meter comes standard with a USB interface so the user can connect it to their PC for remotely reading their station's output power as well as remotely controlling the meter's settings and features. The meter comes with a companion MS Windows-based application for this express purpose. The communication protocol is published in this manual so the operator can easily build alternative applications and interfaces.

METER FRONT PANEL

The front panel can have two different meter faces: Needle and Bar Graphs. Refer to the following sections for descriptions of the displayed regions and/or controls available on the meter.

NEEDLE METER FACE

- **Forward/Reflected Analog Power Meter** – Display real-time forward or reflected power based on the needle's deflection. Refer to the **SWR & Wattmeter Operation** sections for instructions on how to change the meter's display from/to reflected or forward power.

- **Normal/Peak Hold** – Toggles between the power measurement types (normal or peak hold.
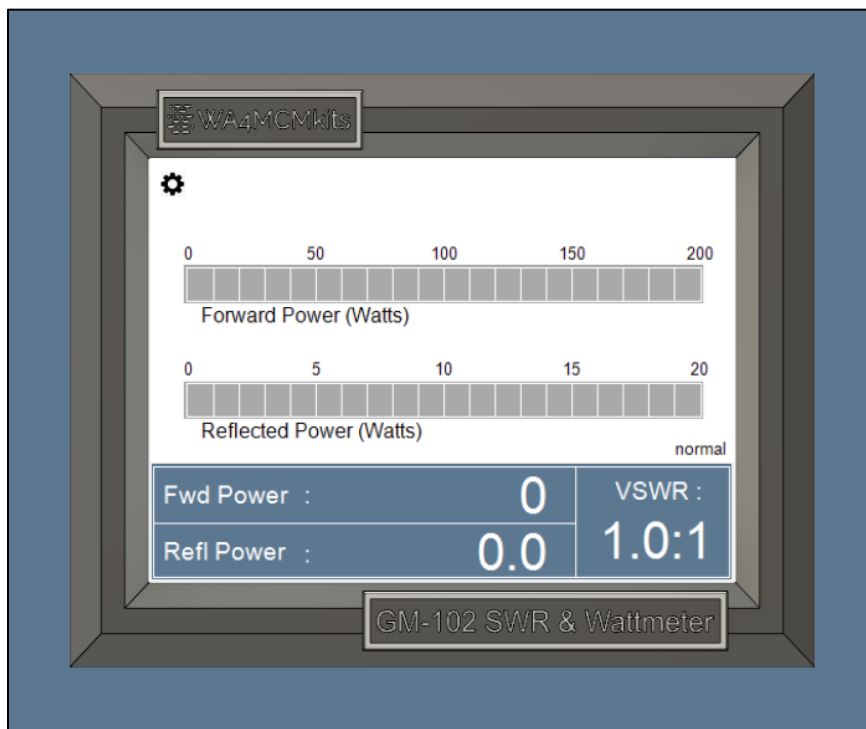

- **Forward Power Digital Pane** – Displays the real time forward power in digital numerals.

- **Reflected Power Digital Pane** – Displays the real time reflected power in digital numerals.

- **VSWR Digital Pane** – Displays the real-time calculated VSWR.

- **Gear Icon** – Opens the settings menu dialog box where you can set the following:

    (firmware prior to 1.2.x)
    - Analog (needle) Meter Source (forward or reflected)
    - Forward Power Scale
    - Reflected Power Scale
    - Power Measurement Type (Normal or Peak Hold)
    - Meter Face Type (Needle, Bars or Full Screen Digital)
    - SWR Null Cal Mode Selection

    (firmware 1.2.x or later)
    - Peak Hold Type (Firmware or Hardware)
    - Firmware Peak Hold Time
    - Screen Saver Timeout
    - Meter Power Scales (10W/100W/1KW -OR- 20W/200W/2KW)

o Meter Face Type (Needle, Bars or Full Screen Digital)
o SWR Null Cal Mode Selection

BAR GRAPH METER FACE

- **Forward Power Bar** – Displays real-time forward power readings as a bar graph.

- **Reflected Power Bar** – Displays real-time reflected power readings as a bar graph.

- **Normal/Peak Hold** – Toggles between the power measurement types (normal or peak hold.

- **Forward Power Digital Pane** – Displays the real time forward power in digital numerals.

- **Reflected Power Digital Pane** – Displays the real time reflected power in digital numerals.

- **VSWR Digital Pane** – Displays the real-time calculated VSWR.

- **Gear Icon** – Opens the settings menu dialog box where you can set the following:

  (firmware prior to 1.2.x)
  o Analog (needle) Meter Source (forward or reflected)
  o Forward Power Scale
  o Reflected Power Scale
  o Power Measurement Type (Normal or Peak Hold)
  o Meter Face Type (Needle, Bars or Full Screen Digital)
  o SWR Null Cal Mode Selection

  (firmware 1.2.x or later)
  o Peak Hold Type (Firmware or Hardware)
  o Firmware Peak Hold Time
  o Screen Saver Timeout
  o Meter Power Scales (10W/100W/1KW -OR- 20W/200W/2KW)
  o Meter Face Type (Needle, Bars or Full Screen Digital)
 o SWR Null Cal Mode Selection

FULL SCREEN DIGITAL METER FACE

Note: This meter face is only available with firmware versions 1.1.x, or higher.

- **Forward Power Digital Pane** – Displays the real time forward power in digital numerals.

- **Reflected Power Digital Pane** – Displays the real time reflected power in digital numerals.

- **VSWR Digital Pane** – Displays the real-time calculated VSWR.

- **Normal/Peak Hold** – Toggles between the power measurement types (normal or peak hold.

- **Gear Icon** – Opens the settings menu dialog box where you can set the following:

    (firmware prior to 1.2.x)
    - Analog (needle) Meter Source (forward or reflected)
    - Forward Power Scale
    - Reflected Power Scale
    - Power Measurement Type (Normal or Peak Hold)
    - Meter Face Type (Needle, Bars or Full Screen Digital)
    - SWR Null Cal Mode Selection

    (firmware 1.2.x or later)
    - Peak Hold Type (Firmware or Hardware)
    - Firmware Peak Hold Time
    - Screen Saver Timeout
    - Meter Power Scales (10W/100W/1KW -OR- 20W/200W/2KW)
    - Meter Face Type (Needle, Bars or Full Screen Digital)
   - SWR Null Cal Mode Selection
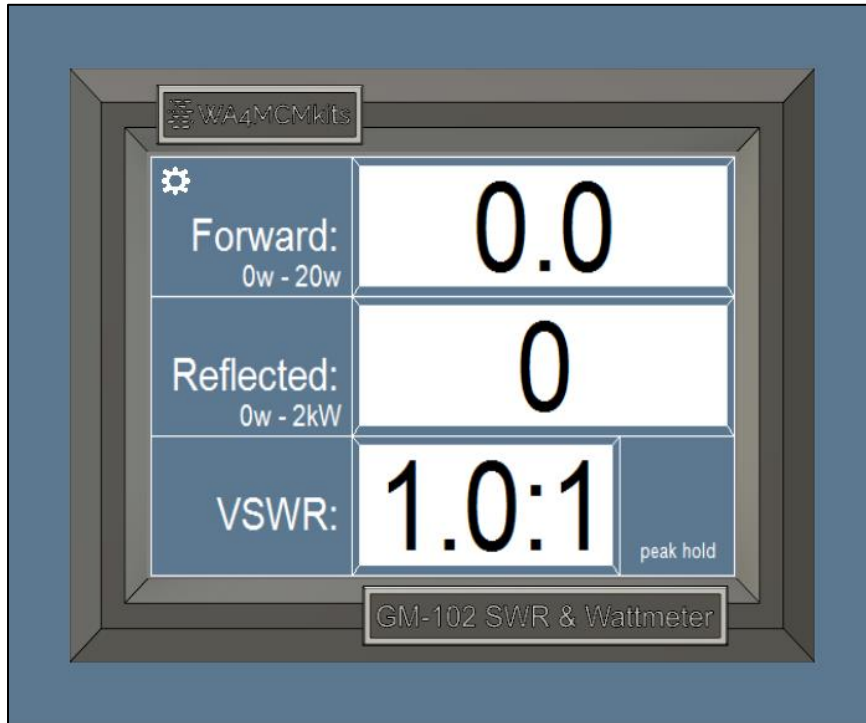
METER REAR PANEL

- **On/Off Switch** – Turns the meter on or off.

- **USB-B Jack** – Connects the GM-102 to your PC for remote control capabilities.

- **DC Power Jack** – The GM-102 comes with a 12 VDC wall adapter, but the user can easily use their shack's 13.8 VDC power bus as the meter will operate on DC voltages between 9 and 15 VDC – the power jack uses standard 5.5mm x 2.1mm barrel-type power plugs.
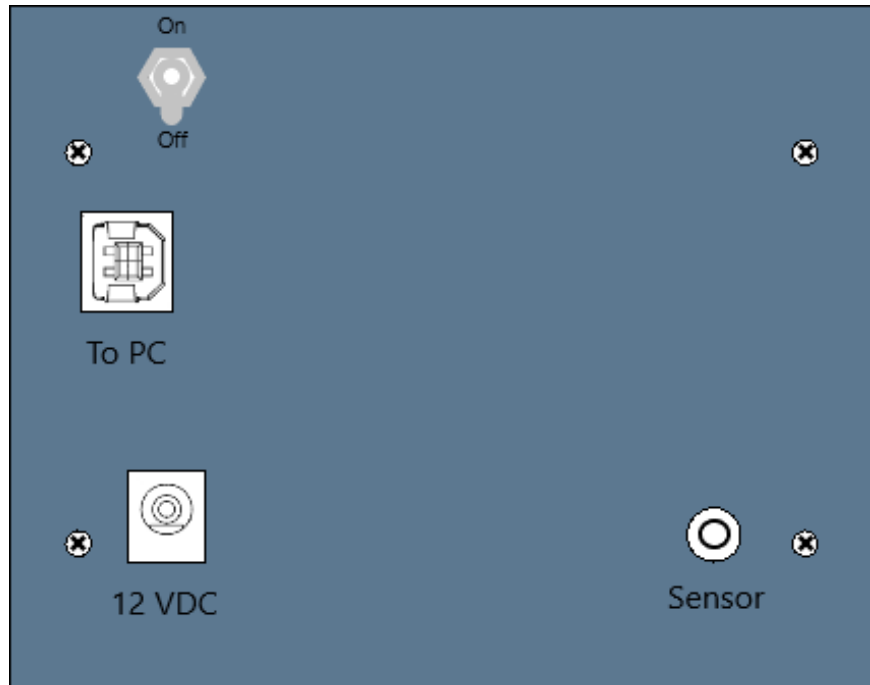
- **Sensor Jack** – Connects the meter to the remote sensor unit via a standard stereo audio cable. Accepts a standard 3.5mm stereo plug.

REMOTE SENSOR UNIT
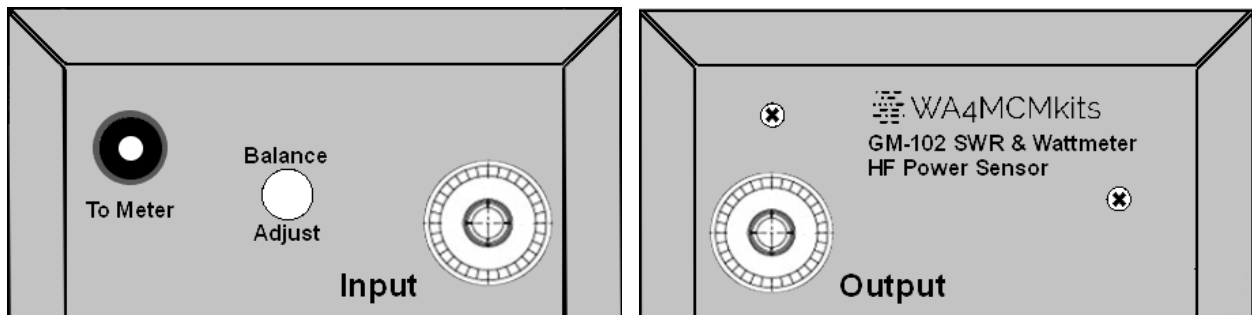
- Input Connector – Accepts the coaxial cable coming from either the transmitter or linear amplifier.

- Output Connector – Accepts the coaxial cable going to either the external antenna tuner (if one is being used) or the antenna.

- Balance Adjust Portal – Provides access to the SWR Bridge's balance adjust capacitor (C12).

- Meter Interface Jack – Accepts the 3.5mm stereo plug on one end of the meter's interface cable.

INSTALLATION

POWER CONNECTION

The GM-102 SWR & Wattmeter comes with a 12 VDC wall adapter whose plug will fit the power socket. However, the unit will accept any 9 - 15 VDC wall adapter with a 5.5mm x 2.1mm plug. The user may also use their station's 13.8 VDC power bus and create their own power cable as long as the mating plug adheres to the previously mentioned dimensions.

CONNECTING TO THE SENSOR UNIT

The sensor unit is connected to the meter via a standard stereo audio cable with 3.5mm stereo plugs on each end. The GM-102 is supplied with a 5 foot cable, but the operator may substitute any length cable needed to accommodate their shack's layout.
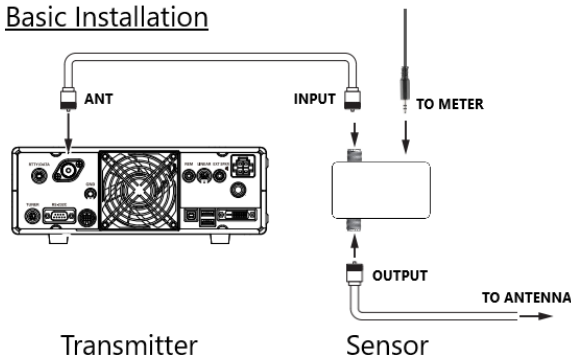
If you substitute a much longer cable, it is advisable to perform the Power Scale Calibration procedure as detailed in the kit's assembly manual while using the longer cable.

FEEDLINE INTERFACE

RELATIVE POSITION IN THE FEEDLINE STRING

The sensor unit should be placed between the exciter (or linear amplifier, if one is being used) and the antenna (or antenna tuner, if one is being used). Refer to the drawings below for guidance:

Basic Installation

ANT   INPUT   TO METER

OUTPUT

TO ANTENNA

Transmitter   Sensor

Installation w/Linear Amplifier and Antenna Tuner

ANT   RF IN   RF OUT   INPUT   TO METER   TO ANTENNA

OUTPUT   TX

Transmitter   Linear Amplifier   Sensor   Antenna Tuner
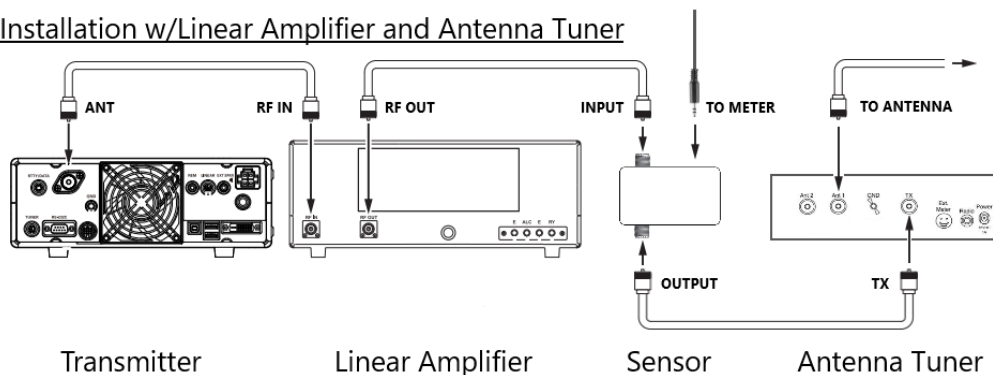
WINDOWS COMPUTER INTERFACE

With the optional USB interface board, the operator may remotely control the front panel push buttons using a Windows PC. The following sections provide the necessary information needed to use the interface.

VIRTUAL SERIAL PORT DRIVER INSTALLATION

The ESP32-S3-WROOM microcontroller used by the GM-102 SWR & Wattmeter uses an integrated USB Serial/JTAG Controller. On MS Windows 10 or newer PCs, the drivers should be installed automatically when you plug in the module for the first time. Once this is complete, you can identify the ComPort assigned to the module by reviewing the Windows Device Manager as shown below:
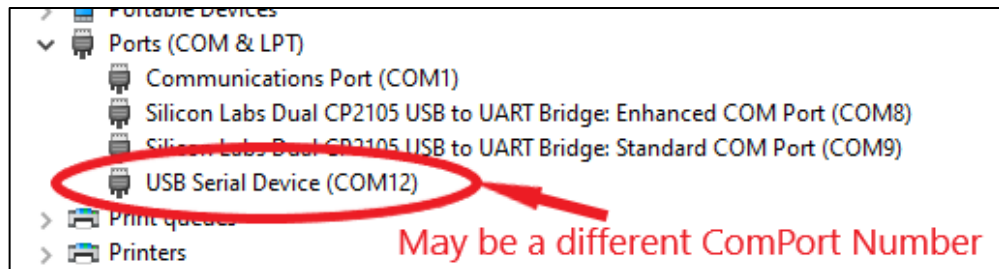
If there is more than one **USB Serial Device** entry, you can easily identify the one associated with the meter's USB controller by unplugging it and observing which entry disappears from the Device Manager listing.

PC TO/FROM GM-102 SERIAL COMMUNICATION PROTOCOL

The GM-102 SWR & Wattmeter continuously sends the real-time forward and reflected power being sensed as well as the meter's current configuration as a single string that can be parsed by whatever application receives it. The string is in the following format:

<div align="center">

PFxxxx.xPRyyyy.yMTaSFbSRcPIdPTeHPfHTggSShhDEiMSj

</div>

The red fields contain the variable data according to the following table:

Field	Description	Values
xxxx.x	Forward power to one decimal place	6 character string representing the forward power
yyyy.y	Reflected power to one decimal place	6 character string representing the reflected power
a	Meter Type	0 (0x30) = Needle; 1 (0x31) = Bar Graphs
b	Forward power meter scale	0 (0x30) = 20W; 1 (0x31) = 200W; 2 (0x32) = 2000W
c	Reflected power meter scale	0 (0x30) = 20W; 1 (0x31) = 200W; 2 (0x32) = 2000W
d	Analog meter power reading	0 (0x30) = Fwd Power; 1 (0x31) = Refl Power
e	Power reading mode	0 (0x30) = Normal; 1 (0x31) = Peak Hold
f	Peak hold type	0 (0x30) = hardware; 1 (0x31) = firmware

gg	Firmware peak hold timeout	00 (0x30, 0x30) thru 19 (0x31, 0x39) to depict the number of milliseconds from 100ms to 2000ms in 100ms steps.
hh	Screen saver timeout	00 (0x30, 0x30) thru 15 (0x31, 0x35) to depict the number of seconds before the meter's screen saver is activated. 00 means the screen saver is disabled.
i	Screen saver deactivate Method	0 (0x30) = Touch/Power; 1 (0x31) = Touch Only
j	Currently selected meter scale range	0 (0x30) = 20/200/2K; 1 (0x31) = 10/100/1K
	Note: the meter scale range may only be changed at the meter itself since changes to this parameter may require recalibration.	

The first eight configuration parameters may be changed remotely by sending the 2-character parameter identifier followed by the parameter's payload as detailed in the above table. The last parameter (MS) is only for sending to the remote application. For example, to change the meter face from the Needle (analog) meter to the Bar Graphs, send the following three byte string:

MT1 (0x4D, 0x54, 0x31)

To change the forward power scale to 2000 Watts full scale, send the following three byte string:

SF2 (0x53, 0x46, 0x32)

And so on…

SUPPLIED WINDOWS REMOTE CONTROL APPLICATION

The GM-102 SWR & Wattmeter comes with a companion Windows application that can be used to remotely control the meter. This application is only supported on Microsoft Windows at this time.

The application is installed by downloading the latest version by clicking on the following link while holding down the Ctrl key:

GM-102 Support Files

and then running the setup.exe file located in the zipped up folder.

Note: The Remote Control Application version is matched to the physical meter's firmware version. Please ensure that you are using the correct version as detailed in the following table:

Meter Firmware Version 1.0.8:   Remote Control App Version 1.0.0.1
Meter Firmware Version 1.1.2:   Remote Control App Version 1.1.0.0
Meter Firmware Version 1.2.1:   Remote Control App Version 1.1.3

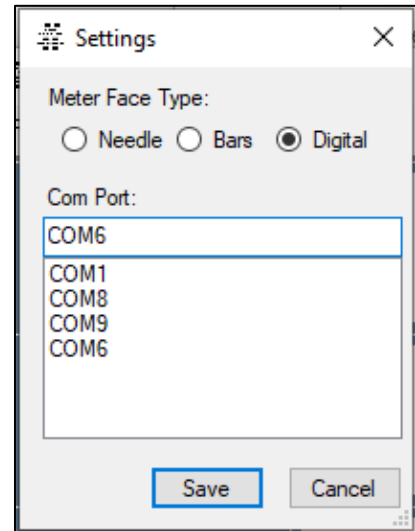The support files web site has the above breakdown as well.

Application Settings (File Version 1.1.0.0 or earlier):

Meter Face Type – Click the radio button next to the desired meter face.

Com Port – Select the ComPort that corresponds to the meter's USB interface.

To identify which ComPort belongs to the switch, follow the steps listed below:

- While the meter's USB interface is plugged in, note the Comports displayed in the **Settings** dialog box.

- Close the **Settings** dialog box and unplug the USB interface cable.

- Reopen the **Settings** dialog box and note which ComPort disappeared – this is the meter's ComPort.

- Plug the USB interface cable back in and reopen the **Settings** dialog box. Select the meter's ComPort and Save the settings.

- You may need to restart the application for the change to take effect.

Application Settings (File Version 1.2.1):

Meter Face Type – Click the radio button next to the desired meter face.

Sync meter face with meter – Un-checking this box with allow the user to maintain different meter faces between the physical meter and the application.

Peak Hold Type – Click the radio button next to the desired peak hold type.

Firmware Peak Hold Time – Use the up/down arrows to select the number of milliseconds for which to hold the peak reading. Applicable only when the firmware peak hold option is selected.

Screen Saver Timeout – Use the up/down arrows to select the number of seconds before the screen will blank out. Selecting "Off" will disable the screen saver.

Deactivate SS Via Touch Only – Un-checking this box will allow the screen saver to be deactivated by either touching the screen, or by transmitting.

Com Port – Select the ComPort that corresponds to the meter's USB interface.

To identify which ComPort belongs to the switch, follow the steps listed below:

- While the meter's USB interface is plugged in, note the Comports displayed in the **Settings** dialog box.

- Close the **Settings** dialog box and unplug the USB interface cable.

- Reopen the **Settings** dialog box and note which ComPort disappeared – this is the meter's ComPort.

- Plug the USB interface cable back in and reopen the **Settings** dialog box. Select the meter's ComPort and Save the settings.

- You may need to restart the application for the change to take effect.
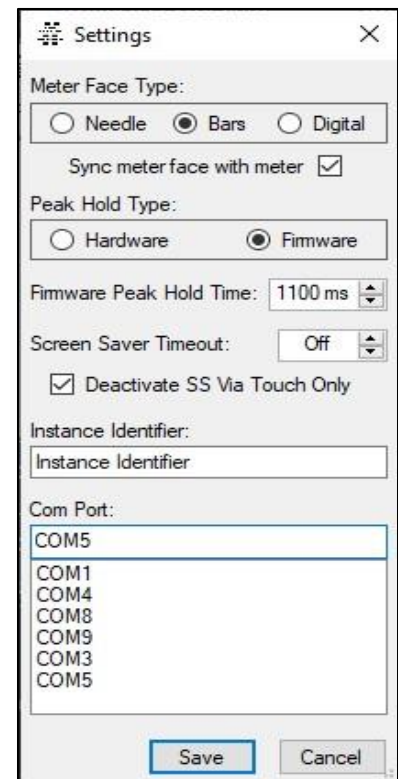
SWR & WATTMETER OPERATION – FIRMWARE VERSIONS PRIOR TO 1.2.1

All of the meter's parameters can be changed by launching the settings dialog box and changing the desired parameter by touching the white box to the right of each parameter to toggle through the available options, then touching the **Save** button. Refer to the images below:
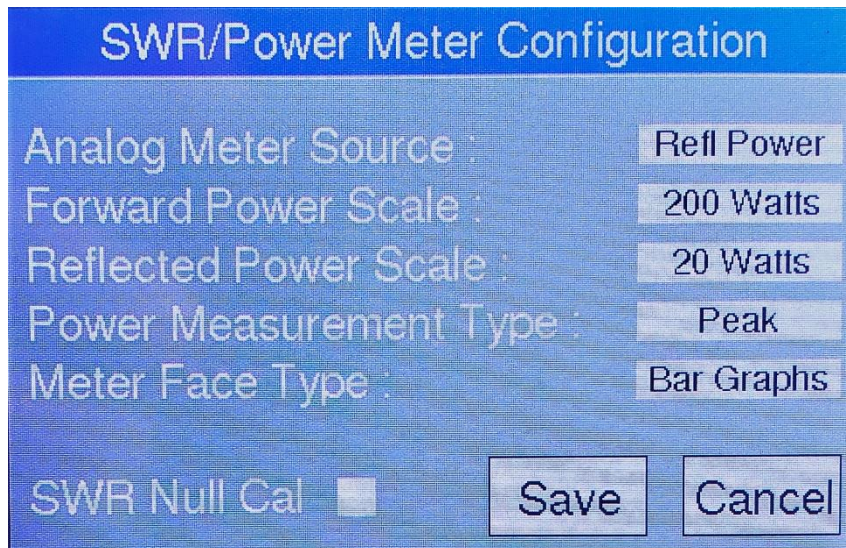
In addition to the settings dialog box, all parameters except the meter face can be changed from the main screen by touching certain regions of the display. Please refer to the following sections for guidance.

METER FACE SELECTION

The meter face can only be changed from within the settings dialog box.

To change the meter face, touch the white box to the right of the **Meter Face Type:** prompt to toggle between Needle, Bar Graphs and Digital.

Note: The digital meter face is only available with firmware version 1.1.x, or later.

CHANGING BETWEEN FORWARD AND REFLECTED POWER (NEEDLE FACE ONLY)

To have the meter's needle react to the forward power, touch anywhere in the **Fwd Power:** digital pane. The meter face will now display **Fwd Power (Watts)** in the center of the meter's face.

To have the meter's needle react to the reflected power, touch anywhere in the **Refl Power:** digital pane. The meter face will now display **Refl Power (Watts)** in the center of the meter's face.

CHANGING SCALES

The meter scales can be changed from the main screen by touching certain regions of the display. These regions depend on the currently selected meter face as described below:

Bar Graphs – Touch the forward power bar to cycle the forward power scale between the available scales. Likewise, touch the reflected power bar to cycle the reflected power scale.

Full Screen Digital – Touch the forward power pane to cycle the forward power scale between the available scales. Likewise, touch the reflected power pane to cycle the reflected power scale.

Needle Face – Touch anywhere on the meter's face (**except the regions around the gear icon and the normal/peak hold label**) to cycle through the three power scales for the currently displayed analog power source (forward or reflected). If you wish to the change the scale for the non-displayed power source, you will need to first change the meter to that power source by following the instructions in the previous section: ***Changing Between Forward and Reflected Power (needle face only)***.

CHANGING MODES (NORMAL OR PEAK HOLD)

The region in the lower right corner of the meter's face contains the label indicating the currently selected measurement mode. Touch the label to toggle the mode between **Normal** and **Peak Hold**.

SWR & WATTMETER OPERATION – FIRMWARE VERSION 1.2.1 OR LATER

In the latest version of the meter's firmware, the following parameters have been removed from the settings dialog box in order to make room for the 3 new features:

- Analog Meter Source
- Forward Power Scale
- Reflected Power Scale
- Power Measurement Type

Methods for changing the above parameters are described later in this section.

All of the other meter's parameters can be changed by launching the settings dialog box and changing the desired parameter by touching the white box to the right of each parameter to toggle through the available options, then touching the **Save** button. Refer to the image below (firmware version 1.2.3):
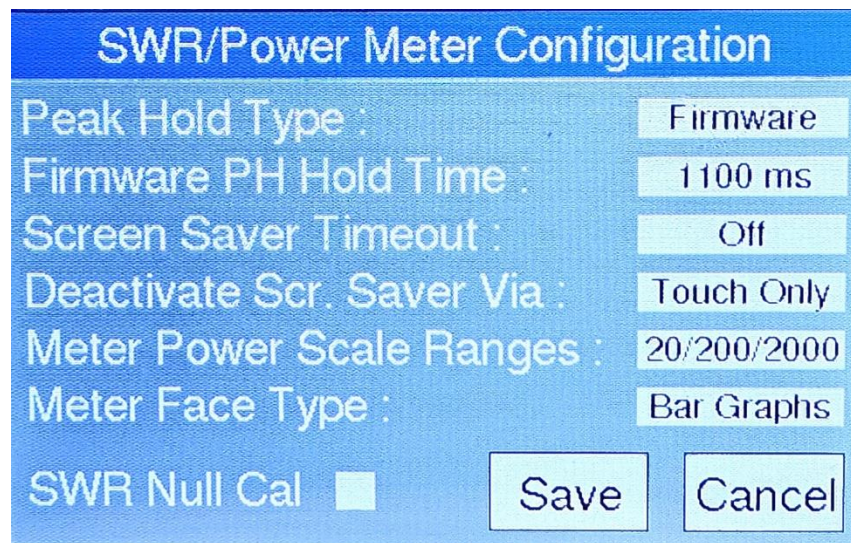
PEAK HOLD TYPE SELECTION

To change the peak hold type, touch the white box to the right of the **Peak Hold Type:** prompt to toggle between Hardware and Firmware.

Hardware peak hold is achieved via an RC circuit built into the meter's main circuit board. It will do a decent job of holding the peak power readings, but you will still see some variations due to the compromise of the RC circuit's decay time.

Firmware peak hold is accomplished by an algorithm in the meter's main software that captures and holds the peak power reading for the duration of the user-selected peak hold time. This option does a much better job of holding the peak reading.

FIRMWARE PEAK HOLD TIME SELECTION

To change the firmware peak hold time, touch the white box to the right of the **Firmware PH Hold Time:** prompt to select a hold time value between 100ms and 2000ms in 100ms steps.

SCREEN SAVER TIMEOUT SELECTION

To enable the screen saver, touch the white box to the right of the **Screen Saver Timeout:** prompt to select a timeout value between 1 and 15 seconds in 1 second steps. Select "Off" to disable the screen saver.

The screen will turn blank once the timeout value has elapsed. Simply touching the screen will turn it back on and restart the countdown timer.

DEACTIVATE SCR. SAVER VIA

Touch the white box to the right of the **Deactivate Scr. Saver Via:** prompt to toggle between deactivating the screen saver by "Touch Only" or "Touch/Power". The "Touch/Power" option will deactivate the screen saver when either the screen is touched, or when the meter detects any power output from the transmitter.

Note: This feature is only available with meter firmware versions 1.2.3, or greater.

POWER SCALE RANGES SELECTION

To change the power scale ranges, touch the white box to the right of the **Meter Power Scale Ranges:** prompt to toggle between 10/100/1000 and 20/200/2000.

METER FACE SELECTION

To change the meter face, touch the white box to the right of the **Meter Face Type:** prompt to toggle between Needle, Bar Graphs and Digital.

CHANGING BETWEEN FORWARD AND REFLECTED POWER (NEEDLE METER FACE ONLY)

To have the meter's needle react to the forward power, touch anywhere in the **Fwd Power:** digital pane. The meter face will now display **Fwd Power (Watts)** in the center of the meter's face.

To have the meter's needle react to the reflected power, touch anywhere in the **Refl Power:** digital pane. The meter face will now display **Refl Power (Watts)** in the center of the meter's face.

CHANGING SCALES

The meter scales can be changed from the main screen by touching certain regions of the display. These regions depend on the currently selected meter face as described below:

Bar Graphs – Touch the forward power bar to cycle the forward power scale between the available scales. Likewise, touch the reflected power bar to cycle the reflected power scale.

Full Screen Digital – Touch the forward power pane to cycle the forward power scale between the available scales. Likewise, touch the reflected power pane to cycle the reflected power scale.

Needle Face – Touch anywhere on the meter's face (**except the regions around the gear icon and the normal/peak hold label**) to cycle through the three power scales for the currently displayed analog power source (forward or reflected). If you wish to the change the scale for the non-displayed power source, you will need to first change the meter to that power source by following the instructions in the previous section: *Changing Between Forward and Reflected Power (needle face only)*.

CHANGING MODES (NORMAL OR PEAK HOLD)

The region in the lower right corner of the meter's face contains the label indicating the currently selected measurement mode. Touch the label to toggle the mode between **Normal** and **Peak Hold**.

APPENDICES

TROUBLESHOOTING

For detailed troubleshooting steps, please refer to the assembly manual's troubleshooting section. For any operational issues, please refer to Table 1 below.

Table 1 - Troubleshooting Matrix

Symptom	Possible Solution
Unexpected power or SWR values	This can happen if the meter's sensor has been placed in the wrong section of the feedline. A common issue is when the sensor is placed AFTER any antenna tuners. The sensor should be moved so that it is located immediately after the last amplifier stage (or the transmitter if no external amplifier is being used). If using an internal antenna tuner, turn off the tuner to have the meter read the true power and SWR.
No display	Check the wall adapter to ensure that it is supplying 12 VDC. Refer to the assembly manual's troubleshooting section for more detailed steps.

UPGRADING THE METER'S FIRMWARE

Periodically, WA4MCMkits may release updates to the meter's firmware. This could be to fix bugs or provide enhancements. Firmware updates may easily be accomplished using the existing USB computer interface by executing the following steps:

Caution: Unless you follow these steps exactly, there is a possibility that you may "brick" your GM-102. Especially if you enter the wrong hexadecimal installation address. Please double-check your work before clicking the "Program" button. If you do end up bricking your meter, please contact WA4MCMkits @ don.friend@wa4mcmkits.com for assistance.

1. Go to https://wa4mcmkits.com/support-files/ and download the latest firmware .zip file to a location on your computer's hard drive where it will be easy to find. Right-click on the .zip file and choose "extract All…". Note the location of the extracted files – the file with the **.bin** file extension is the actual firmware image.
2. Press and **hold** the "boot" button on the bottom-right of the meter's MCU board. While still holding the "boot" button, press and release the "reset" button. This will put the MCU board in a mode for uploading a new firmware image. It will also temporarily change the virtual serial port number being used by the meter while in this mode.
3. Go to the following web site: https://adafruit.github.io/Adafruit_WebSerial_ESPTool/

4. Click the "Connect" button in the upper-right corner of the page, and then select the serial port that is labeled "USB JTAG/serial debug unit" and click connect. Please note that this will be a different virtual serial port than what has normally been used for your meter.

5. Refer to the image for a sample response from the flasher tool – the MAC address you see will be different. The results text should show that you've connected successfully. Once this happens, you'll be able to set up the image file for programming.

```
ESP Web Flasher loaded.
Connecting...
Connected successfully.
Try hard reset.
Chip type ESP32-S3
Connected to ESP32-S3
MAC Address: C0:4E:30:0C:83:B4
Uploading stub...
Running stub...
Stub is now running...
Detecting Flash Size
FlashId: 0x1740C8
Flash Manufacturer: c8
Flash Device: 4017
Auto-detected Flash size: 8MB
```

6. Set the top file offset to 0x10000 (four zeros!) – you can leave the other 3 at 0x0 since you'll only be selecting one file.

7. Click the top "Choose a file…" button and navigate to and select the firmware file that you downloaded and extracted in step one above.

8. Double-check the file offset address!

9. Click the "Program" button and observe the progress bar until it's done.

10. Press the reset button on the meter's MCU board. Watch the splash screen to confirm the new version matches the version number listed as part of the downloaded firmware's filename.