BatteryMonitor Assembly Instructions

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Equipment you'll need

- Surface Mount Device (SMD) soldering kit
  - Temperature controlled soldering iron with fine tip. Insure the tip is grounded!
  - Small vise to hold the PCB
  - Liquid no clean solder flux
  - SMD Tweezers
  - Isopropanol 99%
  - Cotton swabs
  - Solder wick and solder sucker
- Electrostatic Discharge (ESD) protection - mat - wrist strap
- Needle nose pliers
- Wire cutters
- Voltmeter with leads suitable for probing surface mount components.
- Variable regulated power supply with a range of 5v to 25V capable of delivering 0.5A.
- Larger diameter solder 1mm or so, for attaching the leads and 14 gage bare wire pieces to the printed circuit board. Note that a length of fine solder for SMD work is supplied with the kit
- Small flat file for filing down the cable tie in step 9.
- Variable load resistor or resistors capable of drawing 0.5A load current from a 5V or greater supply
- Power supply or battery with a voltage greater than 5V capable of delivering up to 12A, as well as loads that will pull up to 12A for the unit functional verification tests.
- Current meter or voltmeter and shunt resistor capable of measuring 0.5A for the build and up to 12A for unit functional verification tests.
- Custom three pin PICAXE programming cable
- Wire and if available Powerpole connectors for temporary source and load connections
- Xacto knife or utility knife with snap-off blades
- Ruler with mm scale
- Calculator
- Screwdriver with Philips tip

Before You Begin

- Print out the parts list and check the contents of the kit to make sure that none of the parts are missing.
- Print out this document. To help locate components on the printed circuit board, print out the circuit schematic, the PCB top, and PCB bottom component layout pdf's
- It would also be a good idea to take the bag of components and separate the various parts into individual containers.
- Perform the functional verification tests after each section of the assembly is complete. Do NOT proceed to the next assembly section until the verification test has been successfully performed. This is especially important for functional verification test 2 which proves in the voltage regulator. It becomes increasingly difficult to trace voltage regulator supply problems if additional circuitry is installed.
- Watch the part sizes. Most resistors are 0805, and most capacitors 0603, however there are size variances for the same part value so be to use the correct size.

- Resistor tolerances are either one percent or five percent. Resistors are identified by their value and a multiplier. The multiplier R is one; K is one thousand and M one million. So 3k3 would mean 3,300 Ohms, 100R, is 100 Ohms; and 2M0 two mega Ohms. One percent resistors are typically designated with a third digit for example 1k91 is 1910 ohms. When one percent resistors have the same value as five percent resistors the schematic identifies the resistor as 1%. When the kit contains more than one resistor value of a given size all those resistors will have the same tolerance. That is if the kit contains several 1,000 Ohm 0805 resistors, they will all be either 1% or 5% tolerance.
- Temporary leads are soldered to the source and load connections for several functional tests. It is useful to have spare Powerpole connectors for this purpose.

Assembly Tips

1. Use two pair of tweezers, one for pulling up the hold down tape on the parts sheet and opening the SMD part carrier, and the other for mounting components on the PCB. This prevents the tape glue residue from getting on the tweezers used for SMD mounting work.
2. If adhesive does get onto the tweezer's tips parts will stick to them. If this happens wet a cotton swab with isopropyl alcohol. Spread the tweezer tips to clamp around the swab and draw them across the swab to clean the tips.
3. If there is more that one part of a value, remove the part from the strip then return the remaining parts to the parts sheet in their original location and cover them with the strip of tape. The tape used to hold the components to the sheet is special Scotch removable tape so that the parts can be returned to the strip and tacked down or repositioned several times.
4. Orient all resistors in the same direction so that they can more easily be read and identified after installation. Use the same orientation as is used on the PCB silk screen.
5. As you go through each assembly section check off components in the square box beside the component identifier as you install devices.
6. The top side of the PCB is the side that you view when the board is mounted in the enclosure. The display, push button switches, and a few other components are located on the top side. The instructions indicate when a component is to be located on the top side of the board. In most cases it's impossible to solder top side components on the bottom side, but there are a couple notable exceptions. The switches and JP1 look just as good on the bottom until you try and assemble the unit. It's really very messy to change these components to the top once they're soldered on the wrong side of the PCB. Please follow the directions carefully and avoid this mistake.

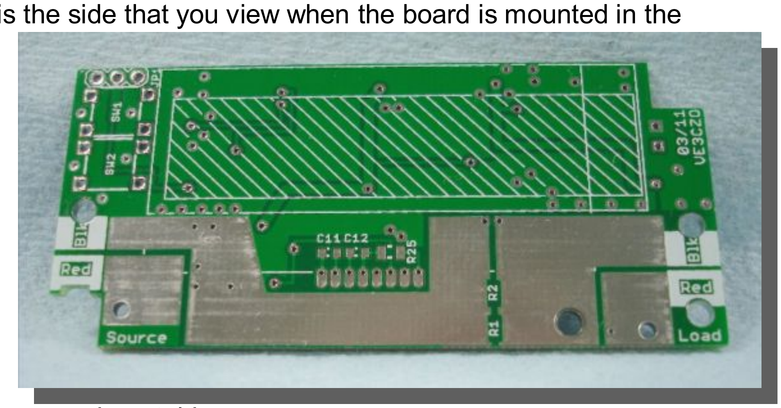

Fig 1 PCB Top Side

1. Install the sense resistors and 14ga. Copper wire pieces.

The PCB resistance between the external source and load wire connections is reduced by adding three pieces of 14 gauge wire along the PCB traces and soldering them to the board. This is a fairly coarse process that requires a lot of heat and solder and will require some bending, positioning, and likely subsequent repositioning of the wire pieces. For this reason this part of the assembly is done first. Soldering these wire pieces in place requires quite a bit of heat from the soldering iron, so if you have an iron with interchangeable tips change the tip for a broad chisel one that will allow you to spread a lot of heat over a large area.

Begin by preparing to install the sense resistors. Melt a thin film of solder on the printed circuit board area under R1 and R2 to help improve their attachment to the PCB. Also tin the solder pads of R1 and R2 with a thin film of solder to improve adhesion to the PCB. The solder thickness on the pads of R1 and R2 should be no more than a thin glaze just enough to wet the pads. If necessary remove any excess solder from the pads with solder wick before installing the resistors. Be sure to apply enough heat and solder so that the solder flows freely under the resistors into the resistor contact pads as this will produce optimum thermal performance and most accurate resistance value.

- ☐ R1 R005 1% (2512) *Top Side*
- ☐ R2 R005 1% (2512) *Top Side*

On the top side of the board form, place, and solder the two pieces of wire that run form the source and load black leads to the sense resistors. The longer of the two wire pieces runs from the source to the sense resistors. This wire must start 8mm in from the left edge of the copper track area so that it will butt up against the black source wire when installed. The shorter wire runs from the sense resistors to the black load wire. It must be soldered near the top of the copper area so that it overlaps the black load wire when installed. Tack solder one end of the wire to the board. Check that the wire is oriented according to the pictures below, then tack solder the other end of the wire. Once both ends of the wire are fixed then solder along the length of the wire. Be generous with the solder so that a smooth meniscus is created each side of the wire as shown in the pictures.

Insert the Vcc wire through the two mounting holes in the Vcc track on the bottom side of the board. Fit the wire so that it lies flat to the PCB. Flip the board over and bend the wire ends sticking out of the vias flat against the board so that they are parallel with the bottom edge of the board as shown in figures 1 and 2. Trim both ends to length so that their ends remain on the solder land. Solder the Vcc wire ends.

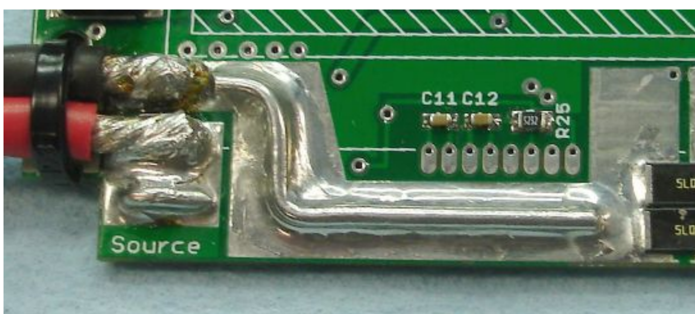

Fig.2 Wire from Source to Sense Resistors

Fig.3 Wire from Sense Resistors to Load

Flip the board back over and solder along the Vcc wire. Again be generous with the solder so that a smooth meniscus is created each side of the wire as shown in the picture.

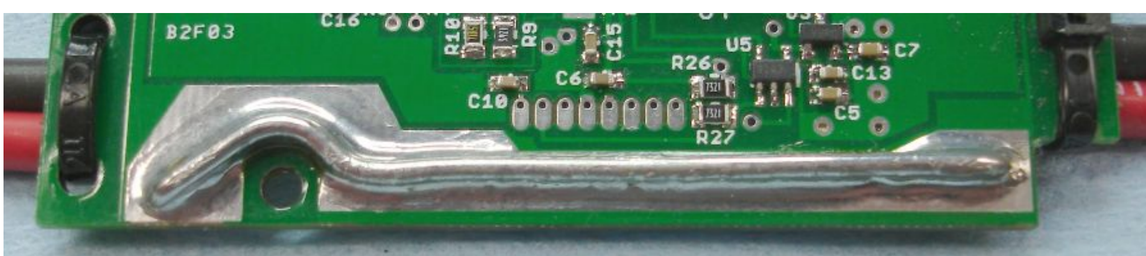

Fig. 4 Vcc Wire

If you have an iron with interchangeable tips change back to one suitable for SMD work.

2. *Install the LT3014 voltage regulator*

- ☐ R11 2M00 1%
- ☐ R12 750k 1%
- ☐ R13 7k32 1%
- ☐ R32 52k3 1%
- ☐ C1 1uF 35V
- ☐ C2 1uF 35V
- ☐ C3 2.2uF 6.3V
- ☐ C18 1uF 35V
- ☐ U2 LT3014.

Functional Verification Test 1

This test verifies that the voltage regulator provides the correct output voltage over its input voltage range and that the regulator shutdown feature works correctly.

a. Solder temporary supply wires to the source PCB lands. Red to Vcc and Black to ground.
b. Adjust a variable regulated supply to 5.2V. It's important not to use more than 5.2V initially just in case something is wrong. By limiting the supply voltage you won't destroy any devices.
c. Apply 5.2V to the temporary supply wires and measure the voltage from TP3 to ground. It should be 0V to 0.2V, as the regulator is in shutdown mode. Initially the voltage at TP3 may show some residual voltage because right now there is no load, but the voltage should drift down to only a few milivolts.
d. Turn off the variable power supply
e. Short J1 by creating a solder bridge across the two contacts and turn the supply back on.
f. Measure the voltage from TP3 to ground. It must be 4.45V +/-.05V (4.40 to 4.50V.)
   - ☐ TP3 voltage. __________ V.
g. If the voltage is within range increase the supply voltage to 25V while monitoring TP3. It must not change from the reading taken when the supply was at 5.2V by more than 20mV.
   - ☐ TP3 voltage at 25V. __________ V.
h. Turn off the external supply and disconnect it. From this point on it isn't necessary to use a regulated power supply, any fixed supply or battery over 5.5V up to 25V can be used to test the unit.

3. *Install the MCP1541 voltage reference, 24AA02 EEPROM and I2C pull-up resistors*

- ☐ R26 7k32 1%
- ☐ R27 7k32 1%
- ☐ C5 2.2uF 6.3V
- ☐ C7 2.2uF 6.3V
- ☐ C13 0.1uF
- ☐ U3 MCP1541
- ☐ U5 24AA02

Functional Verification Test 2

This test verifies that the voltage reference IC U3 is providing the correct output voltage. The EEPROM U5 functionality will be tested later.

a. Connect an external supply to the temporary source leads. Apply any voltage between 5.2 and 25V to and measure the voltage from Pin 18 of U4 the Picaxe

20X2, to ground. The voltage is typically 4.096 and must be between 4.055 and 4.137 (4.096 +/- 1%).

- Record the reference voltage. ____________ V.

b. Turn off the external supply and disconnect BatteryMonitor's temporary leads from the supply.

4. Install the battery voltage sense circuitry

- R19 2M00 1%
- R20 330k
- R31 330k
- R34 750k 1%
- R16 100k 1%
- R17 20.0k 1%
- R18 0R
- C14 0.22uF
- Q1 BC847
- Q2 DMP3098

Functional Verification Test 3

This test confirms that the voltage divider from the battery to the PICAXE A-D input is providing the correct six to one voltage division ratio. It also tests the voltage divider switch used to reduce current in hibernation mode for correct functionality.

a. Reconnect the external supply to the temporary source leads and apply voltage.

b. Measure the voltage from TP5 (just above U4) to ground. It should be 0V.
   - TP5 Voltage _________ V

c. Use the 1500 ohm axial lead resistor provided in the kit. Connect one end to the positive terminal of the external supply and the other end to a SMD probe lead. Touch this probe lead to TP4 (just above U4) while measuring the voltage at TP5 to ground. The voltage at TP5 must be Vsupply/6 +/- 2%. For example if the supply voltage is 12V the voltage at TP5 must be 2V +/-2% or between 1.960 and 2.04 volts.
   - Supply voltage _________V. TP5 __________V Error _______%

d. Turn off the external supply and disconnect BatteryMonitor's temporary leads from the supply.

5. Install the current to voltage converter circuitry

- R3 100R 1% (0603)
- R4 100R 1% (0603)
- R5 158k 1%
- R6 1k91 1%
- R7 17k4 1%
- R8 249R 1%
- R9 3k92 1%
- R10 71R5 1%
- R30 3k3 (1206)
- C4 0.1uF
- C15 2.2uF 6.3V
- C16 4.7nf
- C17 100pf
- U1 LTC2054
- U6 UM5K1N

Functional Verification Test 4

a. Solder temporary load wires positive to red and negative to black. On the end of the wires connect a load resistor (not provided in the kit) that will draw approximately 0.5A. (R=Vsupply/0.5).
b. Reconnect the external supply to the temporary source leads and apply voltage
c. Measure the current in the load resistor using a current meter or calculate it by measuring the voltage across the load resistor divided by the resistance value.
d. Measure the voltage between test point 2 and ground. It will be four times the load current in milivolts. For example if the load current was 500mA then the voltage at test point 2 must be 2.000mV or 2.000V and must have an error no greater than +/- 10% (1.8 to 2.2 volts).
   - Load current _________mA TP2 __________V Error _______%
c. Turn off the external supply and disconnect BatteryMonitor's temporary leads from the supply and load.

6. Install all components around the display (but not the display itself)

- R23 3k3
- R24 1k0
- R25 52.3 1% *Top Side*
- C6 0.1uF
- C10 0.22uF
- C11 2.2uF 6.3V *Top Side*
- C12 2.2uF 6.3V *Top Side*

7. Install the menu switches and associated components

- R14 20k0 1%
- R15 330k
- R28 3k3
- R29 330k
- R33 1k0 1%
- D1 MMDL301 (observe polarity)
- D2 MMDL301 (observe polarity)

Install the two push button switches on the ***top side*** of the printed circuit board using the following procedure:

Straighten out the bent leads on the switches with a pair of needle nose pliers. Insert the switches in the board from the top side. They can be inserted into the board so that there is up to about a two millimeter or so gap between the PCB and the bottom of the switch. This distance can be used to set the switch height to the user's preference. When the switches are snug to the printed circuit board they will be proud of the top cover by about 0.5mm and this should be fine for most users. It is possible to raise the switch so that there is up to about a two millimeter or so clearance between the printed circuit board and the switch resulting in the switch button being up to 2.5mm above the enclosure's top surface. To do this adjustment -

- Un-solder and remove the temporary source and load leads.

Insert the switches into the PCB and make sure the switch bottom is parallel to the board in both axes. Place the board in the enclosure then place the top on the enclosure. Examine the switch top with respect to the top cover. Adjust the switch height to suit. Remove the board from the enclosure, check that the bottom of the switches remained parallel to the board then solder them in place.

- Sw1 *Top Side*

- Sw2 *Top Side*

Begin by soldering one leg of each switch then recheck the switch's orientation. When satisfactory, solder the other three leads of each switch. Trim any excess push button lead length from the bottom of the board with a pair of side cutters.

- Re-solder the temporary source and load leads to the unit.
- Remove the short from J1 in preparation for functional verification test five

Functional Verification Test 5

Sw1 and Sw2 are single pole single throw normally open push button switches whose contacts close when the buttons are pushed. Test five verifies their connection and operation.

a. Connect the external supply to the temporary source leads and apply voltage.
b. Monitor the voltage at TP3 to ground, it should be near 0V.
   - TP3 ___________V
c. Push Sw2 to close its contacts and hold it closed while monitoring the voltage at TP3. The voltage should rise to the LT3014 output voltage measured in functional verification test 1, around 4.45 volts.
   - TP3 with Sw2 closed ___________V
d. Monitor the voltage at U4 pin 4. Push and hold Sw2 but leave Sw1 open. The voltage at U4 pin 4 should be 0V.
   - U4 pin 4 with Sw2 closed ___________V
e. Now simultaneously push and hold both Sw1 and Sw2. The voltage at U4 pin4 should rise to around 4.4V (about 0.99*Voltage at TP3)
   - U4 pin 4 with Sw1 and Sw2 closed ___________V

8. Install the PICAXE processor and programming port

- R21 10k (1206)
- R22 22k (1206)
- C8 10uF 6.3V
- C9 0.1uF
- U4 20X2

Install JP1 on the ***top side*** of the board. Insert JP1 'upside down' so that the plastic spacer is at the top of the connector away from the PCB. Hold JP1 in place. Position its leads so that they just protrude from the bottom of the board and solder one pin. Re-orient the connector if necessary by re-heating the soldered pin so that JP1 is perpendicular to the printed circuit board and the three leads protrude the same distance on the bottom of the PCB. Solder the other two leads. Using a side cutter cut the plastic spacer away from the three leads at the top of the connector.

- JP1 *Top Side*

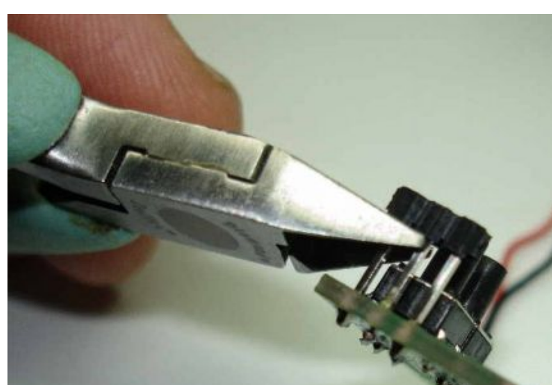

Fig 5. Clipping JP1 l

Functional Verification Test 6

Program the PICAXE processor. This procedure requires a computer running the PICAXE Programming Editor, the program to be downloaded to the BatteryMonitor, and a modified PICAXE serial cable connecting the computer to BatteryMonitor. Details about constructing a modified serial cable are provided in the PICAXE 'Programming Cable for BatteryMonitor' document.

a. Re-solder the temporary source leads to the board if they have been removed.
b. Connect the temporary source leads to an external supply and apply voltage.
c. Connect the PICAXE serial cable to the BatteryMonitor PCB serial connector located on the top left side of the printed circuit board. Insure that the ground pin on the connector mates with the ground pin on the PCB. BatteryMonitor's ground pin is the connector pin closest to the outside edge of the PCB.
d. Start the PICAXE Programming Editor application. Select the View menu item then Options and make sure the 20X2 is chosen as the current mode.
e. Using the 'File' menu select 'Open' and navigate to the program to be loaded
f. Make sure that the Programming editor's Serial Port is working. To do this
    i. In the Program Editor select the 'View' menu item then 'Options...'
    ii. Select the 'Serial Port' tab
    iii. Make sure the 'Serial Port' window identifies the correct serial port for the PICAXE programming cable otherwise select a port then push the 'Test Port' button and follow the instructions.
g. Download the selected program to the BatteryMonitor PICAXE Processor. As the 20X2 doesn't have a reset pin and BatteryMonitor uses a soft power switch do the following:
    i. In the PICAXE Program Editor click on the 'PICAXE' menu item then click on 'Program…'
    ii. The 'Downloading…' window appears followed by the 'Connecting to Hardware…' window
    iii. When the 'Connecting to Hardware…' window appears, push Sw2, and hold it down until the download is complete. The computer should begin downloading the program to the PICAXE.
    iv. When the download is complete disconnect the BatteryMonitor from the supply.
h. Disconnect the unit from the external supply and remove the programming cable.
    - Remove the temporary source and load leads by unsoldering them

9. Install the permanent source and load leads

In this procedure the permanent supply and load leads are stripped and tinned. Then the source leads are soldered to the source pads and secured to the board with a cable tie. The ***load leads are then fed through the holes in the enclosure***, ***soldered to the load pads*** and secured with a second cable tie.

Soldering these connections requires quite a bit of heat from the soldering iron and a lot of solder. If you have an iron with interchangeable tips change the tip for a broad chisel one that will spread a lot of heat over a large area. It would also be wise to use a larger gage solder for these steps. The source and load wires are big and there is very little room for the strain relief cable ties so they must be oriented as indicated in the following steps

a. Insert the four 12 gage leads with the Powerpole 45A contacts into the two pair of Powerpole shells, Keep the wire and shell colour consistent, red wire to the red part of the shell, and black to black. Insert a spring pin through each shell center hole to keep the two parts of each shell from slipping apart.
b. Using a pair of side cutters trim each pair of leads so that they are both exactly the same length.
c. Cut the silicone insulation 7mm from one end of all four 12ga source and load leads. Score the insulation with a Xacto or utility knife by rolling the wire under the knife edge. Be careful to penetrate the insulation but don't cut through the wires.

d. Tin the stripped ends. The high strand count leads will suck back an amazing amount of solder before they are fully tinned, so be patient, focus on applying solder near the tip of the lead, and keep applying solder, turning the lead over at least once to be sure all surfaces are thoroughly wet with solder. Don’t overdo it. This is a bit of a balancing act. Too little solder and the lead won’t solder well to the printed circuit board pads. Excessive solder will wick up into the lead well past the start of the silicone insulation. The leads must remain flexible at the point where they exit the printed circuit board or they won’t fit properly into the enclosure. The solder must NOT wick up the lead past the start of the silicone insulation by more than 3 or 4 mm.

e. Install the source leads. At the switch end of the board on the top side connect one black wire to the solder pad closest to the middle of the PCB, and a red wire to solder pad closest to the edge of the PCB. Soldering these leads takes a lot of heat, so it may be useful to wear a glove to insulate your hand while positioning the leads. Keep the leads as close together as possible; the wires should be at the inner edge of the PCB tracks. Be liberal with the solder but make sure that there are no solder bridges when finished.

f. Install a cable tie strain relief around the source leads. Position the cable tie head on the bottom of the board over the hole nearest the switch. Wrap the strap around the end of the board, across both wires the feed the tongue of the strap through the hole in the board into the cable tie head underneath. Tighten securely and insure that the strap rests in the notch at the bottom edge of the board. The cable tie head is too thick to fit into the case so file the head back until it no longer interferes with the board’s fit in the case. Determine the acceptable finished height of the cable tie strain relief by cutting off the end of a cotton swab and use it as a gauge. Hold it against one of the mounting screw bosses in the case and mark its height with a pencil. Use this height as a gage when filing the cable tie.

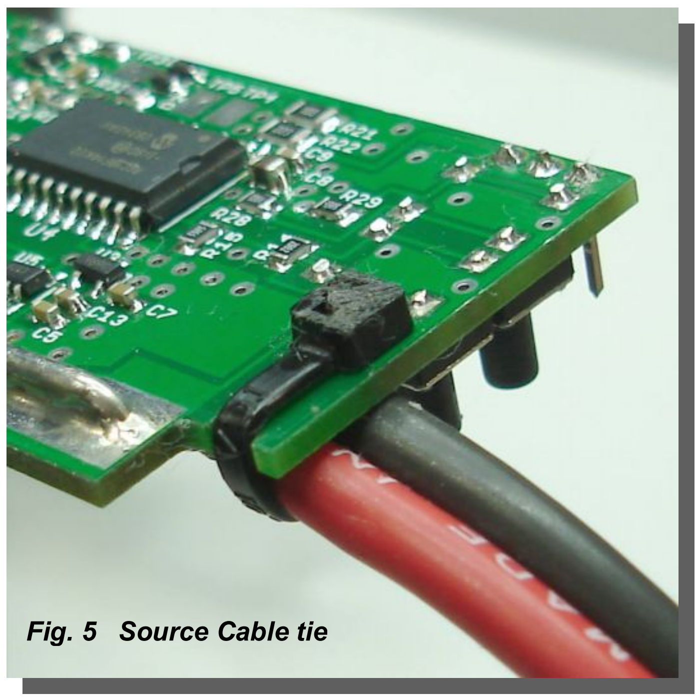

Fig. 5 Source Cable tie

g. Install the load leads. ***Push the leads through the two holes in the enclosure*** that are furthest from the enclosure’s top mounting screw posts. The red wire fits through the hole closest to the bottom edge of the case. Solder the remaining pair of wires to the other end of the board on the top side, black to the top solder pad and red to the bottom. Again keep the wires close together hugging the PCB track gap and be liberal with the solder but make sure there are no solder bridges.

h. Install the load cable tie strain relief around the both leads. Feed the cable tie from the top side of the PCB, through the hole closest to the center of the PCB. Then feed the tie across the underside of the board and through the hole at the bottom of the board to the top side. Feed the tie across the leads and into the cable tie head. Tighten securely.

i. Ease the PCB into the enclosure and check for fit.

Fig. 7 Leads Soldered to PCB

10. Install the LCD display

Although the display is a through hole device with fairly large leads you would be wise if you have a soldering iron with interchangeable tips, to change back to a tip suitable for SMD work and use the fine solder provide with the kit when installing the display.

a. Remove the printed circuit board from the enclosure.
b. Two double sided adhesive strips are provided to secure the display to the PCB. Remove the backing from one side of one the adhesive strips and place it on the PCB over the crosshatched area on the PCB’s top side. Remove the backing from the top of the adhesive strip.
c. Remove the backing from one side of the second adhesive strip and place it directly over the first strip. Remove the strip protecting the upper adhesive.
d. Keep the display away from the adhesive strip. Tip the display so that the backlight leads are farthest away from the PCB board then begin to insert the display leads into the PCB. With patience, align additional display leads with the PCB holes while keeping the display from contacting the mounting tape adhesive. When all display leads are inserted into the PCB holes, continue rotating the display toward the PCB and insert the backlight leads into the PCB.
e. Make sure the top of the display is parallel with the top of the PCB, and then ease the display down onto the adhesive tape.
f. Using a light pressure on the display push it gently against the board to secure the display to the adhesive strip...
g. Solder all display leads and clip excess lead length from the bottom of the PCB using a pair of side cutters.
   - ☐ Disp1 Newhaven NHD-C0216CiZ

Functional Verification Test 7

a. Connect the unit to a supply using the Powerpole connector on the source leads. The unit should power up and the display should be active initially showing the splash screen. The software then proceeds to the measuring system. If the unit doesn't power up press Sw2 momentarily. On the very first use the Ah/Wh display area will be blank or may contain invalid or random characters.
b. The external EEPROM will contain either all 1"s or random data. Follow the following procedure to verify the EEPROM operation and store a valid data set. Do not turn the unit off or interrupt power during the following steps. If power is interrupted restart the following sequence.
    i. Invoke the utilities menu by pushing Sw1 for less than two seconds. Navigate to the 'Choose Ah or Wh' menu item and press Sw2 momentarily to enter this submenu. Press either Sw1 or Sw2 to select either Ah or Wh. After selection the program returns to the measuring system and the Ah / Wh section should now be viewable although the reading may be incorrect.
    ii. Invoke the utilities menu again and navigate to the 'Set Backlight' utility. Press Sw2 momentarily to enter this submenu. Press Sw1 to cycle through the backlight levels and stop at the 'Backlight Low' menu item. Press Sw2 momentarily to select this item. The program will return to the measuring subsystem.
    iii. Invoke the utilities menu again. This time navigate to the 'Select Battery' menu item. Press Sw2 momentarily to enter this submenu. The first line of the display will read 'Next Battery' and the second display line may be up arrows or other random characters. Press Sw1 momentarily to scroll through the battery list. Stop at '6 Cell LeadAcid' and press Sw2 momentarily to select this battery. The program will return to the measuring subsystem.
    iv. Invoke the utilities menu again and navigate to the 'Show Vmin & ILp menu item. Press Sw2 momentarily to enter this submenu item. Press Sw1 'Y' to clear readings. The program will return to the measuring subsystem.
    v. Invoke the utilities menu once more and navigate to the Clear Readings' menu item. Press Sw2 momentarily to enter this submenu. Press Sw1 'Y' momentarily to clear the readings. The program will return to the measuring subsystem.
    vi. Press Sw1 for more than two seconds until the display reads "Hibernating Bye" then release Sw1.
    vii. Press Sw2 momentarily to power the unit. The display should read 'Resuming from Hibernation" then the software will proceed to the measuring system.
    viii. Invoke the utilities menu again. Navigate to the 'Clear Readings' item and press Sw2 momentarily to enter this submenu. Press Sw1 'Y' momentarily to clear readings. The display should return to the measuring system
    ix. Press Sw2 for more than two seconds until the display reads 'Bye Bye' then release Sw2. The unit will turn off.
    x. Press Sw2 momentarily to turn the unit on. The unit should show the splash screen then go to the measuring system without showing the 'Resuming from Hibernation' screen.
c. The external EEPROM is now programmed for standard operation. The backlight level should have remained set to the 'low' level.

Final assembly and verification

1. Secure the PCB to the case with one screw.
2. Remove the protective plastic film from the display glass
3. Place the lid on the case making sure the menu switches move freely, and then screw the lid to the case bottom using the two black screws.
4. Place a cable tie wrap about half way along the source and load leads to help keep them together.
5. Connect the unit’s source leads to a supply and the load leads to a load.
6. Check that the source voltage reading is accurate.
7. Vary the load current. Set it initially at 0.5A then 2A then 12A and note the display. Verify that the current reading on the display matches the load currents and that the unit autoranges correctly. The display should read 500mA then 2.00A and finally 12.0A. +/- 7% before calibration.
8. After several minutes of use, note the display Ah or Wh readings and the time. Put the BatteryMonitor into Hibernation by pressing Sw1 until the display shows ‘Hibernating…Bye’ then release Sw1. Then power the unit up by briefly pressing Sw2. Check that the Ah or Wh and time readings have resumed correctly from hibernation.
9. Select a battery for use with BatteryMonitor. Press Sw1 momentarily (less than two seconds) to enter the utilities menu. When in the utilities menu press Sw1 momentarily to scroll through the menu items stop at ‘Select Battery’ and press Sw2 momentarily to enter the subroutine. Press Sw1 momentarily to cycle through the stored battery choices. Press Sw2 momentarily to select a battery. The unit should then return to the measuring system.
10. Print the Quick Reference Card document and tape it to the bottom of the enclosure
11. Calibrate the unit using the Utility submenu ‘Sf & Tick Cal’ as detailed in the BatteryMonitor User Manual.