

# INSTRUCTIONS

## For Final Assembly of the Pill Reminder

Shrimpware LLC

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<http://www.shrimpware.com/pillreminder/TOU.html>.

### 1) TOOLS AND SUPPLIES.

Before beginning final assembly of the Pill Reminder, the following tools and supplies should be at hand:

#### a) Tools:

- i) Soldering Iron
- ii) Needle Nose Pliers
- iii) Diagonal Cutter
- iv) Wire stripper
- v) Small (jeweler's) straight screwdriver (for 3.5 mm screw terminals)
- vi) Phillips and Straight Screw drivers
- vii) Electrician's tool (optional; for crimping die for #22 - #14 AWG wire crimp connectors)

#### b) Supplies:

- i) Electrical solder
- ii) Electrical tape
- iii) Solder wick or solder remover
- iv) #22 AWG stranded copper wire, insulated (two colors; green and yellow suggested)
- v) 1/8 to 1/16 shrink tube insulation, about 14 inches.
- vi) Shield PC board, assembled
- vii) Enclosure, assembled except for display panel, LED panels, and cover latches

#### c) Optional:

- i) Soldering iron stand

- ii) PC board adjustable soldering stand
- iii) Magnifier
- iv) Multi-meter

## **2) ASSEMBLY INSTRUCTIONS, GENERAL INFORMATION.**

### **a) Order of assembly.**

- i) Preparation.
- ii) Display Panel Assembly.
- iii) Sub-Assembly AM/PM LED Panels
- iv) Assembly Instructions Electronics
- v) Mounting the Arduino Uno and Shield Board.
- vi) Combining Electronics and Case
- vii) Dressing the wires and assembling the cover catches.
- viii) Testing.

### **b) Soldering.**

Assembly requires that you have knowledge of skill of electronic soldering. A good tutorial on this subject can be found at:

<https://learn.sparkfun.com/tutorials/how-to-solder---through-hole-soldering>

### 3) ASSEMBLY INSTRUCTIONS, PREPARATION.

#### a) LCD

The LCD needs connection pins soldered on to it. The instructions are as follows:

Break off a 16 pin section from the breakable male header. Either the straight pin headers or the 90 degree angled pin headers can be used. Insert the short end of the 16 pin header through the holes at the top, back of the LCD module. Hold the pin header in place with some electrical tape and then solder the two end pins on the front side of the display. Then, solder the remaining 14 pins and inspect the solder connections. Remove the tape.

Take the 40 lead female-female ribbon cable and carefully count out 16 leads from either end. Tear off the 16 lead section to form a 16 lead ribbon cable.

Starting from pin 1 of the LCD header connector, insert each female connector, in order, from one end of the ribbon cable into each succeeding pin of the LCD male pin header, taking care to connect the wires in the order that they are in the ribbon cable. Figure 3-1 shows a completed LCD using an angle header (straight header is similar).

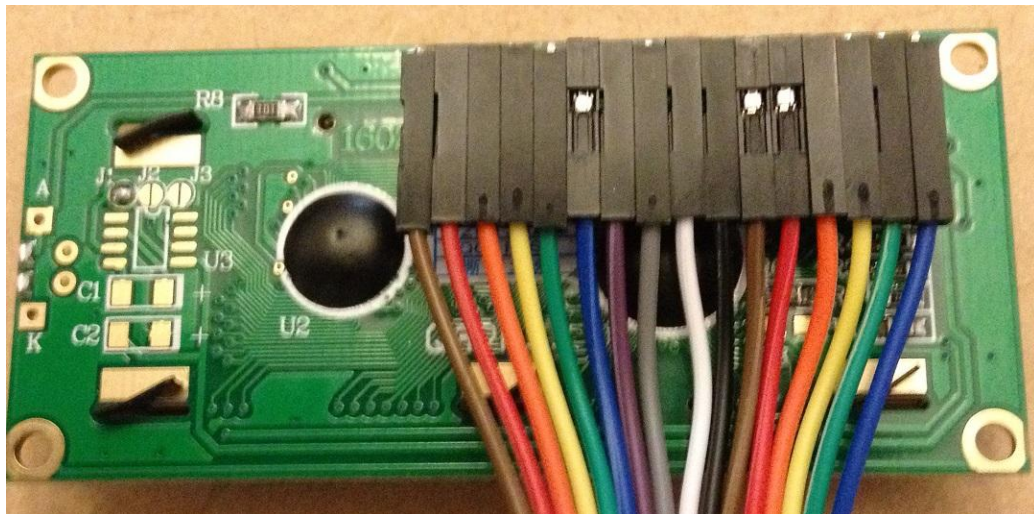


Figure 3-1. LCD with 90-degree header pins and cable.

*Note: the cable is at the TOP of the LCD module.*

#### b) Chronodot Realtime Clock (RTC) Module.

The RTC module needs the battery inserted and two pull-up resistors soldered onto it. The instructions are as follows:

Insert the battery in the Chronodot, positive (+) side up. The battery slides into the battery holder from the front. Make sure that the battery is fully inserted into the battery holder.

The battery side of the Chronodot RTC has mounting holes for two pull-up resistors. Use 5.6K ohm resistors for both of these. Note that the module is made for 1/8 watt axial lead resistors which are hard to find. 1/4 watt resistor leads will fit through the holes, but the resistor bodies are a little larger than the spacing provided and the leads need to be bent under the resistors to fit through the holes. It is acceptable to use 1/4 watt resistors as long as care is taken not to short the bent leads to anything.

Insert the leads of two, 5.6K ohm axial lead resistors through the holes provided on the Chronodot with the resistors on the top (battery) side of the board. After inserting the resistor leads through the board, bend the leads on the back side of the board to hold the resistors in place. Carefully solder all 4 leads and inspect. Use diagonal cutters to clip off excess leads from the bottom of the module. The result should be as depicted in figure 3-2.

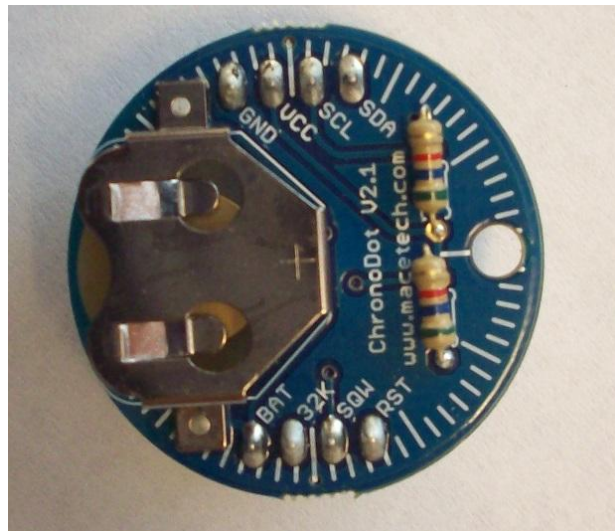


Figure 3-2. RTC with pull-up resistors added.

*Note: The Chronodot comes with male pin headers already soldered in place.*

Now, peel four female-female wire jumpers off of the 40 pin ribbon cable. Attach the left side RTC male pins to the Shield Board “RTC” connector pins, as follows:

*Ground* (bottom most pin in the RTC module) to Shield pin 1.

*Vcc* (next pin up on the RTC) to Shield pin 2.

*SCL* (next pin up on the RTC) to Shield pin 4. (Note: out of sequence!)

*SDA* (next pin up on the RTC) to Shield pin 3. (Note: out of sequence!)

*Note: Shield pins 5 and 6 are not connected.*

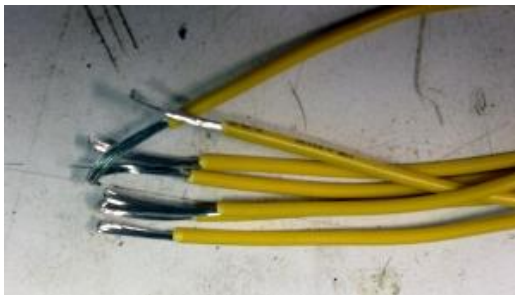
**c) LED connection “pigtail” wires.**

Connection of the LEDs to the Shield Board requires that pairs of LED leads be soldered (or crimped) to “pigtail” leads. It is highly recommended that two colors of wires be used; e.g. green and yellow.

Cut 7 green wires and 7 yellow wires (14 total); each wire approximately 5 inches long.

Using a wire stripper, strip off approximately ½ inch of insulation from one end of each of the 14 wires. Strip of approximately 1/8 – 3/16 inch of insulation from the other end of each of the 14 wires. Inspect all wires to ensure a clean strip; i.e. no broken strands.

Put these “pigtail” wires aside for future use.



**d) Programming the Arduino.**

The Pill Reminder software should be programmed into the Arduino before assembly of the Pill Reminder. This will facilitate using the software to test individual steps during assembly. See the document “*Pill Reminder Arduino IDE Installation*” for details.

#### 4) ASSEMBLY INSTRUCTIONS, DISPLAY PANEL.

The display panel consists of a subpanel and a front panel, as shown in figure 4-1.

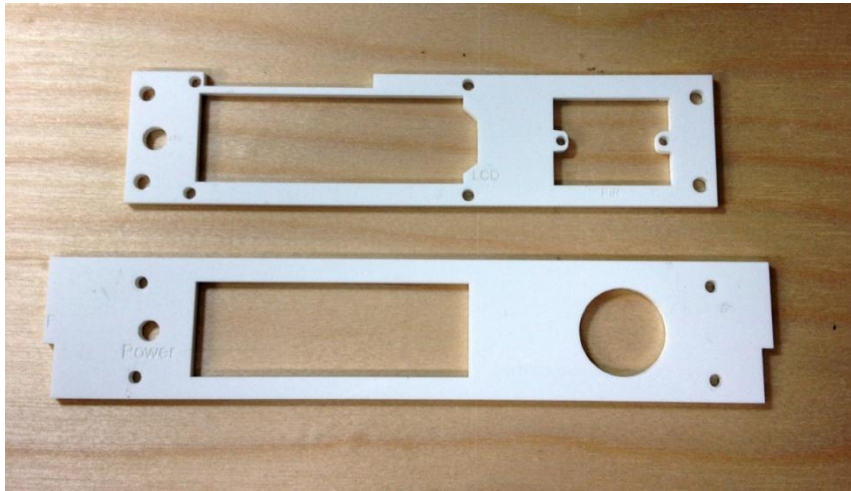


Figure 4-1. Sub-panel (top) and Front Panel (bottom).

Figure 4-1 shows the sub-panel (top) and the front panel (bottom), both as seen from the front of each panel. As depicted in the figure, the proximity detector (PIR) module mounts on the right, the LCD mounts to the left of the PIR and the POWER LED mounts to the left of the LCD. The PIR and LCD mount to the back of the sub-panel, which is then affixed to the front panel. The POWER LED mounts through the front of the front panel and through the sub-panel.

##### a) Mounting the PIR Module.

The PIR is mounted from the rear of the sub-panel. Insert two 2-56 nylon screws, 3/8" long, through the mounting holes on the front of the sub-panel and then through the mounting holes on the PIR. The PIR is mounted so that the cable connections are at the bottom and the two trim pots are at the top. Hold the PIR in place with 2-56 nylon nuts and tighten.

*Note: Nylon screws and nuts should be used on electronic modules to preclude shorting.*

It should not be necessary to adjust the pots. However, there is a jumper on the top, left side of the module (as viewed from the rear). Make sure that this jumper jumps the top two pins of the 3 pin jumper (the bottom pin is bare).

Tear a "ribbon cable" of 3 wires with female-female connectors from the 40 pin female-female ribbon cable. Place the three wires, in order, on the three male connector pins at the bottom center of the PIR module.



*Note: the PIR module comes with a 3 pin cable that has bare leads at one end. This cable is not used.*

**b) Mounting the LCD Module.**

The LCD is mounted from the rear of the sub-panel. Note that the connectors are at the top of the module. Note also that there is a protrusion on one side of the module so that the LCD module can insert through the sub-panel only one way.

Insert four 4-40 nylon screws, 3/8" long, through the mounting holes on the front of the sub-panel and then through the mounting holes on the LCD module. Hold the LCD module in place with four 4-40 nylon nuts and tighten.

*Note: Nylon screws and nuts should be used on electronic modules to preclude shorting.*

**c) Mounting the POWER LED.**

The POWER LED is a green LED. It press fits through the front of the sub panel. The POWER LED is press fit into the sub panel. The fit is tight. Take care not to break the LED. If the fit is too tight, it may be necessary to gently file out the mounting hole. *Take care not to file out the hole too much.* The LED must fit snugly into the mounting hole. If you file away too much of the hole, a dab of hot glue can be used to hold the LED in place.

At this point, the sub-panel should look like Figure 4-2.



Figure 4-2. Sub panel with parts mounted.

**d) Completing the Display Panel.**

The front panel is attached to the sub-panel using four 4-40 machine screws (1/2 inch long) and eight 4-40 nuts. Place a machine screw through each of the four mounting holes on the front panel, from the front (where the LED shows). Now, place a nut on each screw and tighten down. These nuts act as spacers between the front panel and sub-panel. The front panel should look like figure 4-3.



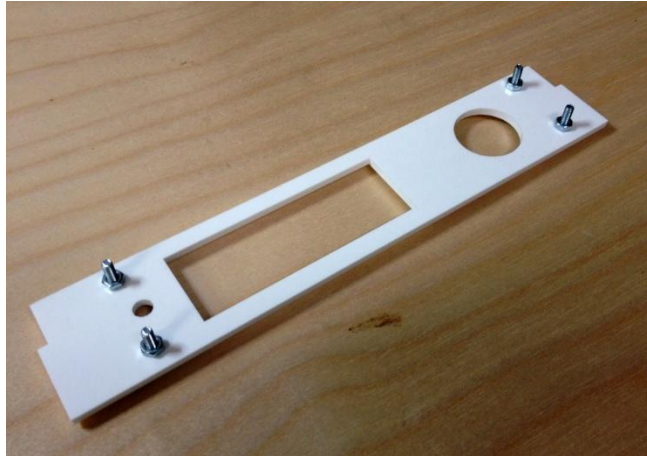


Figure 4-3. Front Panel with mounting screws and nuts

Next, put the sub-panel through the mounting screws in back of the nuts, so that the LCD and PIR align with their cutouts in the front panel. Now attach the remaining four 4-40 nuts to the back of the screws and tighten. Figures 4-4 through 4-6 show the assembled front display panel, front and top views respectively.



Figure 4-4. Assembled Display Panel – Front View.

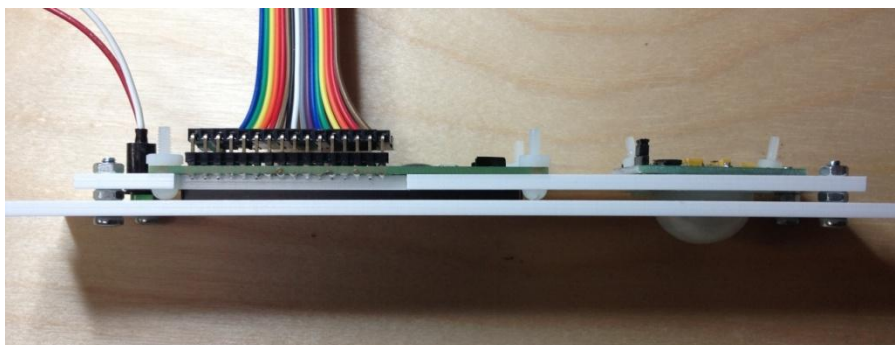


Figure 4-5. Assembled Display Panel – Top View.

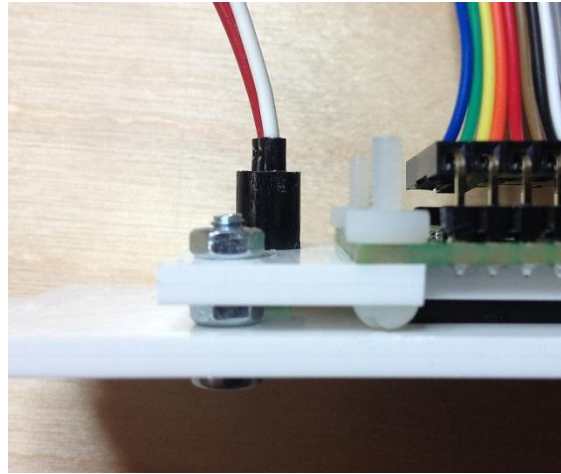


Figure 4-6. Detail view of sub panel attached to front panel

## 5) SUB-ASSEMBLY INSTRUCTIONS, AM/PM LEDs.

### a) Overview.

The LEDs press fit into the holes on the mounting panels. The leads of the AM LEDs are trimmed and the ends stripped. An AM/PM pair of LEDs (same day) are then wired “back to back” and soldered to the pigtail wires prepared in section 3 c), above. The groups of wires are soldered (or crimped) together and the ends of the pigtails attached to the shield board screw terminals.

*Make sure to use a proper wire stripper on the proper stripping die (#22 AWG or larger).*

### b) Mounting the LEDs.

Seven amber colored LEDs are used for AM, and seven green colored LEDs are used for PM. Firmly, but gently, press each LED into its mounting hole in the AM and PM panels. It will help later on if you twist the leads for each LED together, as shown in figure 5-1.

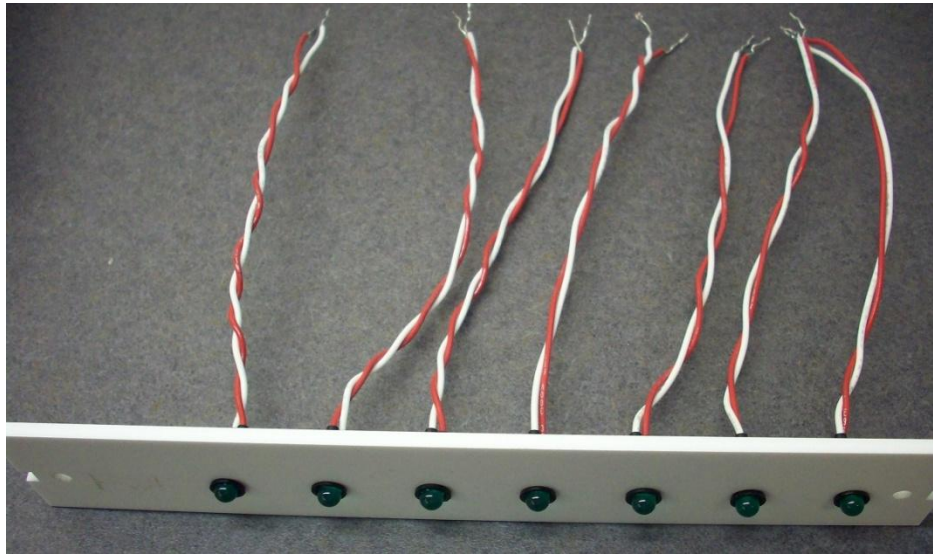


Figure 5-1. LEDs Mounted in PM Panel with Twisted Leads.

### c) Wiring the LEDs.

This step will require:

- i) Trimming and stripping the leads from the AM LEDs
- ii) The “pigtail” wires prepared per section 3 c), above.
- iii) Soldering iron and solder
- iv) Shrink tubing
- v) Jeweler's screwdriver for slotted head screws in Shield Board terminals.

Identify the AM LED panel. Trim each of the leads from the AM panel LEDs to 3.5 inches long as shown in figure 5.3.

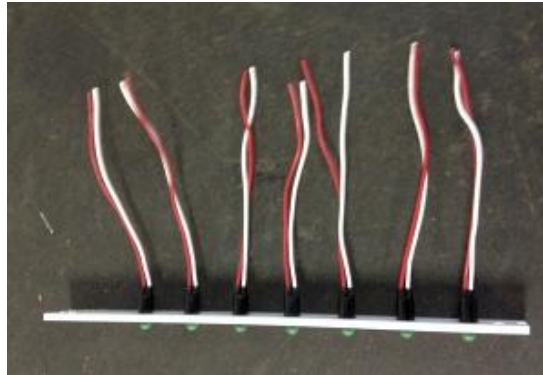


Figure 5-3. AM LED Leads Trimmed to 3.5 Inches

Use wire strippers to remove one-half inch of insulation from each of the fourteen wires.

In preparation for the next step, lay the AM LED panel on top of the PM LED panel and align the end of the LED leads as shown in figure 5-4.

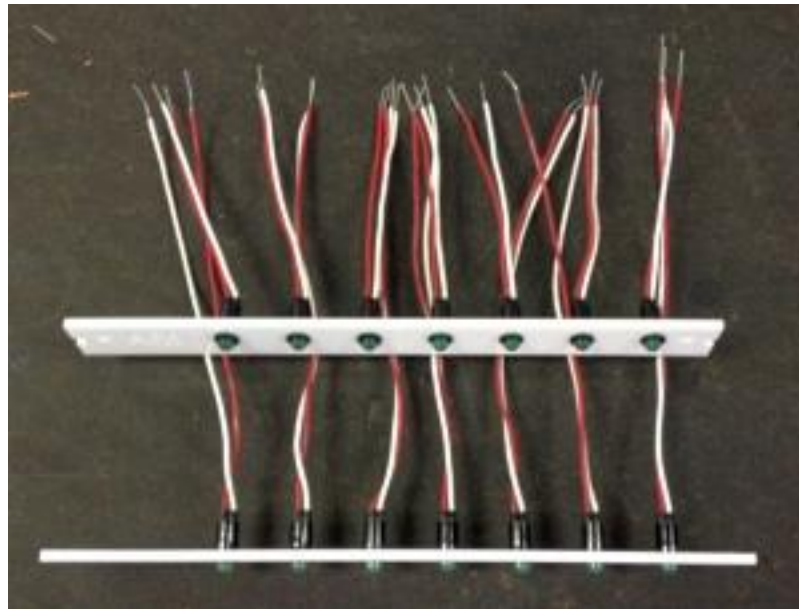


Figure 5-4. The LED Panels Prepared for Soldering

The first step is to identify the pair of AM LED leads that corresponds to each pair of PM LED leads. Start with the Sunday LED leads and bend the two pairs of leads upward so that they are obvious and distinct from the LED leads for all other days.

Next, identify the red lead of the AM LED for that day and the white lead of the PM LED for the same day. Wiggle the leads and look at the back of the LEDs to be sure that you have the correct wires. Take one of the green pigtail leads previously prepared and use the longer stripped end of the pigtail. Now, twist the red wire from the AM LED, the white wire from the PM LED and the green pigtail together. Twist these wires together well so that the bare leads are well connected and the insulation of all three wires starts at the same height.

Now identify the white wire from the PM LED and the red wire from the AM LED. Twist them together with the long stripped end of one of the yellow pigtail leads. Your work should look like figure 5-5.



Figure 5-5, The Sunday AM/PM LED Lead Pairs with Pigtail Wires.

Now solder the two twisted sets of wires together.

At this point, you have one pair of LEDs (an AM and PM LED for the same day) wired together with a green and yellow pigtail lead hanging free.

Repeat the above step with each of the other days. Be careful to always connect the LED leads of the same day together. Always connect the red lead of one LED with the white lead of the other. When you are done place a small piece of shrink tubing over each of the soldered groups and heat it to shrink it in place.

Starting with Sunday, identify the proper day of the week on the miniature screw terminals at the back of the Shield Board. Place the bare end of the green pigtail into the left side (as viewed from the front) of the 2 position screw terminal for the proper day of



the week and use the jeweler's screwdriver to tighten down the screw at the top of the screw terminal to hold the wire firmly in place. Make sure that the bare end of the pigtail is fully inserted into the screw terminal before tightening the screw and that no bare wire shows. After tightening the screw terminal, gently pull the pigtail outward to ensure that it is firmly gripped by the screw terminal. Next, repeat this step for the yellow pigtail into the right side of the same screw terminal.

After completing the AM and PM Sunday LED connections, repeat these steps for Monday ... Saturday LED pairs, in order. Figure 5-6 shows a close up of the connections to the shield board. When done your assembly should look like figure 5-7.

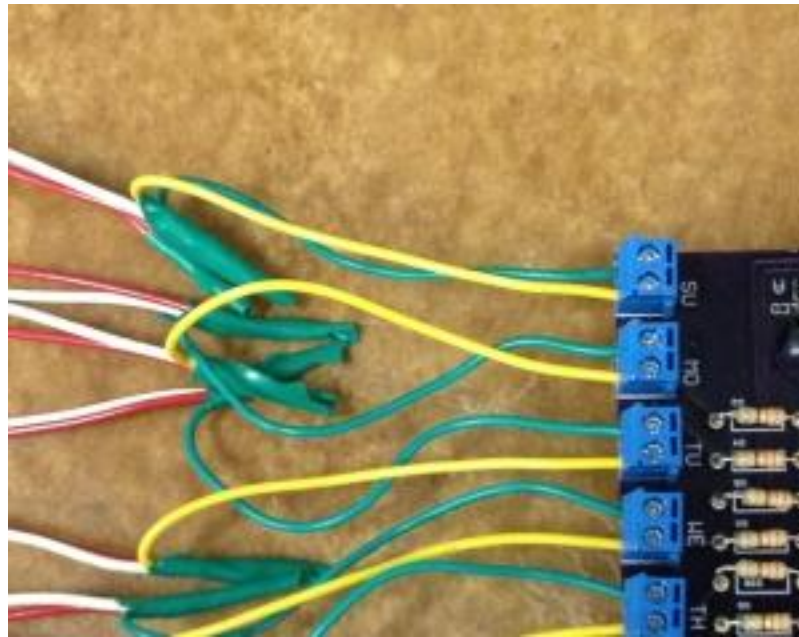


Figure 5-6 LED Pigtails Attached to Shield Board

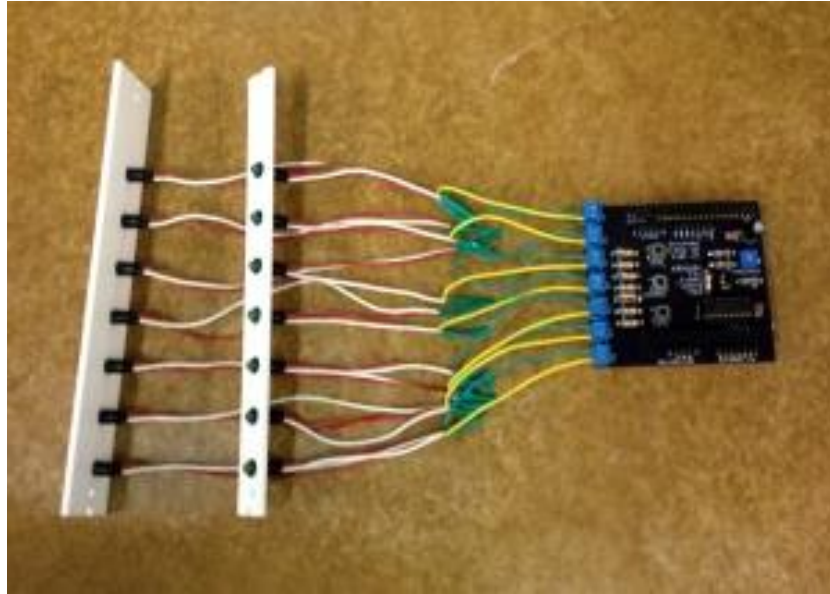


Figure 5-7. LED Pigtailed and Shield Board Assembly

**d) Testing the LEDs.**

Wiring up the LEDs is a complex procedure and it may help to test the first pair (Sunday) before proceeding on to the next pair of LEDs. To test your LEDs during assembly you will need to attach the shield to the Arduino board. At any time during this procedure, as any number of complete AM/PM pairs is wired, the LEDs may be tested as follows:

- i) Make sure that all bare wires are bent away from the Shield Board.
- ii) Plug the Pill Reminder “wall wart” power supply into an AC outlet and into the power connector on the back of the Arduino Uno board.
- iii) The Calibration sequence should start up. This sequence flashes the Sunday AM LED, then the Sunday PM LED, then the Monday AM LED, then the Monday PM LED, etc. through the Saturday AM and PM LEDs. This sequence repeats four times. With only some LEDs wired up, you will have to wait for each of the cycles to go through the entire week before the cycle repeats (about 2.5 seconds per cycle). The four repeats should be sufficient to observe that the LEDs that have been wired up are connected correctly.



## 6) ASSEMBLY INSTRUCTIONS, ELECTRONICS.

This section describes mounting the Arduino Uno, the Shield Board, and the RTC into the Pill Reminder enclosure.

### a) Mounting the Arduino Uno.

*Note: It is recommended that the Pill reminder software be programmed into the Arduino before assembly of the Pill Reminder. This will facilitate using the software to test individual steps during assembly. See the document “Pill Reminder Arduino IDE Installation” for details.*

The Arduino Uno mounts into the enclosure electronics bay, under the cover, via three nylon screws. The holes for the screws are in the bottom of the enclosure, and the rear of the enclosure has cutouts for the power plug and the USB connector. See figure 6-1 for details.

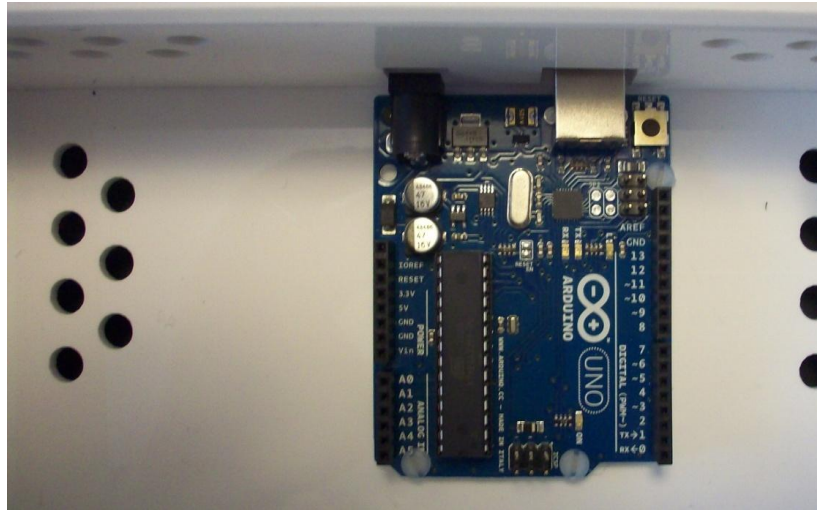


Figure 6-1. Arduino Uno Mounted in the Enclosure.

The Arduino Uno has four mounting holes, but only three are used, as shown in figure 6-1. Use three 4-40 Nylon screws, ½ inch long, to mount the Arduino Uno board. Place the three screws through the three holes on the Uno shown in figure 6-1. Place a 4-40 nylon nut on the back of each screw and tighten. These nuts serve as spacers between the bottom of the Uno and the bottom of the enclosure.

Now, place the three screws previously mounted to the Uno through the holes in the bottom of the enclosure. Place a 4-40 nylon nut on each screw and tighten. Place a second 4-40 nylon nut on each screw and tighten to lock the Arduino onto the enclosure.

## 7) COMBINE LED SUB-ASSEMBLY WITH CASE

In this section you will add the LED sub-assembly to the Pill Reminder case.

### a) Mounting the Standoffs

Before mounting the LEDs onto their respective panels, screw four metal 4-40 threaded standoffs, 25mm tall, into the enclosure, using metal 4-40 screws, ½” long.



Figure 7-1. One standoff in place. There are four to be installed.

### b) Position the parts

Lay the LED sub-assembly on the case in the correct position. Be sure the AM LED panel is on top of the wires for the PM LED panel as shown in figure 7-2.

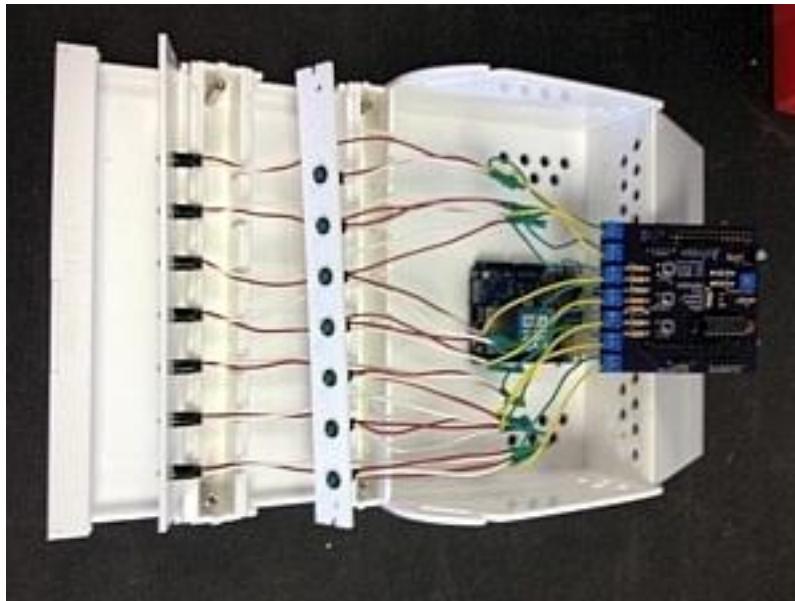


Figure 7-2. LED sub-assembly set in position.

**c) PM LED leads into place**

Gently press the PM LED leads down into the slots provided. Near the bottom of each slot is a small bump that prevents the leads from coming back up the slot. You may need to use a small flat edged screw driver to gently push each wire past the bump. You will hear the leads “snap” into place. Figure 7-3 shows the PM LED leads in place.

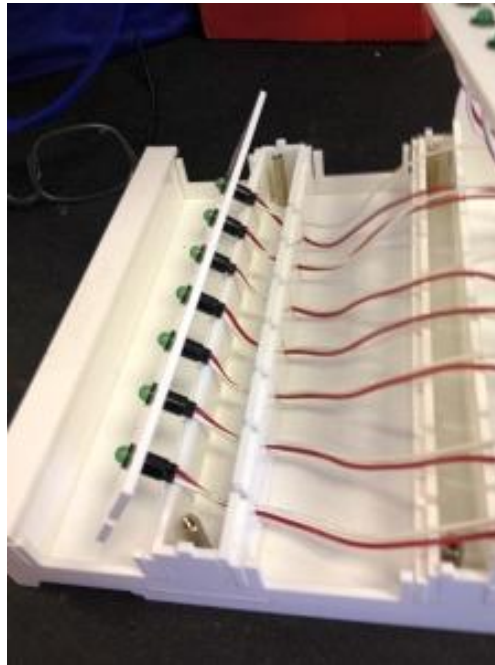


Figure 7-3. PM LED leads are snapped in place

Now follow the PM LED leads towards the back of the Pill Reminder case and press the leads down into the next two sets of slots. Your assembly should now look like figure 7-4.



Figure 7-4. PM LED leads are all in place.

Now gently work the PM LED bezel into place so that the two holes at the edges of the bezel align with the two standoffs in the case. Use two 4-40 screws to hold the bezel in place. Your Pill Reminder should look like figure 7-5.

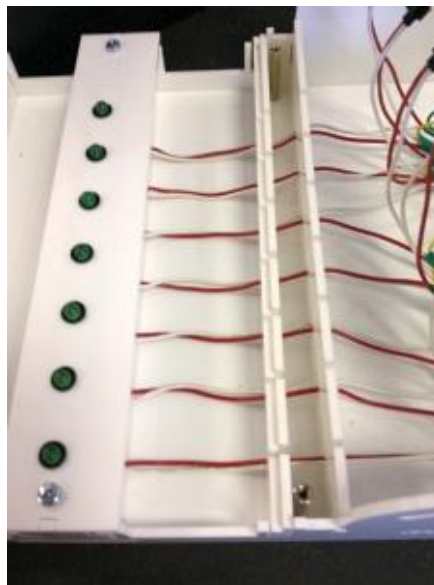


Figure 7-5. PM LED bezel assembled into case

#### **d) AM LED leads into place**

Lower the AM LED bezel so that the LED leads can be added to the slots leading the back of the case. Gently press the leads from each LED into the back slots. There will

now be four leads in each slot entering the back of the case. Gently work the AM LED bezel down into place and secure it with two 4-40 screws. Your case will look like figure 7-6.

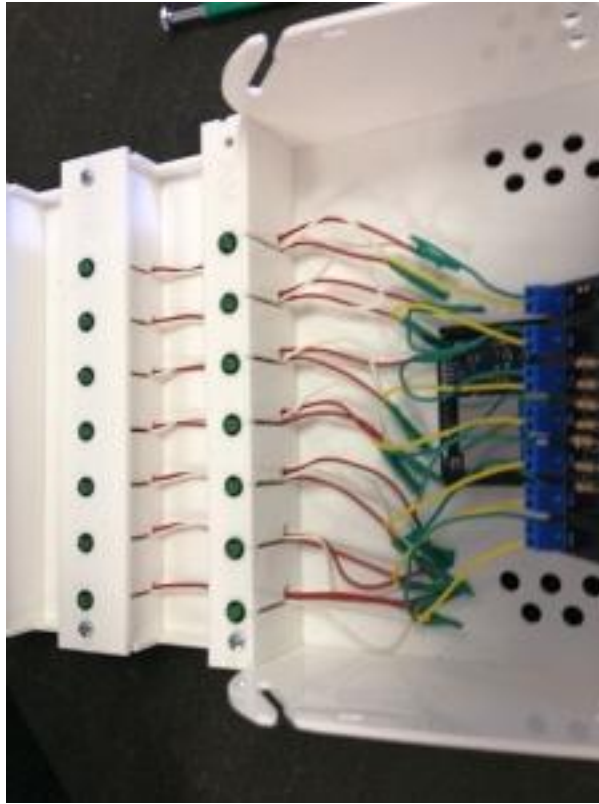


Figure 7-6. LED bezels in place.

#### e) **Attach Shield to Arduino**

For the final step, move the LED leads and pigtails to the sides so that you can lower the shield on to the Arduino. The Shield Board press fits into the Arduino Uno using the female shield header connectors on the Uno and the male mates on the Shield Board. Carefully line up the pins on the assembled Shield Board with the header on the Uno board and press the Shield Board all the way into the Uno connectors (as far down as they will go). Your Pill Reminder should look like figure 7-7.

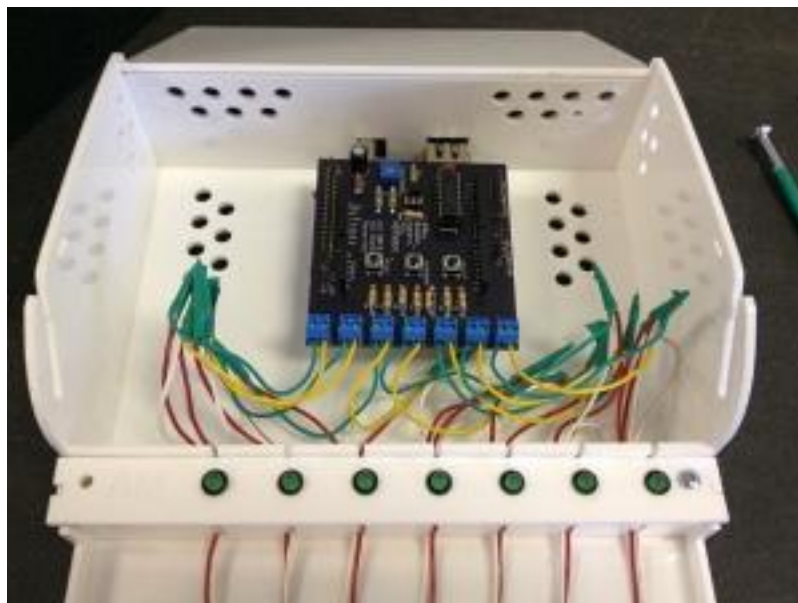


Figure 7-7. LEDs and shield in place.



## 8) ASSEMBLY INSTRUCTIONS, COMPLETION.

Place the assembled Display Panel into the grooves provided in the sloped front of the Pill Reminder enclosure. Make connections of the Chronodot, PIR, the LCD display, and the POWER LED as described below. *Note: the Display Panel does not fasten to the enclosure. It sits in the grooves and is held into place by the top cover.*

### a) Mounting the Chronodot RTC Module.

The RTC module is mounted to the back of the enclosure via a nylon standoff and two nylon 4-40 screws (1/4" long). The back of the enclosure has a mounting hole to mount the standoff to the enclosure. The Chronodot RTC has a mounting hole that is used to mount it to the other end of the standoff. The RTC mounted into the enclosure and wired to the Shield Board is shown in figure 8-1.

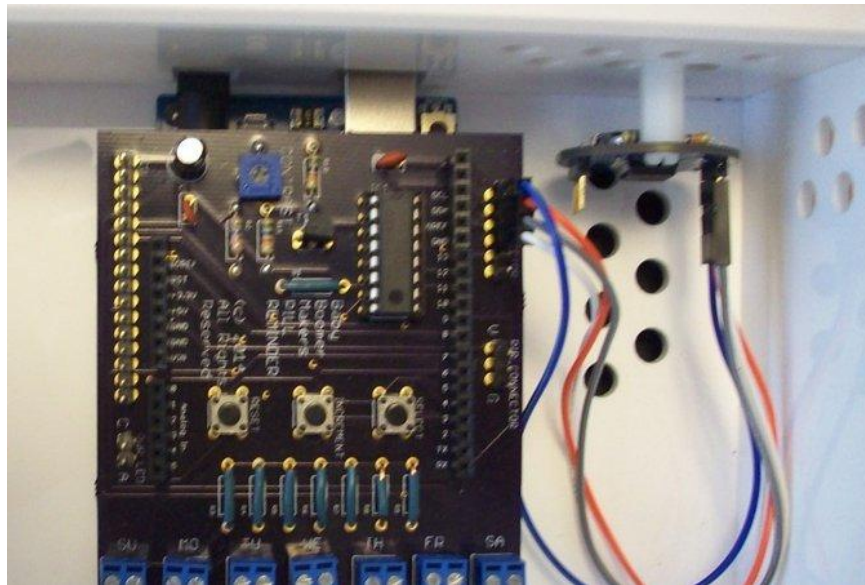


Figure 8-1. Chronodot RTC Mounted and Wired to Shield Board.

*Note: The pull-up resistors must be soldered to the RTC module prior to assembly – see section 3 b) above.*

First, place a nylon 4-40 screw (1/4" long) through the back of the enclosure and screw down the 4-40 x 1/2 inch long double threaded standoff to it with the standoff inside of the enclosure. Then use another nylon 4-40 x 1/4 inch long screw to attach the Chronodot RTC to the standoff, as shown in figure 8-1.

### b) Wiring the PIR module.

From section 4 a), the PIR module has three wires with female pin header connectors ready for connection to the PIR connector on the Shield Board. The rearmost pin of the



PIR Connector is marked “V” and gets connected to the “+5V” lead from the PIR module. The next pin is the signal and gets connected to the “OUT” lead from the PIR. The last pin is “G” and gets connected to the “GND” lead of the PIR.

**c) Wiring the LCD module.**

From section 4 b), the LCD Display module has a 16 wire ribbon cable with female pin header connectors ready for connection to the LCD connector on the Shield Board. Connect the 16 wires of the cable on the LCD to the 16 pins of the male LCD connector on the Shield board, one at a time, noting that pin 1 of the LCD is on the left end as viewed from the front and pin 1 on the Shield Board is the rearmost pin. Start with pin 1 and advance through the 16 pins in ascending order, making sure not to cross any wires (the pins on the LCD connect to the corresponding pins on the Shield Board LCD connector, in exact order).

**d) Wiring the POWER LED.**

From section 4 c), the POWER LED has a bare red and bare white wire hanging loose. Peel two wires off of the 40 wire female-female ribbon cable and press a bare wire from the LED into one end of each female-female cable. The cable connected to the red LED wire is then plugged into the “A” pin on the “PWR LED” connector on the Shield Board. The cable connected to the white LED wire is plugged into the “C” pin on the “PWR LED” connector on the Shield Board.

**e) Dressing the Cables.**

The wiring of the Pill Reminder is now complete. Stick-on cable tie holders and cable ties should be used to dress the wires neatly and securely inside the Pill Reminder electronics bay. Refer to figure 8-2 for ideas about dressing the wires.

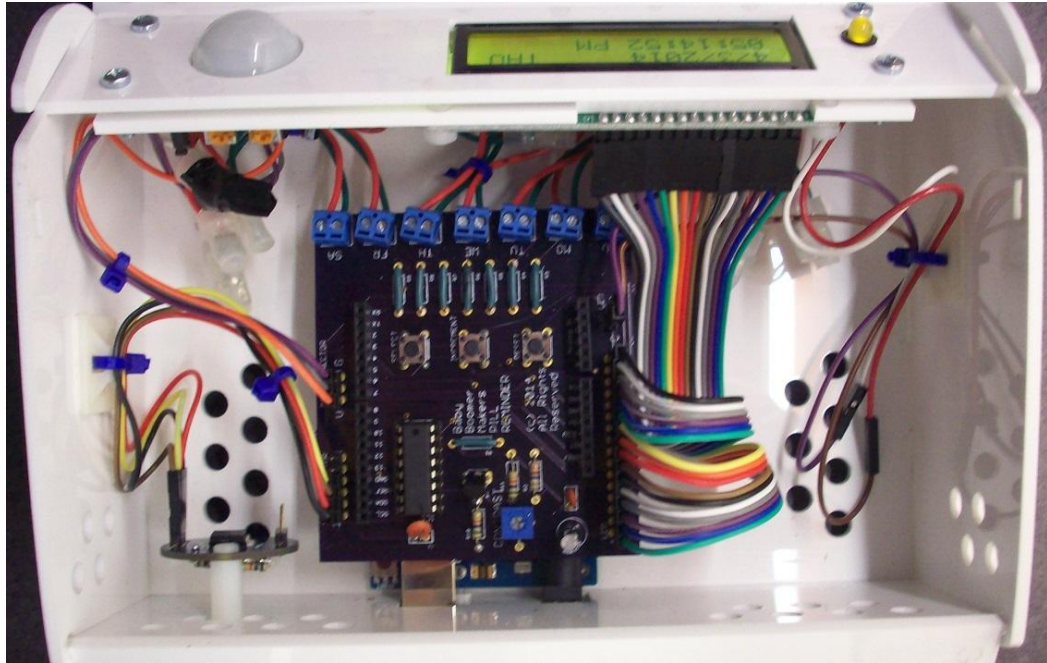


Figure 8-2. Dressing Wires for Final Assembly.

#### f) Assembling the Top Fasteners.

The last items to assemble are the catches that are used to keep the electronics bay cover closed whenever the Caregiver does not need to access the electronics. Each cover catch is secured to the cover via a 4-40 machine screw (3/8" long) and two nuts. It is suggested that the first nut be metal and the second nut, used to secure the nuts from falling off, be nylon. Note that the two catches are slightly different. Figure 8-3 shows the catches with their paper cover still attached. You will note that there is an etched portion on each catch. That bit should be face up when the catches are attached to the case top.



Figure 8-3. Left catch and Right catch

Figure 8-4 shows the assembled catch in the closed and locked position (left) and in the open position (right). When assembling the cover catches to the electronics bay cover,

make sure that the catches are loose enough to move easily and that they each seat properly in their respective slots in the side of the Pill Reminder enclosure.

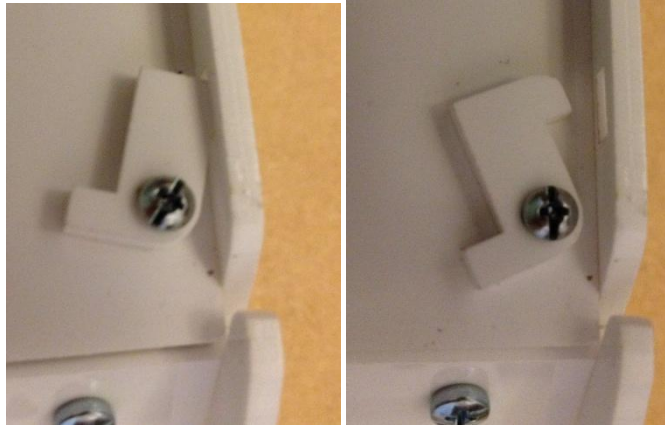


Figure 8-4. Cover Catches, Properly Assembled.

## 9) TESTING.

The Pill Reminder software provides a self test of the LEDs at the startup and calibration time. After calibration, the unit displays the date, day and time on the LCD and will blink a lit LED the first time that the PIR is tripped after calibration (assuming that the time is appropriate for an LED to be lit). Complete instructions for testing the Pill Reminder can be found in the document “Pill Reminder User Manual”, section 5.4.

Set the date and time into the Arduino as described in the “Pill Reminder User Manual”, section 5. Then, unplug the power for 5 seconds and reconnect power. After about 10 seconds of “Calibrating ...”, the LCD should display the correct date, day and time. If so, you have successfully completed assembly up to this point.

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