

Coulometrix™ ,LLC



Metiri™ Scientific version 2

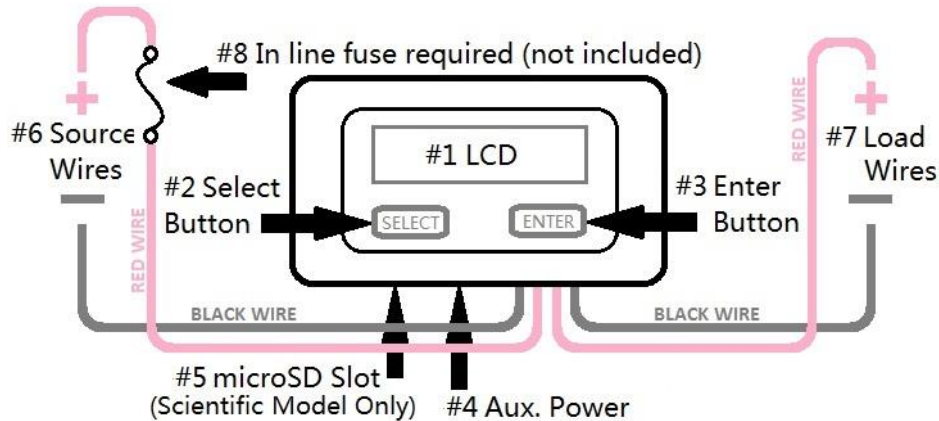
Portable Smart Energy Meter and Data Logger

Users Manual for Firmware ver: 1.0.65 / published Mar. 22, 2017

For part numbers: COUMET60100SC

WARNING: Working with electricity can be dangerous. This product should only be used by people that are comfortable working with electricity and electronic circuits. By using this product, the user accepts all responsibility for his or her safety and property.

QUICK PRODUCT EXPLANATION



1. **LCD:** Back-lit primary display.
2. **Select Button:** Touch sensitive button with LED touch indicator. Press to scroll through data options or Smart Graph.
3. **Enter Button:** Touch sensitive button with LED touch indicator. Press to return to the main screen. If on the main screen, will scroll through set-up options.
4. **Aux. Power:** Female socket for device auxilliary power, 5.0Vdc +/-10%. Compatible with USB mini-B Plug.
5. **MicroSD Slot (Scientific Model Only):** Card slot for recording of measured values. Can accept standard microSD flash memory formatted with FAT32. Metiri™-S will automatically detect card, create a CVS file, and start writing measured data.
6. **Source Wires:** Connect to power source or battery up to +60Vdc. Current flowing from Source to Load is considered positive current. Forward continuous current should never exceed 50 amperes.
7. **Load Wires:** Connect to power load or battery up to +60Vdc. Current flowing from Load to Source is considered negative current. Negative continuous current should never exceed 50 amperes.
8. **In Line Fuse (Sold Separately):** The Metiri™ products do not provide protection against excessive current. A fuse installed in series with the positive Source Wire is required. Current should never exceed the current specified in the Safe Operating Area graph.

TECHNICAL SPECIFICATION

Part Number	COUMET60100SC
Maximum Operating Values	
Voltage Operation Range	+6.5Vdc to +60.0Vdc
...with Aux Power Supply	0.0Vdc to +60.0Vdc
Maximum DC Current	Less than +/-50Adc sustained
Maximum Peak Current	+/-100A for less than 9 seconds
Input Current from Source or Load	8mA to 149mA*
...with Aux Power Supply	<1mA
Measurement Capabilities	
Voltage Detection Resolution	10mV
Current Detection Resolution	1mA when less than 6.0A; 10mA otherwise
Current Measurement Accuracy	+/-20mA**
Current Measurement Bandwidth	7KHz
Sample Resolution	20Hz (every 50mSec)
Clock Resolution	+/-0.5%
Ambient Temperature Range/Resolution	-40°C to 120°C +/-0.1°C
System Temperature Range/Resolution	-40°C to 120°C +/-0.1°C
Max Energy Recordable Value	+/-2,147,483,648 Joules (watt seconds)
Max Clock Recordable Value	65,536 days
Recording Capability	
MicroSD Card Size Capability	FAT32, up to 128GB
SELECT or ENTER Screen Timeout	10 seconds

* Device current depends on source voltage. Higher the voltage, the lower the current.

** Current accuracy depends on proper calibration.

PRODUCT OPERATION

Connections: The Metiri™-S2 Smart Energy Meter product line is an inline voltage, current, and energy measurement device with all of the features and tools a solar enthusiast, RC hobbyist, or Scientific community would love.

The Metiri™-S2 Smart Energy meter is in series with a pair of pure copper 10 AWG wires, one **RED** and one **BLACK** in color. The **RED** wire is the positive or power wire and the **BLACK** wire is the return or ground wire. Metiri™-S2 measures voltage between these wires and uses a low side resistive shunt for monitoring current. The two exposed wires closer to the USB connector should be connected to a power source or battery, and the two exposed wires farthest from the USB connector should be connected to a power load or battery.

WARNING: Do not place a negative voltage or reverse the voltage polarity of the wires or damage to the Metiri™, and your system, might occur.

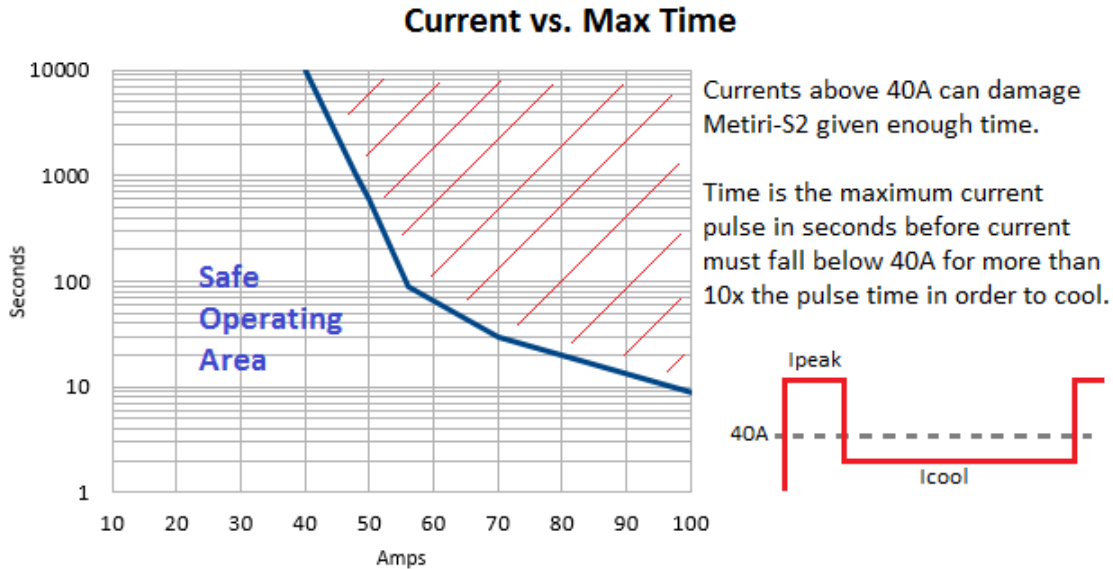
DANGER: Always install an in line fuse rated to 150% of the maximum expected current of your system, not exceeding 120A in series with the Metiri™-S2 Smart Power Meter

Device Power: The Metiri™-S2 Smart Energy Meter will get the power it needs to run from the wires it is measuring and requires a minimum voltage across those wires to function. If a voltage is desired to be measured that is lower than the minimum voltage, auxiliary power will be needed. The Metiri™-S2 products provide an auxiliary power input using a readily available mini USB connector. Simply plug in a mini USB cable into Metiri™, and the other end into any USB power source, and Metiri™-S2 will shut down its internal regulator, running off of the USB power only.

Device Measurement: When operating Metiri™-S2 from the Auxiliary USB, the Source or Load cables should not be left unconnected (otherwise known as high impedance) or leakage will cause incorrect measurements to occur.

Safe Operating Current: The Metiri™ products are capable of bi-directional current and will record current flowing in either direction. This makes the Metiri™ products perfect for monitoring energy flowing in and out of a system battery bank. The

Metiri™ products attempt to interfere as little as possible with current moving through it. Therefore the user must ensure the current through the Metiri™-S2 Smart Energy Meter does not exceed the Safe Operating Current shown in the following graph.



If the Metiri™-S2 Smart Energy Meter detects the sense resistor temperature is too hot, then the LCD will begin to flash rapidly, warning the user. Allowing the current to exceed this value for sustained periods of time can result excessive heat to the device and the wires connected.

DANGER: Operating at currents above 40Adc can cause the Metiri wires, or the unit itself, to get extremely hot. You should never hold the Metiri Smart Energy meter by the wires with your bare hands or allow the wires to come in contact with anything flammable.

Temperature Measurement: Metiri™-S2 has two temperature sensors, one measuring the air temperature inside Metiri™-S2 and the second measuring the temperature of the sense resistors. Metiri™-S2 does not contain a fan as the the most common failure in electronics is the fan. This unfortunately means that as Metiri™-S2 heats up due to use, the ambient temperature measurement can read higher than actual outside air temperature.

The sense resistors heat up as current passes through them, and if the sense resistors get too hot, then the Metiri™-S2 can be permanently damaged. When the sense resistors get too hot, then the home screen will show the warning message "TOO HOT!" on the bottom right corner. If the sense resistor temperature continues to rise, then the LCD backlight will begin to flash repeatedly to alert the user that Metiri™-S2 is exceeding the safe operating temperature. If this happens, Metiri™-S2 should be immediatly disconnected from the power source and allowed to cool.

DANGER: Failure to stop current flowing through Metiri™-S2 after the LCD backlight begins to flash can result in fire and hazardous smoke that can lead to serious injury. If Metiri™-S2 repeatedly overheats, discontinue use in your system.

HOME SCREEN

The default display is the screen shown when the Metiri™-S2 starts up or if the ENTER button is touched in any other SELECT screen. This is also the screen the Metiri™-S2 will return to after 10 seconds of inactivity in any screen except when scrolling through the Smart Energy Graph screen.

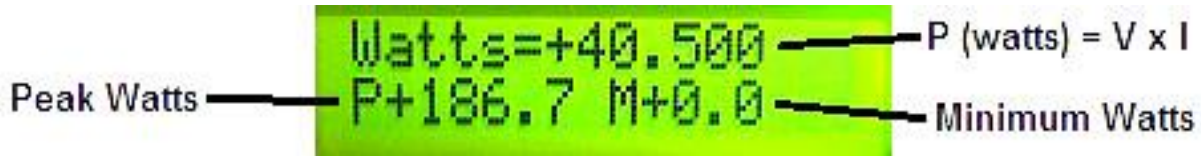


All measured values presented are in real time and updated at the same rate as the sample rate. The top right of the display is programmable and is set in the **Set Home** screen. The bottom right of the display will show the time since start in the format HH:MM:SS. If more than 24 hours pass, the time will roll over to 00:00:00 and will automatically switch back and fourth from time to number of days passed.

For each day passed, Metiri™-S2 will start a new data array for the Smart Energy Graph and will also start a new CVS file for recording of measured data, if applicable.

SELECT SCREENS

Watts Screen: Touching SELECT when on the *Home* screen will display power in watts on top. Bottom left will display peak watts (P) and bottom right will display minimum watts (M) recorded. The LCD will return to the Home Screen after ten seconds or if the ENTER button is touched.



Min & Max Values: Touching SELECT when on the *Watts* screen will display peak (Vp & Ip) and minimum (Vm & Im) voltage and current values recorded. The LCD will return to the Home Screen after ten seconds or if the ENTER button is touched.



Temperature Values: Touching SELECT when on the *Min & Max Values* screen will display the ambient temperature (A), Peak temperature (P), System temperature (S), and Minimum temperature (M). The bottom right of the screen displays the temperature units. The LCD will return to the Home Screen after ten seconds or if the ENTER button is touched.



Smart Graph: Touching SELECT when on the *Temperature Values* screen will start the Metiri™-S2 Smart Graph program. The LCD will return to the Home Screen after ten seconds unless the SELECT button is touched again. Touching the SELECT button again will scroll the Smart Graph data to the left of the LCD, and will stay there until the ENTER button is touch, returning the Smart Graph to the first hour.

The purpose of the Metiri™-S2 Smart Graph program is to organize energy recorded over time in a way that is quick and easy to understand. The program will organize energy measured into 24 bars by the hour recorded, with the current hour flashing. The hour with the most energy will be represented as the highest bar (16 pixel rows high) with its value printed on the left side of the screen, and all other hour's energy will be drawn relative to that highest bar. ($16 \times \text{Current Energy Hour} / \text{Peak Energy Hour} = \# \text{ of pixel rows}$).



If the energy measured goes negative at any time, the Metiri™-S2 SmartGraph will change so that the top 8 pixel rows of the graph represent positive energy recorded, and the bottom 8 bars represent negative energy recorded. The hour with the most absolute energy will be shown as a full bar (8 pixel rows) and all other hour's energy will be drawn relative to that highest bar. ($8 \times \text{Current Energy Hour} / \text{Peak Energy Hour} = \# \text{ of pixel rows}$).



ENTER SCREENS

Set Home Screen: Touching the ENTER button when on the **Home** screen will present the user with the units currently programmed in the user screen, which appears on the top right of the Home screen. Touch SELECT to begin scrolling through the available units to appear on the user screen. Touch SELECT to enable or remove a unit, touch ENTER to continue to the next unit. Touching ENTER after the last selection will return to the **Home** screen and save the selection to memory. After 10 seconds of inactivity, the LCD will return to the **Home** screen. The choices are as follows.

1. Show Joules: One Joule (J) is equal to one watt for one second.
2. Show Watt Hours: A Watt Hour (Wh) is one watt for 3,600 seconds.
3. Show Coulombs: A Coulomb (Q) is one Ampere for one second.
4. Show Amp Hours: An Amp Hour (Ah) is one Ampere for 3,600 seconds.
5. Show Watts: A Watt (W) is one Volt multiplied by one Ampere.
6. Show deg. C: This shows the ambient temperature in degrees Celcius.
7. Show deg. F: This shows the ambient temperature in degrees Fehrenheit.

Reset All Values: Touching the ENTER button when on the **Set Home** screen will ask if the user wishes to clear all values. Touch SELECT to reset all recorded values or touch ENTER to continue to the next screen. After 10 seconds of inactivity, the LCD will return to the **Home** screen.

All time, voltage, current, and energy values including the Metiri™-S2 Smart Graph data will be cleared. Data saved to the microSD card, calibration data, and device settings are not affected by this reset.

Mount/Unmount SD Card: Touching the ENTER button when on the **Reset All Values** screen present the user with the option to mount or unmount the microSD card. Touch SELECT to eject the SD card or touch ENTER to continue to the next screen. After 10 seconds of inactivity, the LCD will return to the **Home** screen.

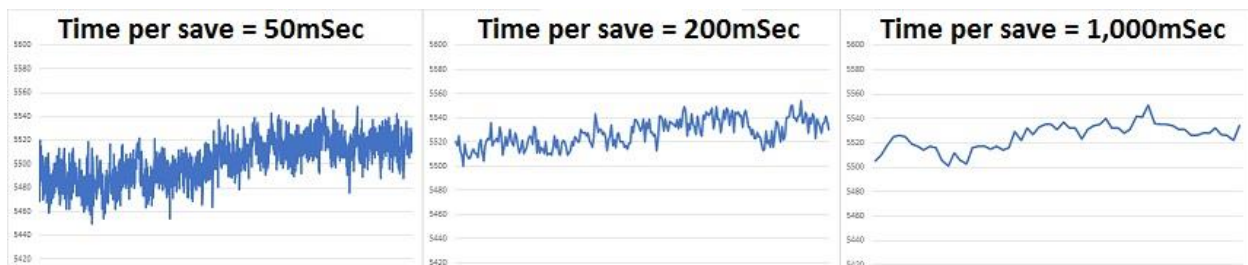
To Unmount: If an SD card is mounted and in use, touching SELECT will cause the Metiri™-S2 will save all remaining data, close out the open CVS file, and unmount the card. The microSD card is not physically ejected, and will have to be manually removed by grasping the edge of the card and pulling straight out.

To Mount: If an SD card is inserted but was previously unmounted. Touching SELECT will cause the Metiri™-S2 to remount the SD card and start writing a new CVS file.

If no SD card is inserted, then the Metiri™-S2 will simply report that no SD card is availalbe, and the only option will be to continue on by pressing the ENTER button.

SD Write Time: Touching the ENTER button when on the **Eject SD Card** screen will ask the user the desired recording resolution, or time in between data being saved to the microSD card. Touch SELECT will change the time between saves, or touch ENTER to continue to the next screen. After 10 seconds of inactivity, the LCD will return to the **Home** screen.

This option is used to set the recording resolution. If a properly formatted microSD card with enough space is inserted, the Metiri™-S will automatically save recorded data in a CVS file at time intervals set by this screen. The current recorded in the **mA(SD BW)** column is also averaged in between each time interval, and reported on the CVS file. The value chosen is written to non-volatile memory and choices range from 50 milliseconds to 60 seconds between saves.



WARNING: Setting the SD Write Time to the minimal time can result in very large data files as each data entry can be up to 64 bytes. A minimum free space of 100MB per day is suggested.

Positive Current/Voltage-B Calibration: Tocusing the ENTER button when on the **Reset All Values** (or **SD Write Time** for Metiri-S) screen will prompt the user to begin the **Positive Current/Voltage-B Calibration** program. Connect a DC voltage or current through Metiri™-S2 as instructed on the LCD and touch SELECT to confirm for each step, or touch ENTER to cancel. The initial screen will return to the **Home** screen after 10 seconds of inactivity. Once calibration has begin, the screen will stay until calibration is complete or until the ENTER button is pressed to cancel calibration.

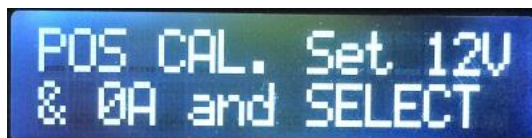
NOTE: All Metiri™ products are calibrated at the factory and user calibration is not required initially. It is suggested that user calibration be completed yearly or whenever operating environments drastically change. Calibration is not required after

upgrading the firmware.

STEP 1: Connect the Auxillary USB power for calibration. Connect a calibrated power source to the SOURCE wire side and a load to the LOAD wire side capable of 12.0 Amperes and 12 volts.

NOTE: Voltage and current is read at different times. You can start the calibration with a 12 volt supply and switch to another power source capable of 12.0 ameres.

STEP 2: Touch the ENTER button until you see the Positive Current/Voltage-B Calibration screen shown below. If the negative current calibration is desired, touch ENTER once more and instructions for Negative Current/Voltage-A Calibration will show.



STEP 3: Connect +12 volts to the SOURCE wires, make sure there is no current flowing through Metiri, and touch SELECT to save the Voltage-B and zero current OFFSET Value. No voltage is needed beyond this point, only current.

STEP 4: Increase the current so that exactly 1.00 Amperes is flowing through the Metiri Smart Energy Meter from SOURCE to LOAD. Touch SELECT to save this value.

NOTE: If you do not have an electronic load, you can short the LOAD wires together and set the supply to CC (Constant Current) mode for STEP 4, 5, and 6.

STEP 5: Increase the current so that exactly 5.00 Amperes is flowing through the Metiri Smart Energy Meter from SOURCE to LOAD. Touch SELECT to save this value.

STEP 6: Increase the current so that exactly 12.0 Amperes is flowing through the Metiri Smart Energy Meter. Touch SELECT to save this value. Touching SELECT at this point will save all calibration values. If a mistake is made, simply touch ENTER to delete the saved values and try again.



STEP 7: Calibration is complete. The calibration results will be printed on the display and will be saved to non-volatile memory. The values printed represent the measured voltage, current offset, and measured current in milliamperes. These values are for reference only and do not need to be remembered.

In order to ensure proper current and voltage measurement, both the positive current and negative calibration should be done together. It is very important that calibration be done with a low noise power supply and load. Remember that the ENTER button can be touched to cancel the calibration routine anytime before STEP 7 is reached.



Negative Current/Voltage-A Calibration: Tousing the ENTER button when on the **Positive Current/Voltage-B Calibration** screen will prompt the user to begin the **Negative Current/Voltage-A Calibration** program. Connect a DC voltage or current through Metiri™-S2 as instructed on the LCD and touch SELECT to confirm for each step, or touch ENTER to cancel. The initial screen will return to the home screen after 10 seconds of inactivity. Once calibration has begin, the screen will stay until calibration is complete or until the ENTER button is pressed to cancel calibration.

The steps to complete the Negative Current Calibration program are identical to the Positive Current Calibration program except that the power supply needs to be connected to the LOAD wires, and the load needs to be connected to the SOURCE wires so that current is flowing backwards. Remember that the ENTER button can be touched to cancel the calibration routine anytime before STEP 7 is reached.

Clear User Calibration: Tousing the ENTER button when on the **Negative Current/Voltage-A Calibration** screen will prompt the user with an option to clear all user calibration data, and restore factory calibration. Touch SELECT and all user data will be cleared from memory, calibration data will be loaded from factory memory, and will return to the home screen. Touch ENTER and you will be returned to the **Home** screen without any action taken.

DATA LOGGING ON SD CARD

Inserting a microSD card: When a microSD card is inserted, or when Metiri™-S2 starts with a card already inserted, the Metiri™-S2 will automatically detect and start the mounting procedure. The mounting procedure checks to see if the inserted microSD card can be used by checking the following:

1. Is the Card Formatted? The microSD card must be formatted using the FAT32 filesystem before it can be used. The Metiri™-S2 will not attempt to format an unformatted microSD card.
2. Is there enough space available? The microSD card must have enough free space to equal a full days worth of data to be used. The number of bytes needed is equal to 5,529.6KB divided by the SD Write Time in seconds. For example, if the SD Write Time is set to 1 minute in between saves, the amount of space needed is $5,529.6\text{KB} / 60 \text{ seconds} = 92.16\text{KB}$. If the SD Write Time is set to 50mSec, then the amount of space needed is $5,529.6\text{KB} / 0.05 \text{ seconds} = 110,592\text{KB}$ or roughly 100MB.
3. Is there an available CSV name? The Metiri™-S saves measured data in CSV (Comma Separated Values) format named using 8.3 filenames. The Metiri™-S2 names files according to the current day proceeded by the letter 'M' followed by two letters starting at 'AA'. If that filename is already taken, then the prefix letters will be incremented to 'AB' and so on until a free filename is found. If all 676 combinations of postfix letters are used using the same date code, then the microSD card cannot not be used. (EXAMPLE: On day 13, the Metiri™-S will look for filename `M00013AA.CSV` and if it does not exist, will create a new CVS file with that name. If the file already exists, then a new file named `M00013AB.CSV` will be created. Data will only be saved in the root space, so if all available files names are taken, simply moving the old files to a folder will solve this issue.

If all three checks pass, then the Metiri™-S2 will attempt to mount the SD Card and start recording measured data to the new file created.

SD Error Codes: If an error is encountered trying to use a microSD card, the Metiri™-S will display an error message on the LCD and stop trying to use the card. The user should remove the card and take care of the issue or insert a new card. The following is a list of error messages and their meaning.

1. `SD CARD ERROR`: This message occurs if Metiri™-S2 is unable to read the card or if the physical connection is not reliable. The user should change to a different microSD card.
2. `SD NOT FORMATTED`: If this message comes up the microSD card either not formatted using FAT32, or something is preventing the Metiri™-S from interfacing with the card. It is suggested to use a card that has been formatted to FAT32, be between 2GB and 128GB in size, and not be too old.
3. `SD MOUNT ERROR`: The Metiri™-S2 has recognized the card as formatted correctly but has failed to mount the file system. This usually happens if the file system is corrupt or accessing the card returns too many read errors. The user should try reformatting the microSD card or use another.
4. `NOT ENOUGH SPACE`: The microSD works correctly and has been mounted, however not enough space is available to start a new measurement record. The user should delete or move files off of the microSD card to make more space available.
5. `SD FILE ERROR`: The SD card is mounted and has plenty of space, but the Metiri™-S2 cannot find an available file name that can be used to record data into. The user should move old Metiri™-S2 CVS files to another folder before the card can be used.
6. `OPEN FAILURE`: Metiri™-S2 encountered an error attempting to start a new file, or open an existing file. This is usually caused by the card locked to read only or something in the file system is preventing Metiri™-S2 from writing to the SD card. The error will need to be corrected before the microSD card can be used.
7. `WRITE FAILURE`: Metiri™-S2 received back a different value for the number bytes that should have been written to the card. Metiri™-S2 will stop using the SD card to prevent corrupting existing data. The card should be removed and repaired using a CHKDSK or similar utility.

Removing an SD Card Data: Metiri™-S2 needs to unmount the microSD card and close out the file being used for recording before the card should be physically removed. This is accomplished by touching the ENTER button three times so the user is prompted with, "Unmount SD Card?". Touching SELECT will cause the current file to be closed, and card to be unmounted. When the user is prompted with, "SD CARD EJECT, Ready to remove" the microSD card can be removed. If the SD card is inserted but not mounted, touching the ENTER button three times will prompt the user with, "Mount SD Card?". Touching SELECT will remount the card and begin the recording process according to the resolution set by the **SD Write Time** screen.

To remove the microSD card, grasp the edge of the card firmly and pull straight out. The Metiri™-S2 does not use a card ejection mechanism to ensure the card does not accidentally fall out during use. Removing the microSD card before unmounting it can cause data corruption. If this happens, Metiri™-S2 will force the file system to be unmounted and prompt the

user, "SD CARD REMOVED, NOT UNMOUNTED".

CSV File Data: Data recorded by the Metiri-S2 is in CSV (Comma Separated Values) file format and is easy to modify using a spreadsheet program. The CVS file format is compatible with Microsoft Office, Apache OpenOffice, and most cloud based spreadsheet tools. Open or import the CVS file into your spreadsheet program and select the comma "," as the cell separator and each record is separated by a new line + line feed. Below is the list of data values arranged in columns recorded by Metiri-S2.

- **Days:** This is the number of days since recording started.
- **Count:** This is the time since recording started in hh:mm:ss.000 time format. In MS Excel, you will need to format the cells with this custom time format or Excel may present the time incorrectly.
- **mV:** This is voltage in millivolts at the time of data recording. This value is not averaged or filtered.
- **mA (SD BW):** This value is the current average between recording time periods. The more time in between each record, the less noise will be recorded but also the less current resolution.
- **mA (Roll Ave):** This value is the same current value reported on the main LCD screen which is a rolling average over the last 1,000mSec. This value is not averaged further.
- **J (W*Sec):** This is the Joules of energy that has passed through the Metiri-S2 unit, otherwise known as watt seconds. 3,600J = 1 watt hour.
- **C (A*Sec):** This is the Coulombs of charge that has passed through the Metiri-S2 unit, otherwise known as amp seconds. 3,600C = 1 Amp hour.
- **NOTE:** Setting the correct bandwidth is key to a successful measurement. If you are interested in seeing the discharge curve of a battery over a period of 1 hour, and the load is noisy like a motor, then you will want a low bandwidth (more time in between measurements). If you want to see the current pulses of a refrigerator compressor, then you will want a high bandwidth (less time in between measurements).

USB-UART DATA INTERFACE

Installing the USB-UART Interface: The full speed USB port on the Metiri™-S2 is capable of emulating a UART interface through USB. Download the latest driver from our website, plug the Metiri™-S2 into your computers USB port, and install the Metiri™-S2 driver when prompted. The latest Metiri™-S2 USB-UART driver can be download from our website at <http://www.coulometrix.com>. Currently only Windows drivers are available.

You will need a serial interface program to interact with the Metiri™-S2 through the USB-UART. Many free and open source programs are available and one of our favorites is the PuTTY SSH and telnet client. You can download this open source program at <http://www.putty.org> and install on your computer. Once your favorite serial interface program is installed, open the appropriate COM port for your Metiri™-S2 USB Serial Device using 115,200 baud rate. Once your serial screen is open, hit the "s" key to signal to the Metiri™-S2 to start the USB-UART interface and data will start scrolling onto the Sensor Area, and the User Area will show the main menu.

```
Coulometrix, LLC Metiri-S2 1.0.61
COUMET60100SC Copyright 2015
Metiri-S2 UART Interface. Press 'h' for help menu.
#####
Day=0 Time=0:0:31
Volts=+11.856 Vmax=+11.887 Vmin=+11.827
Current=+4.985 Imax=+5.033 Imin=+4.948
Power=+59.102 Pmax=+59.676 Pmin=+58.658
Temperature=+19.97*C/+67.94*F Tmax=+19.97*C Tmin=+19.46*C
Joules=+1831 Watt_Hours=+0
Coulombs=+154 Amp_Hours=+0
#####
/>h
q=Stop USBUART, s=Start Updates, c=Command Menu
```

Model Information

Sensor Information

User Area

Hit the "q" key anytime while on the main menu will halt the USB-UART interface. This should always be done when the USB-UART is no longer needed to free system resources and reduce operating current.

USB-UART Interface Commands: Hit the "h" key while on the main screen will show a list of command menus below the User Area. When in any command menu, hitting the "q" key will return you to the main menu. Below is the current list of command menus and the commands for each menu. Check the website often for Firmware upgrades and new commands are

added often.

- `q=Stop USBUART`: This stops the output of data to the main screen. This should always be done before exiting the terminal.
- `s=Start Updates`: This starts the continuous data output to the sensor field.
- `c=Command Menu`: This opens up the command menu.
 - `q=Go Back`: This will return the user to the home menu.
 - `r=Reset Unit`: This will reset all measured values to zero and reset the time. This does not affect calibration or user settings saved.
 - `d=Write Diag. File`: If an SD card is present, then this stops the data recording process and creates a new text file `DFILE000.M2D` onto the SD card. This file is used for debugging and troubleshooting reasons. The SD card will then be unmounted regardless if writing the diagnostic file was successful or not. The SD card can then be removed or remounted.

USB-UART Software Interface: The data in the USB-UART Sensor Information screen was formatted to be easily read and parsed using a computer program to automate data collection.

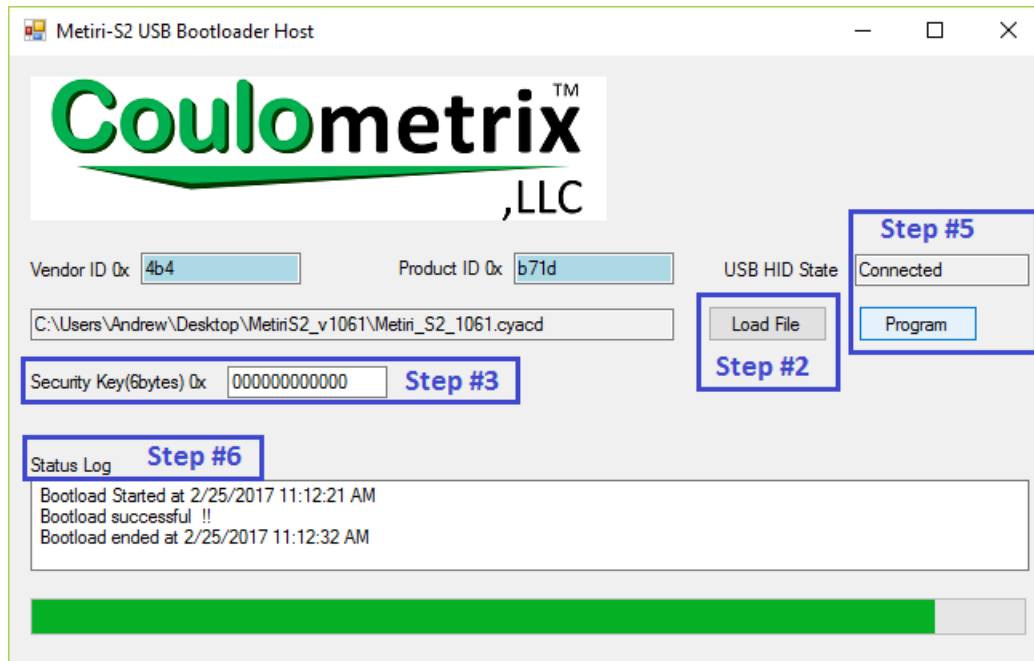
- The Sensor Information Field is bordered by the hash "#" characters.
- Data entries are separated by the space "Space" character.
- Data values follow the data labels and the equal sign "=" character.
- The characters "*F" or "*C" indicate a temperature value.
- The forward slash "/" character indicates the following value is a data conversion of the previous value.

To reserve system resources for the microSD card interface, USB-UART data updates are polled whenever the Metiri™-S2 processor is free. Therefore, time intervals between sensor updates is not guaranteed.

USB FIRMWARE UPDATES

Getting the latest Metiri™-S2 Firmware and Bootloader: The Metiri™-S2 is capable of updating its firmware using the USB interface. When the Metiri™-S2 first powers up, it waits a few seconds for a bootloader program to initiate the boot loader process. If no boot loader software is detected, the Metiri™-S2 continues to boot the firmware currently loaded in flash memory. The the latest Bootloader software, USB driver(s), and latest firmware image can always be downloaded on our website under support. <http://www.coulometrix.com>.

Updating the Metiri™-S2 Firmware: In order to update the Metiri™-S2 (model number COUMET60100SC) firmware, the unit must be started with USB power. All external power must be removed before plugging in the USB cable or your Metiri™-S2 will not look for new Firmware. After downloading the latest software packet, extract the files to your computer and follow the instructions below.



1. Find and run the program "USBBootloaderHost.exe". Microsoft .NET framework is required to run this application. If not installed, you will be prompted to download and install this software before you may run the Bootloader Host program.
2. Click the **Load File** button and select the "Metiri_S2_1061.cyacd" file found in your Bootload Host program folder.
3. Leave the field **Security Key(6bytes) 0x** alone. This should read "000000000000".
4. Plug your Metiri™-S2 into your computer using a mini-USB to USB-A cable.

NOTE: You only have 2 seconds from when the USB cable is plugged in to initiate the Firmware update. If the update time period is missed, simply unplug the Metiri™-S2 and try again.

5. If properly connected, the box **USB HID State** will show "Connected", click the button **Program** before the 2-second timeout occurs.
6. The **Status Bar** and **Status Log** will show the progress of the Firmware update. Do not unplug the USB cable while the firmware is being uploaded.

WARNING: Interrupting the firmware update process before it is completed can result in the flash memory being corrupted. Always wait for the message "Bootload ended at <date><time>", in the **Status Log** before unplugging the USB cable.

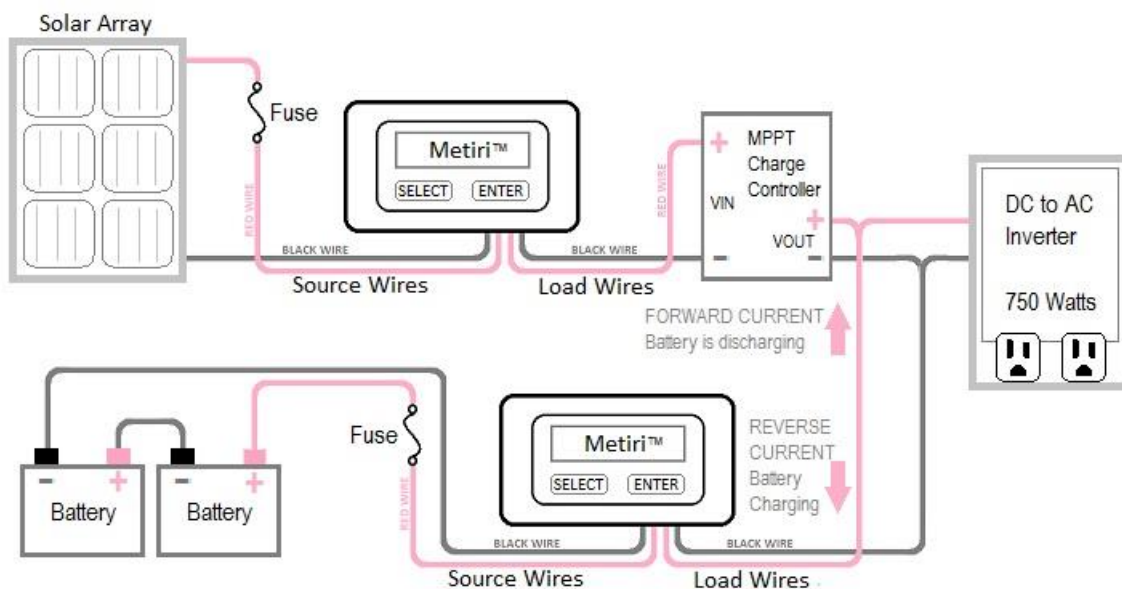
If the upgrade is successful, your Metiri™-S2 should restart and display the firmware version on the LCD Display. You should never attempt to update a Metiri™ product with Firmware not designed for it. Check the part number on the back of your Metiri™ product to ensure it matches the compatible part numbers listed on the front page of this document.

Obtaining New Metiri™-S2 Features: Check the website often for new firmware updates. We also encourage you to send us an email or post a comment online if you have any questions or product suggestions.

Notice Summary: The following rules should always be obeyed when using the Metiri Smart Energy Meter.

1. Working with electricity can be dangerous. Always use the Metiri Smart Energy Meter with an inline fuse and consult a professional before using this device.
2. Never exceed 50A for any sustained length of time. If 50A is exceeded, the Safe Operating Current time should be used as a reference to the safe time at higher current.
3. The Safe Operating Current can vary according to temperature, humidity, and altitude. Safety testing was performed in a 25°C ambient environment, at less than 15% humidity and an altitude of 6,200 feet. Temperatures or humidity levels higher than the stated values will decrease the Safe Operating Current levels and time.
4. Never touch the wires when operating the unit. They may be hot and can cause burns to exposed skin or material.
5. Do not allow the unit to be exposed to the elements. Direct sunlight or exposure to rain and moisture can damage the unit.
6. The Metiri™-S2 model is not waterproof. If the Metiri™-S2 units gets wet, do not use. If you notice the unit is wet while in use, do not touch it! Electrical shock hazard may exist.
7. Metiri™-S2 can be used in DC lines where current can flow in random directions. The voltage on the RED wire must always remain higher than the voltage on the BLACK wire. Reversing the voltage can damage the unit.
8. Never use any Metiri™ product to measure an AC line.

Product Use Example: The Metiri products are idea for monitoring power input from a solar array, monitoring current flow in and out of a battery, measuring voltage and current surges, practically anything that uses a DC voltage. The image below shows an example of a small solar array using Metiri™ products for monitoring.



Equations, Acronyms, and Facts to Remember: It is important to understand the difference between units of energy or charge when trying to track energy flow. A Joule is a derived unit of energy in the International System of Units and is equal to one watt (1 volt * 1 Amp = 1 Watt) for one second (1 watt x 1 second = 1 Joule).

EXAMPLE: Consider a 12V battery connected to an inverter needing 100 watts of constant power for an off-grid AC solution for one hour. The amount of energy needed is simply (Power x Seconds = Joules or Ws) 100Wh or 360,000Ws or 360,000 Joules. The inverter will always require 100 watts regardless of the battery voltage, therefore as the battery voltage starts to drop the amount of current needed to equal 100 watts goes up. ($P = V \times I$ so $I = P / V$) Using Ah to measure energy, makes this very difficult as voltage will constantly be changing.

- Volts = Current in Amperes x Resistance in ohms ($V=I \times R$)
- Power = Volts x Current ($P=V \times I$)
- 1 Coulomb (C) = Current x Time in seconds ($C=I \times T$) = 3.6 x mAh
- 1 Joule (J) = Power x Time in seconds ($J=P \times T$) = 3.6 x mWh
- 3,600,000 Joules (J) = 3,600,000 Watt Seconds (Ws) = 1,000 Watt Hours (Wh) = 1 Kilowatt Hour (1KWh)
- Electrons are negatively charged. So when you plug a load into a battery, current is actually flowing from negative (Ground) to Positive.
- Metiri in Latin means to measure or estimate.