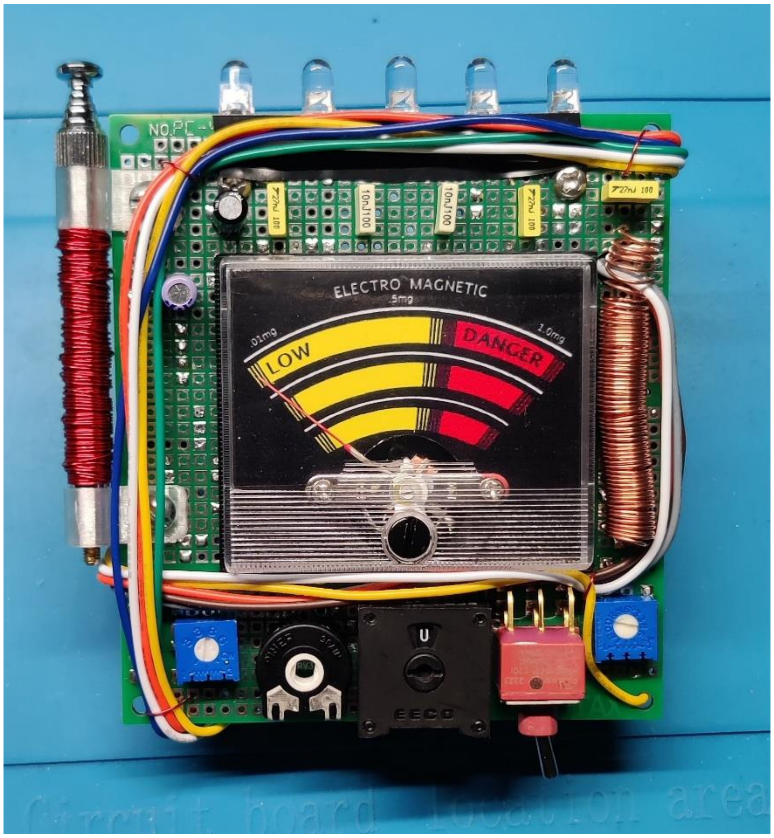
EMF Meter Build

Contents

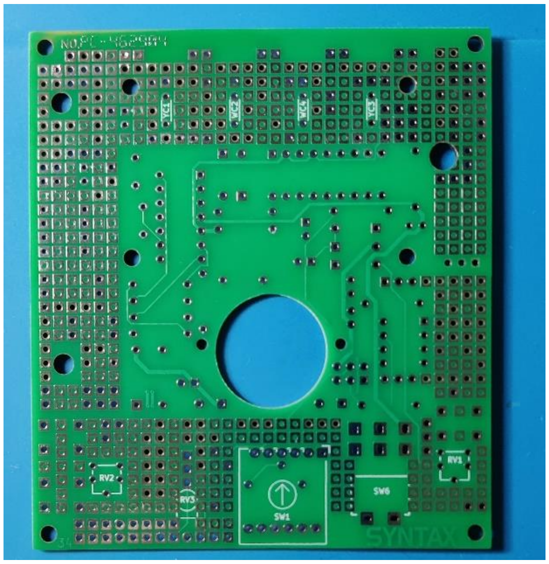
Description



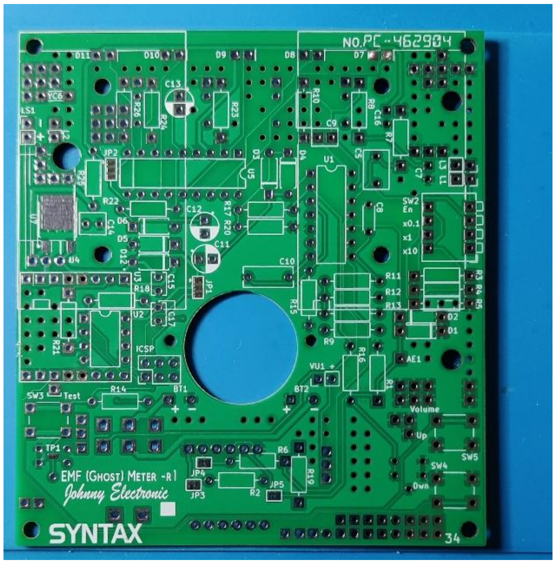
Assembled EMF Meter

Printed Circuit Board

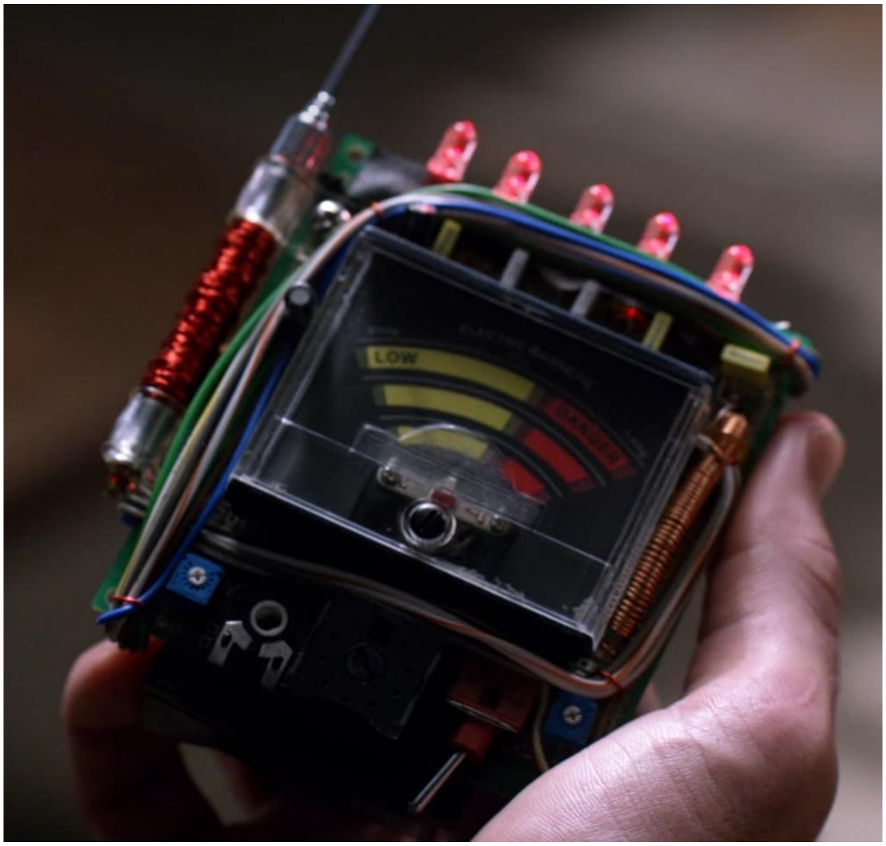
Front



Back



This document describes the assembly of the EMF Meter which was made to be a replica of the one used in the Supernatural TV series. I based my initial version on Sam's EMF Meter from S4 E13 (and seen in a few other seasons).



SAM's EMF Meter with 5 Capacitors (S4 E13 25:10)

This is a functional EMF meter that can detect both Electric and Magnetic fields. It can also be built as a simple prop by not populating the analog components. The meter was designed to replicate a variety of the meter configurations used in the TV series. Great prop or cosplay item.

The meter can be powered by one of three methods:

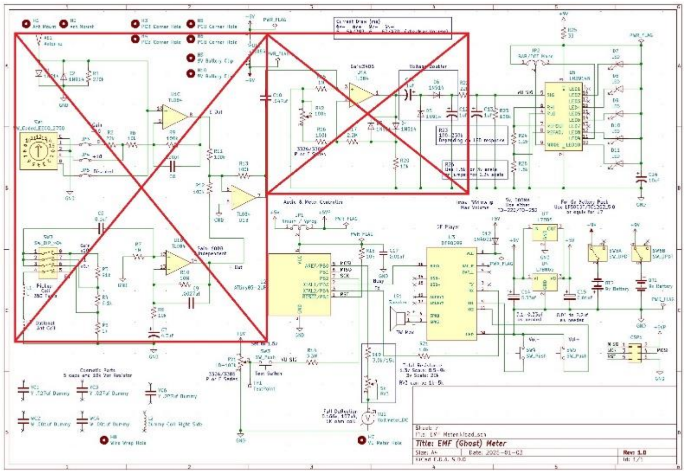
- Using two 9-volt batteries to provide +/- 9 volts
- Using either one or two 9v batteries with a 9v negative voltage buck converter
- Using 4 AA batteries to provide 6v with a 6v negative voltage buck converter

The board was designed to support a number of different part selections for the components:

- Optional 5th yellow capacitor
- Supports 3326 or 3386 F and P series blue potentiometers
- Supports PT10 or PT15 black potentiometer
- Uses a functional EECO switch to select gain for the E-Field detector and can support a number of different EECO switches. Specifically, EECO 2700 series -02, -19, -31, -33, -41, -44 will work as is and others can be adapted to work. The PCB footprint supports 6 and 12 pin switches.
- Flexible wiring options.

An ATTiny85 is used to control the DF Player sound board and the analog meter deflection. Programming for the ATTiny85 can be done before mounting and can also be accomplished using an In-Circuit Serial Programming (ICSP) port to program the mounted part on the board. There is a jumper option (JP1) to select either the main board power or to use the ICSP port for programming power. I also have available a soft touch programming cable for programming this part. There are many YouTube videos on Arduino programming options.

If you only want to make the prop version (No real EMF detection) then do not populate IC1 (TL084) and associated components and switches. See crossed out sections to remove.



Board Details

- Dimensions: 86 x 95 mm
- Parts Supported:
  - RV1/2: 3326 or 3386 Bourns blue F or P series potentiometer
  - RV3: PT15 or PT10 series black potentiometer
  - EECO Switch: 27xx02/19/31/33/41/44
  - 5-volt regulator. Using a 9v supply a 7805, 500 ma regulator, TO-220 package can be used or similar DPAK type. If using a 6v supply a Low Drop Out (LDO) regulator must be used. The LF50 and TC1262 will both work.
- Programming using an ICSP port.
- Detects E-Field and H-Field signals (Electric and Magnetic Fields) with 3 gain settings for each (-10, 0, +10). No guaranteed accuracy of the meter.

Parts List

See the EMF Board BOM for a detailed list of parts and part suppliers.

Pre-Assembled Boards

Due to the availability of certain parts the pre-assembled meters may vary. The listing for any pre-assembled meter will show the specific items used for that build.

In general, an assembled EMF Meter will have the following the standard build options:

- A 4 capacitor build (2 yellow and 2 White). A fifth yellow capacitor will be included with the meter in case that is a configuration you prefer to add. You can also make a comment with the order if you want it installed. An effort will be made to have the correct capacitor value of 22n for yellow and 10n for white.
- LED display mode set to BAR
- 6v AA power pack with a buck converter providing -6 volts.
- 5v LDO regulator
- 3326 Series blue potentiometers
- PT15 black potentiometer
- EECO switch will vary based on availability

- Antenna will vary based on availability. If the ATT 5100 6mm is available it will be used otherwise it will be a 5mm standard telescopic.

See the

- Board Options/Configuration section for additional details.

Assembly Guide

Caution: Electrostatic discharge (ESD) is a sudden and momentary flow of electric current between two differently-charged objects when brought close together or when the dielectric between them breaks down, often creating a visible spark associated with the static electricity between the objects. [1]

This type of shock can cause damage to ESD sensitive parts such as those used in this build especially U1,2,3,5. Proper ESD protection and soldering equipment should be used to prevent damage to parts during assembly and implementation into your project.

Assembly Planning

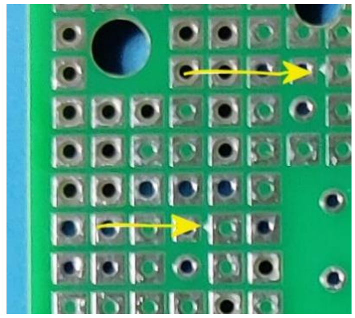
This assembly uses all through hole parts except for possibly the 5-volt regulator. A medium to fine tip soldering iron is useful along with 0.034" or smaller flux core solder and extra flux if needed. See the references section for a YouTube video link on assembling this board.

PCB Assembly

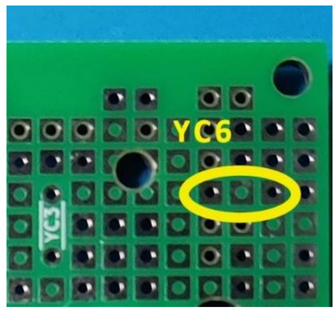
- PCB assembly can be completed in any order except with U2 and U3. See assembly notes below.
- You will want a good set of wire cutters that can cut flush to the PCB surface. The area under the meter should be as flat and level as possible. Also, any components soldered under L2 should not have leads through to the top surface as they may be shorted by the coil. Cut the leads as short as possible before soldering. There is no connection between the top and bottom pads for connections in this area.
- The majority of components will be installed on the back of the PCB. The board was designed to hide most of the components under the VU Meter.
- My recommendation is to complete the back of the board first by mounting all the IC's starting with U1 and U5.
    - NOTE: U2, R18 and R21 must be installed before U3. Install U2, R18 and R21 then U3 on top of those parts.
    - You should plan on programming U2 prior to installation. Programming code is available in Github. The link is in the references section at the end of this document.
- Mount the 5-volt regulator (U4 or U7 depending on the type used) next.
- You can apply solder jumpers for JP1 and JP2 now or later but do not forget them.
- Install the resistors, capacitors, and diodes next.
    - NOTE: Capacitors C5,8-13 should be mounted as flat as possible against the PCB so there will be clearance for the battery pack latter in the assembly. See assembly images at the end of this document.
    - NOTE: C7, C16, YCx, WCx will all be installed on the top of the PCB. C7 and C16 mounting locations are shown on the bottom of the board. Both of these are polarized parts so look for the small "+" on top of the board for proper placement. You also have the option of installing a 5th yellow capacitor and it's mounting location is shown on the bottom also.

Cap Polarity Marks

[1] Definition provided by From Wikipedia, the free encyclopedia. For more information on ESD see https://en.wikipedia.org/wiki/Electrostatic_discharge



YC6 – 5th Yellow Capacitor

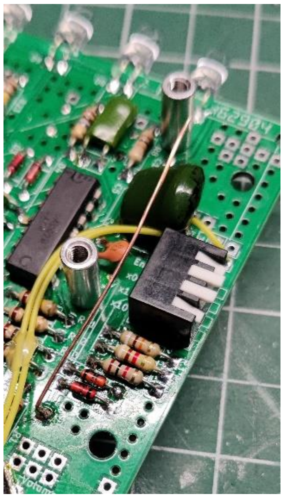


- Next install SW2 to SW5
- The LEDs can be installed either on the bottom or the top. Looking at images from the TV series they have done it both ways so it's your choice. Mounting on the bottom lets you use some hot glue to better secure the LEDs to the PCB.
- This completes the bottom assembly

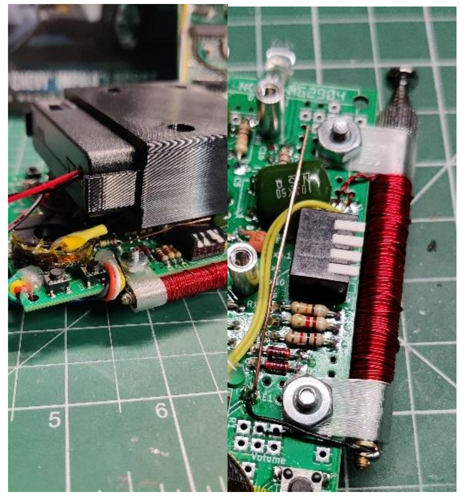
- Continue to the top of the PCB and mount the power switch SW6 and EECO switch SW1
- If you did not mount the capacitors C7, C16, YCx, WCx then mount them now.
- Mount the potentiometers RV1-3
- This completes the PCB assembly. Continue to the mounting of the antenna and coils for the next step for this assembly.

Antenna, Coil Assembly and Mounting

- Main Antenna. An antenna is used to detect electric (E) fields. The telescopic antenna can be used for added sensitivity or you can use a short piece of wire about 1 ½ - 2" (You can use the same 22 AWG solid copper wire used for coil L2). For the copper wire antenna make a right-angle bend at one end and solder that short section to pad AE1. To connect the telescopic antenna, use a short piece of solid wire. Strip one end and wrap around the base of the antenna. If possible, solder the wire to secure it. Connect the other end to pad AE1. Both antennas can be connected.

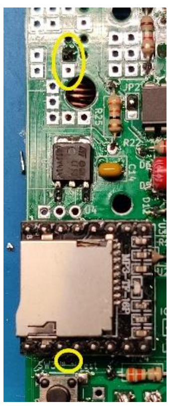


Short Wire Antenna



Telescopic and Short Wire Connected

- There are three coils that can be mounted with two of them functional and one cosmetic only.
- Coil L2 is mounted to the right side of the meter and is cosmetic only. The mounting holes are marked on the bottom of the meter. The coil was made using 22 ga. plain copper wire around a wire wrap tool (I used a #2 Craftsman Philips screwdriver shaft to get a 6.4mm diameter coil). The coil should be the length of the meter or about 1 ¾”.

  There are two upper pads and one lower pad for mounting L2 so you can stretch the coil or make it longer if desired.

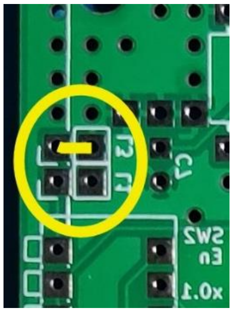
  Note: If you have any wires that poke though and touch the coil you can add a small bit of hot glue to coil bottom to both secure it and isolate it from shorting out parts.

- Coil L1 and L3
  - Coil L1 is a 350 turn of 36 AWG enameled wire that is hot glued to the bottom of the PCB at either the lower left or right side. See the available video of making the coil and 3D files are available for printing the core.

  - Coil L3 is the coil around the antenna and it can be included in the circuit to pick up magnetic fields. I used 26 AWG red enameled wire to wrap around the antenna. Before wrapping the antenna with wire, you will want to attach the p-clips with 6-32 3/8” screws with nuts. Align the screws/p-clips with the PCB mounting holes but do not mount it to the board. Once you have the p-clips aligned tighten the nuts so the clips do not move. You can now start wrapping the enameled wire between the two p-clips. If you will be using the coil in the circuit you will need to start and end the coil toward the top of the antenna so it can be attached to the circuit board.

- Make the first layer wrap tight and uniform around the antenna. On the second pass feel free to add multiple layers and give it a non-uniform look much like a free-handed wire wrap.
  - NOTE: If you do not use the coil in the circuit then a small jumper wire will be needed to jump the L3 connection.

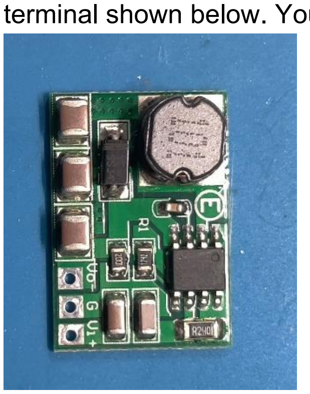
  - Mount the antenna/coil using P-Clips. 3D files are also available for printing these.
- Coil sensitivity is based on form size and number of windings. Increasing windings will make the magnetic field detection more sensitive.

Attach Speaker

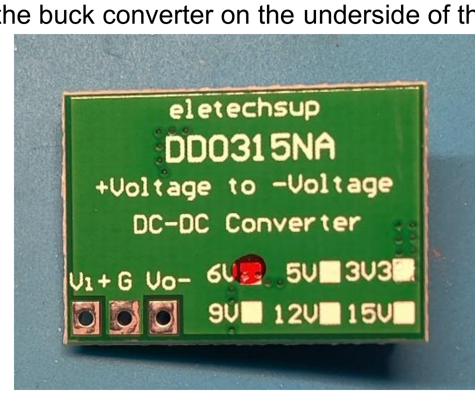
- Connect the speaker to the LS1 pads following the polarity printed. You will mount the speaker to the battery holder in the next step.

Mounting Battery Packs

- Using hot glue attach the speaker to the bottom of the battery/pack holder. Make sure you have enough wire to allow the battery/pack holder to attach to the PCB.
- Use either 4-40 or M3 screws to mount the battery/pack holder with a minimum of 10mm standoffs. I’ve provided some 3D files for 9-volt battery holder and a 4-AA battery pack holder so they can be mounted to this board.
- For 9v connect two battery clips to BT1 and BT2 following the correct polarity, Red +, Black -.
- For 6v connect the 4-AA battery pack to BT1. If using the additional EMF circuit (ie: TL084) then connect a buck converter such as a DD0315NA configured for ***-6v with Vo- to BT2 – and G to BT2 +***. This was originally the negative supply which is why the connections may seem backward. The Vi+ will connect to the power switch terminal shown below. You can use hot glue to mount the buck converter on the underside of the battery holder.



Buck Converter Front



Buck Converter Back

Buck Converter Vi+ Connection

- 9v systems can also use a -9v DD0315NA instead of the second battery or the two batteries can be connected in parallel for longer use.

Mounting Meter

- Once the battery packs are mounted the VU meter can be installed. Review the available video for options for making the meter. I've provided a 3D print file for the meter base I used and it will also align with the battery pack mounting screws.
- Use a small dot of hot glue in each corner of the meter and mount the meter to the front of the PCB placing it through the hole provided. Use more hot glue on the back of the PCB around the area where the meter goes through the PCB. This will add additional hold for the meter.
- Connect the meter wires to VU1 and follow the proper polarity.

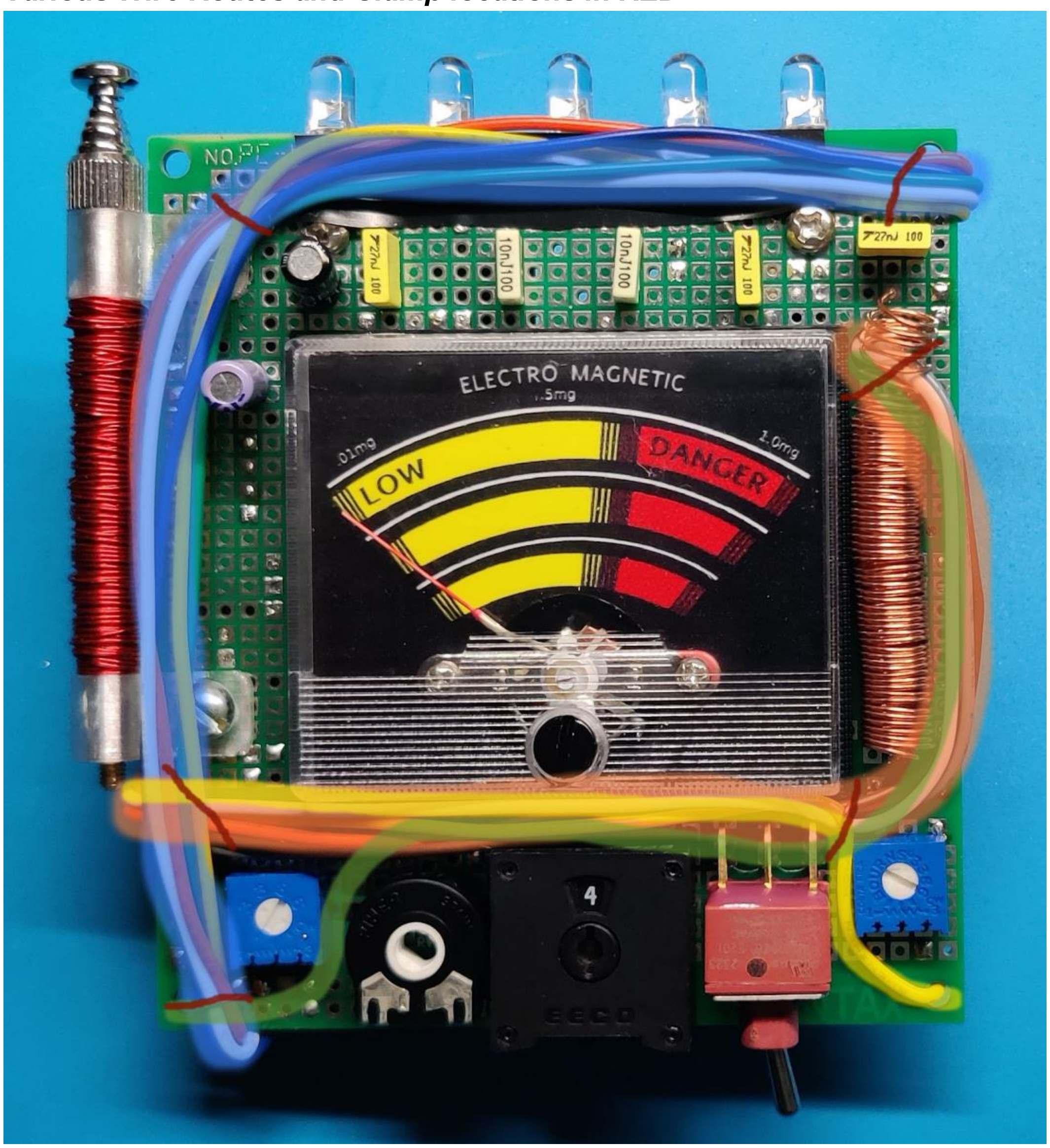
Adding Cosmetic Wires

- This board was designed to support various wiring options. The wires can be either hot glued to the back of the PCB or in some cases soldered to available pads.
- From various references wire gauge is either 28 AWG or 24 AWG. My preference was 24 AWG based on the various images from the TV series. I've noted some of the wire combinations seen in the series in the table below.
- Available wire clamp locations are also shown in the image below (Marked in RED). 22 AWG wire seems to be what was used in the show versions.
- Feel free to pick your own wire colors and routes.

Series/Episode Shown	**Upper Harness**	**Lower Harness**	**Option 1A**	**Option 1B**
General Prop Analysis	2-3 Grn, Blu, Wht/Brn, Wht/Org	Wht/Brn, Grn		
Rainbow Prop Analysis	Wht, Org, Yell, Blu, Grn, Red			
Westaby Rainbow (28awg)	Grn, Blu, Purp, Gry, Wht	Brn, Red, Org, Yell, Blk		Brn, Yell, Blk
S2 E18 8:54 - Dean's, 4 caps	Brn, Wht, Blu,Grn, Gry?, Yell	Brn, Grn, Yell	Yell	
S11 E23 14:30 - Dean's 4 caps, no blue pots	Red, Org, Blu, Yell, Wht, Grn	Wht, Purp, ??? Different routing		
S3 E14 17:08	Wht, Blu, Yell,	Yell, Grn, Blu,	Yell, Brn?	

- Sam's 4 cap	Grn,	Brn?		
S4 E13 25:10 - Sams 5 cap	Grn, Blu, Wht/Org, Wht/Yell, Gry?	Wht/Org, Gry,	Wht/Yell	
S7 E4 3:40 - Sam's 5 cap	Grn, Blu, Wht/Org, Wht/Yell, 5th Clr	Wht/Org, Wht/Yell, Gry,	Wht/Yell	
S11 E16 8:08 - Sam's 5 cap, no blue pots	2-3 Grn, Blu, Wht/Org, Wht/Yell,	Wht/Org, Wht/Yell, Gry,	Wht/Yell	
My Selection	Grn, Blu, Yell, Org, Wht	Brn, Wht, Gry Org	Yell	

Various Wire Routes and Clamp locations in RED

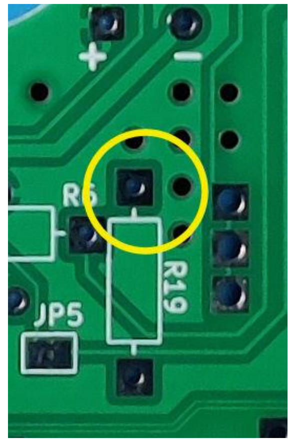


Modifications

These modifications are only used for the full EMF meter assembly (IE: Using the TL084 and associated parts)

1) PWM Mod. The PWM signal for driving the VU meter goes near the e-field circuit. It is recommended to use a 270K ohm resistor for R1. However, it can be increased to 1 M for greater sensitivity using this mod and the -6v modification below. See the schematic version 1.1 for notes on this mod. It requires cutting the trace from pin 5 of the ATTiny85 that goes to the meter. The best location is shown in the image below.

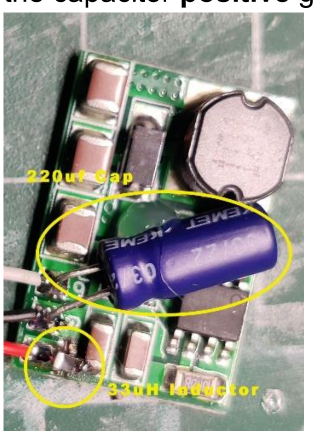
Cut trace here



Emitter to R19 here

Then connect a 470k resistor to pin 5 going to the base of a transistor such as an 2n3904 or equivalent. A 0.1uf capacitor is connected from the base to ground. Connect the transistor collector to 5v and the emitter to R19 (Cut side).

2) If using a -6 volt buck converter then a second mod is needed to filter noise. Place a 33uH inductor inline to the Vi+. Connect a 10v (or greater) 220uf capacitor to the -6v line. This is a negative supply so the capacitor **positive** goes to **G or ground** and the negative goes to Vo-.



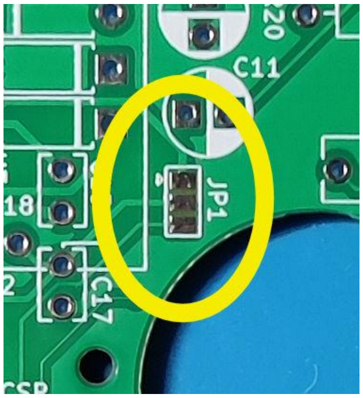
Board Options/Configuration

This section should be reviewed for those that are assembling the board themselves or purchased a pre-assembled version.

Using the table below determine which power method will be used for programming. Selecting JP1, 1 & 2 will connect U2 (ATTiny85) to the main 5-volt supply for programming. Using JP1, 2 & 3 you can draw programming power from the ICSP port instead. You will need to remove the solder jumper on 2&3 after programming and connect 1&2 for normal use.

Jumper Options

JP1	1-2 – Main 5v 2-3 – ICSP 5v

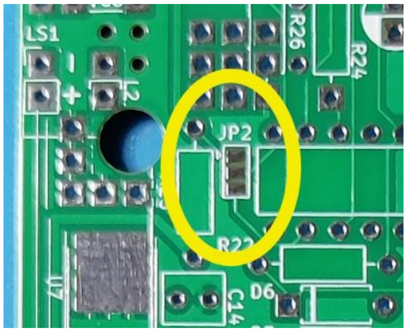


Solder jumper selecting programming power option. ^ marks pin 1

Using the table below determine which display method will be used for the LED's. Selecting JP2, 1 & 2 will provide a BAR display mode. Using JP2, 2 & 3 will provide a DOT display mode and also helps conserve battery power.

Jumper Options

JP2	1-2 – BAR Mode 2-3 – DOT Mode



Solder jumper selecting display mode option. ^ marks pin 1

Making a solder bridge

You can make your connection by selecting which half of the bridge to connect but make sure you do not connect both parts. The center pad will connect to either the upper or lower pad, ie pad 1-2 or 2-3. Once you determine the pads to connect add some solder to each pad then continue to heat both pads adding more solder if needed until the two pads are connected. The images below show some examples:

Step 1
Example bridging pad 1 & 2

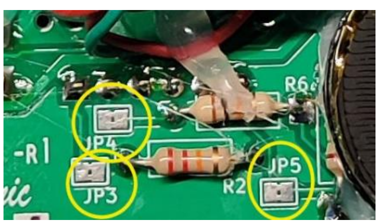
Step 2
Completed Bridge

Bad Solder Bridge
All pads connected

Switch Settings

SW1
EECO Series 2700 Switch
The rotary EECO switch is used to control the gain and operation of the E field circuit. The operation of the switch will depend on the type of switch used. The tables below show a number of switch types and their associated setting. This allows adjustment of the E-fields sensitivity or the ability to disable the E-Field and just check for H-fields.

Most of the pre-assembled boards will have a 271131M installed and use the last chart below. If you need to use another type of switch or want to rewire an existing one you can use JP3,4 and 5. These bridged jumpers can be cut in the center so that the connection is broken. Wires can then be added to attach to different terminals.



27xx -02, Table B02 (Terms 1,2,8)
BCH 1-pole, 10 position
27xx -33/34, Table B07 (Terms 1,4,8)
BCH 1-pole, 16 position (Orange and Blue Section)

Dial	1	2	4	8	Function	
Truth Table					B02	B07
0					Gain 0	Gain -10
1	●				Gain -10	Gain 0
2		●			Gain +10	Gain -10
3	●	●			Gain +10	Gain 0
4			●		Gain 0	Gain +10
5	●		●		Gain -10	Gain +10
6		●	●		Gain +10	Gain +10
7	●	●	●		Gain +10	Gain +10
8				●	Disabled	Disabled

9	●			●	Disabled	Disabled
10		●		●		Disabled
11	●	●		●		Disabled
12			●	●		Disabled
13	●		●	●		Disabled
14		●	●	●		Disabled
15	●	●	●	●		Disabled

-19, Table C13 (Terms 1,2,8)
BCH 1-pole, 10 position

Dial	1	2	4	8	Function	
Truth Table					**C13**	
0	●			●	Disabled	
1				●	Disabled	
2	●	●	●		Gain +10	
3		●	●		Gain +10	
4	●		●		Gain 0	
5			●		Gain -10	
6	●	●			Gain +10	
7		●			Gain +10	
8	●				Gain 0	
9					Gain -10	

27xx -31/41, Table C16 (Terms 1,4,8)
BCH 1-pole, 16 position

Dial	1	2	4	8	Function	
Truth Table					**C16**	
0	●	●	●	●	Disabled	
1		●	●	●	Disabled	
2	●		●	●	Disabled	
3			●	●	Disabled	
4	●	●		●	Disabled	
5		●		●	Disabled	
6	●			●	Disabled	
7				●	Disabled	
8	●	●	●		Gain +10	
9		●	●		Gain +10	
10	●		●		Gain +10	
11			●		Gain +10	
12	●	●			Gain 0	
13		●			Gain -10	

14	●				Gain 0	
15					Gain -10	

SW2
Piano DIP Switch
The lever DIP switch is used to control the gain and operation of the H field circuit. The table below shows the setting for each switch position. For normal operation switch 1-3 must always have one selection enabled along with switch 4 unless disabling H-Field then all should be off or up.

1	**Gain x10** – Provides a gain setting of 10
2	**Gain x1** – Provides a gain setting of 1
3	**Gain x0.1** – Provides a gain setting of 0.1
4	**Enable** – Connects or disconnects coil L1 and L3 if used. Enables checking for E-fields only. ***To disable all switches should be up (Off position)***

Sound Files (MP3)

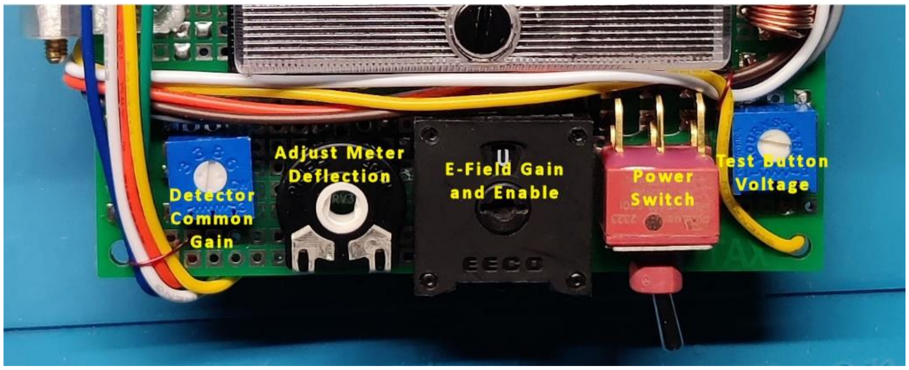
The sound files are stored in a folder named /mp3 on the SD card. Six files are available but only five are used in the program for the EMF meter. This table lists the files, functionality, and associated code define. The sound files are available in Github. The link is in the references section at the end of this document.

File Name	Define Name	Function
0001_emf start.mp3	EMF_TONE_START	Initial startup when a signal is detected or test button pressed, 0.238s
0002_emf low short.mp3	EMF_TONE_LOW	Used for mid-point signals that are neither high or low, 0.238s
0003_emf steady short.mp3	EMF_TONE_STEADY	Short high tone - Not used
0004_emf steady long.mp3	EMF_TONE_STEADYL	Long high tone when signal reaches maximum, 1.435s
0005_emf steady end.mp3	EMF_TONE_END	Signal going back down to off, 0.282s
0006_emf power up.mp3	EMF_POWER_UP	Used for initial setup/power on (5 LED)
0007_emf power up.mp3	EMF_CHARGE_UP	Used for initial setup/power on (10 LED)

EMF Meter Adjustments and Power Up

1. Before powering up the meter check for any shorts by doing an ohm measurement across the +/- battery connector.
2. Adjust all three potentiometers to their mid points.
3. Enable one of the gain switches of SW2 (1-3) and enable 4.
4. Set SW1 (EECO Switch) to one of the enabled gain settings.
5. Insert SD card with audio files into the DFPlayer.
6. Connect or install batteries and flip the power switch(s) on.
7. With in a second you should see the meter briefly deflect and a sound from the DFPlayer.
8. Press SW3 (Test Button) and you should see the LEDS and VU Meter deflect and some sound effects. While pressing SW3 adjust RV1 until all 5 LEDS are on.
9. Again, press and hold SW3 and adjust RV3 for full meter deflection.
10. RV2 (Detector common gain) see meter adjustments below.
11. To test the E-field circuit touch the wire antenna with your finger. The meter should react.
12. To test the H-field circuit move the meter toward a wall transformer or electrical appliance.

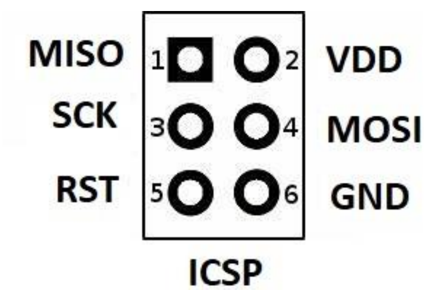
13. Removing the AA battery pack from the holder is easiest by firmly pulling battery pack straight out from the battery holder. To insert slide the battery pack in so the power switch is facing out and the clasps are at the edges of the pack. Slide in until it locks into place.



Meter Adjustments

RV1	Test button voltage – CCW increases level
RV2	Detector Common Gain – CW decreases gain. Reduce gain if the H/E-Field is too sensitive or increase for more sensitivity.
RV3	Meter Deflection – CW increases deflection

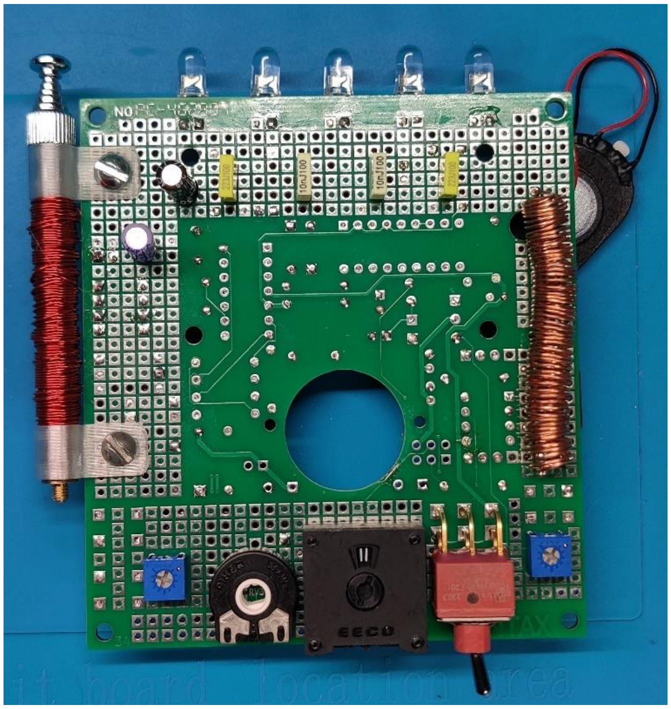
ICSP Header

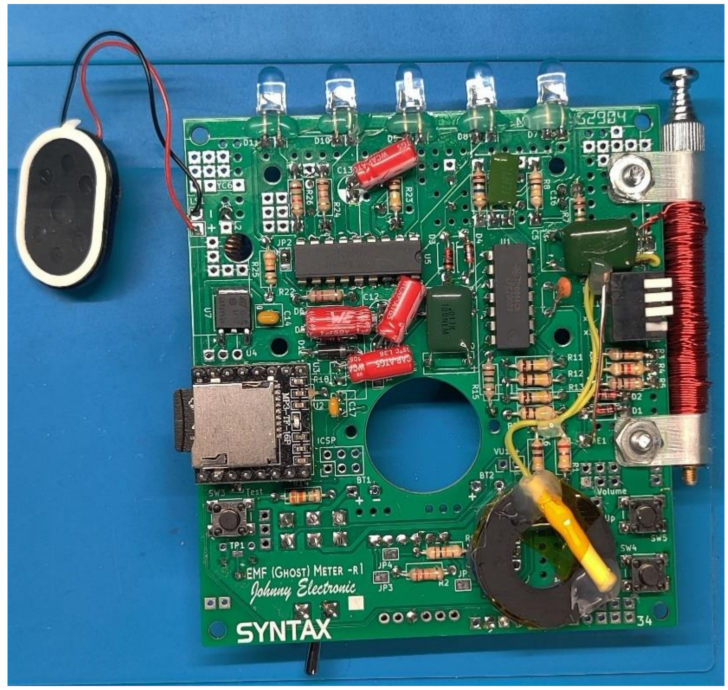


The ICSP connector follows this layout which is the same used for Arduino boards. There are a number of YouTube videos showing various methods for programming including using UNO or Nano boards as an AVR In System Programmer using the ArduinoISP sketch.

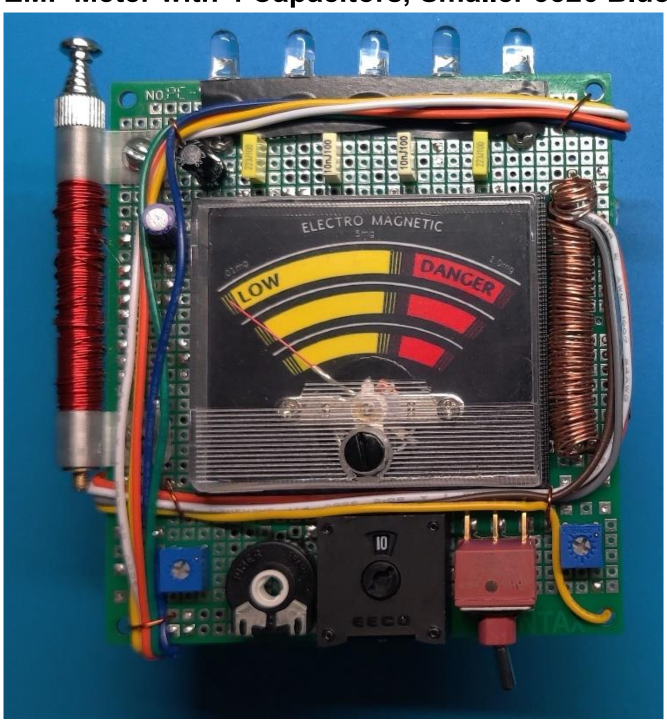
I also offer a soft touch programming cable to eliminate the ICSP header and connect directly to the board.

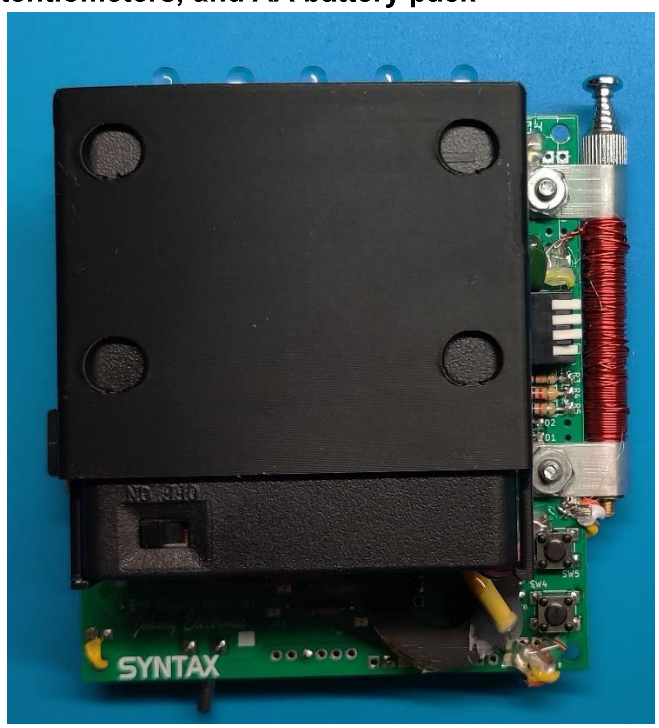
Assembly Images
Partial Assembly



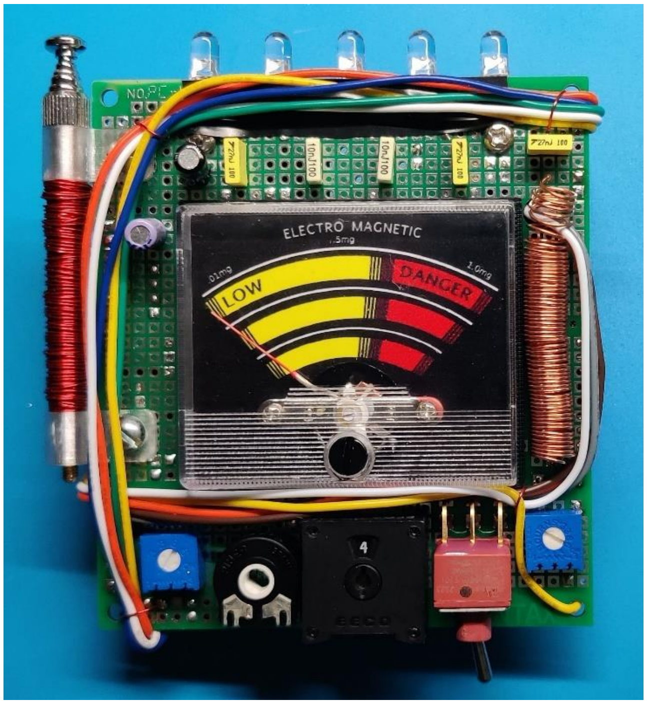


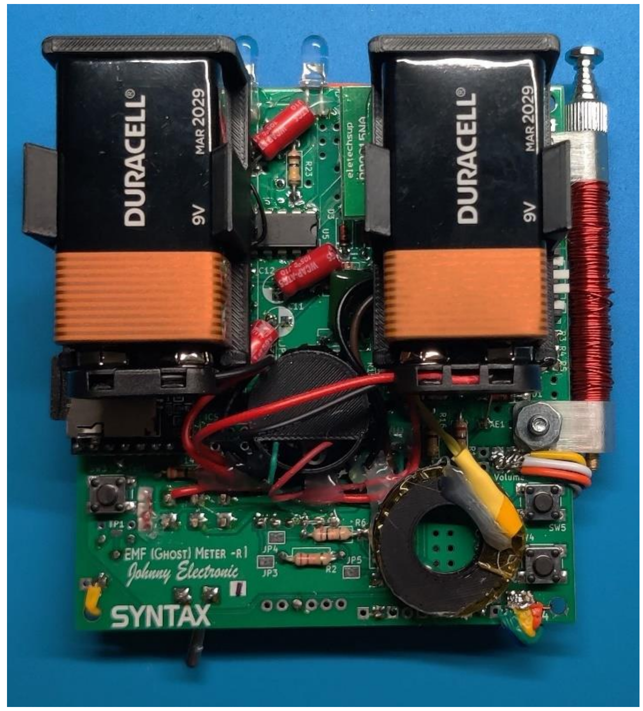
EMF Meter with 4 Capacitors, Smaller 3326 Blue Potentiometers, and AA battery pack





EMF Meter with 5 Capacitors, Larger 3386 Blue Potentiometers and 9v Batteries





References

- **Github: Development board documentation, schematics, and related files.**
  - **https://github.com/JohnnyElectronic/EMF_Meters/**
- **YouTube: Board assembly and project videos that are related to this project.**
  - **https://www.youtube.com/@Johnny_Electronic**

Revisions

R1.1	First board release, First document release
R1.2	Added EMF User Guide section
R1.3	Added PCB modification descriptions to align with the 1.1 version of the schematic.
R1.4	Corrected RV2 Detector Common Gain to CW for decreased gain. Added new images for antenna connection and modified buck converter.

Disclaimer

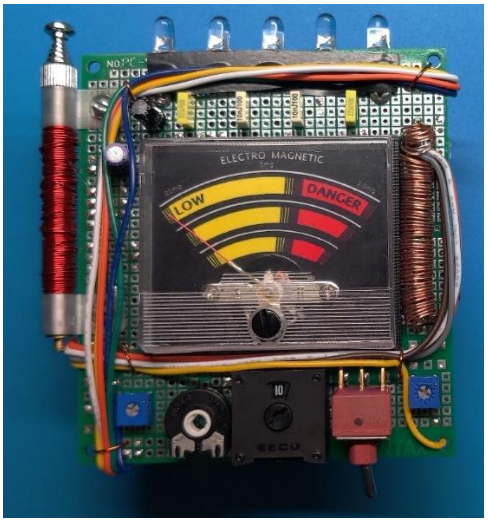
This information is provided “as-is” with no representation or warranty of any kind whether express or implied. However, I’ve tried to make this document (as well as the supporting videos) as useful and accurate as possible. If you find something that is incorrect or confusing, please let me know as I would like to make the correction so others will not have the same issue.

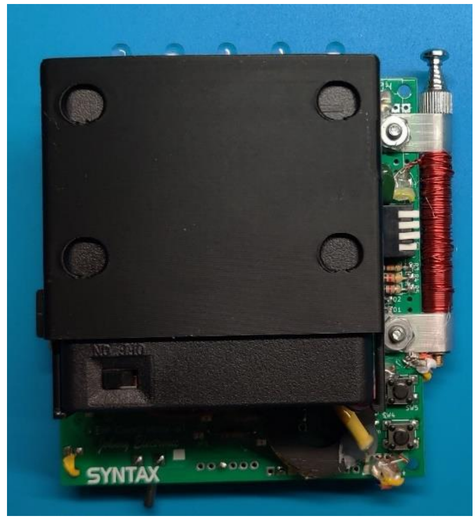
This meter is for entertainment purposes only and there is no representation as to the accuracy of the meter readings.

Feel free to email me any time for issues you may have with this build.
johnnyelectronic1@gmail.com

Legal note

EMF Meter User Guide





This EMF Meter was made to be a replica of the one used in the Supernatural TV series. I based my initial version on Sam's EMF Meter from S4 E13 (and seen in a few other seasons).

This is a functional EMF meter that can detect both Electric and Magnetic fields. The meter was designed to replicate a variety of the meter configurations used in the TV series. Great prop or cosplay item.

Meter Details

- Dimensions: 86 x 95 mm
- Powered by 6v AA power pack, 4 AA batteries
- Configured for 4 or 5 top capacitors. (If you ordered a 4-cap version the 5th will be included separately)
- 5 LED BAR display mode
- Functional EECO rotary switch
- ATTiny85 to control the meter deflection and DF sound board
  - Re-programming possible using an ICSP port.
- SD card with sound files
- Detects E-Field and H-Field signals (Electric and Magnetic Fields) with 3 gain settings for each (-10, 0, +10). No guaranteed accuracy of the meter.

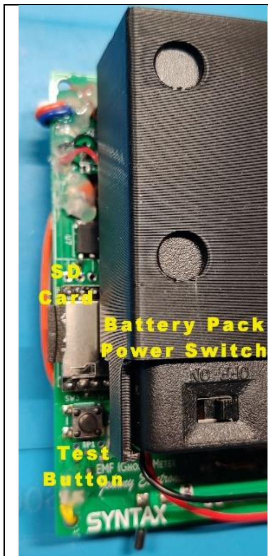
Meter Operation

If you purchased an assembled unit then all adjustments have already been made and an programmed SD card has been installed. Otherwise review the EMF Meter Adjustments and Power Up section in the build guide.

- Install the batteries in the battery pack if you have not already done so.
  - To remove the battery pack just pull it straight out from the holder.
  - To insert slide the battery pack in so the power switch is facing out and the clasps are at the edges of the pack. Slide in until it locks into place.
- Check that the SD card is inserted properly.

- If the battery pack power switch is not on, move it to the ON position.
- Flip the front power switch to the ON position, left.
- You should see the meter (Not the LEDS) deflect briefly and the EMF detected sound played.
- Use the Test button to force an EMF event otherwise you can move around and see if any Electric or Magnetic fields can be detected.
- There is a VOLUME UP and DOWN to control the meter sound.
- Review the remaining sections for gain adjustments of the meter.
- This meter was designed as a novelty item and no calibration of field strengths was performed.
- Hold the meter on the right side so you do not block E-field reception. For greater E-field detection extend the telescopic antenna.

Meter Settings

<table>
<tr>
<td>
</td>
<td>Left Back Side of Meter

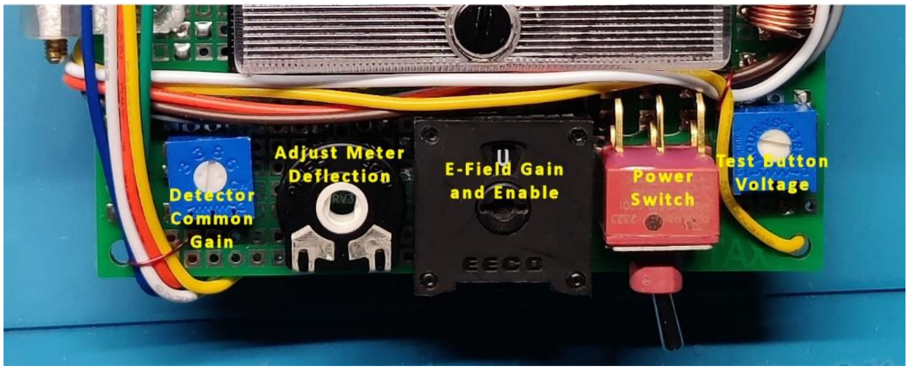
Battery Pack Power – Main power switch

SD Card – Contains sound files for meter operation. If you do not hear any sound check that the SD card is inserted properly. Press in to release and insert. You should hear a click when inserting.

Test Button – This button can be pressed to simulate an EMF event.</td>
</tr>
<tr>
<td>
</td>
<td>Right Back Side of Meter

Piano DIP Switch (SW2) – Used to control the H-Field gain as well as enable and disable of H-Field detection.

Volume Control
        Up/Down – Used to control the volume level of the meter sound</td>
</tr>
</table>



Meter Adjustments

RV1	Test button voltage – CCW increases level
RV2	Detector Common Gain – CW decreases gain. Reduce gain if the H/E-Field is too sensitive or increase for more sensitivity.
RV3	Meter Deflection – CW increases deflection

EECO Switch (SW1) – E-Field Gain and Enable/Disable

The EECO switch installed in this meter is a 271131M and the table below will show the various E-Field gain settings based on the switch position.

Dial	Function
0-7	Disabled
8-11	Gain +10
12	Gain 0
13	Gain -10
14	Gain 0
15	Gain -10

Piano DIP Switch (SW2) – H-Field Gain and Enable/Disable

The lever DIP switch is used to control the gain and operation of the H field circuit. The table below shows the setting for each switch position. For normal operation switch 1-3 must always have one selection enabled along with switch 4 unless disabling H-Field then all should be off.

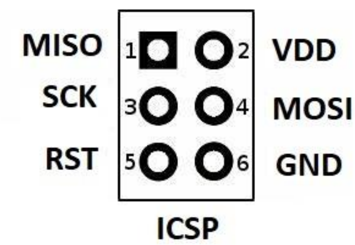
1	**Gain x10:** Provides a gain setting of 10
2	**Gain x1:** Provides a gain setting of 1
3	**Gain x0.1:** Provides a gain setting of 0.1
4	**Enable:** Connects or disconnects coil L1, and L3, if used. Enables checking for E-fields. ***To disable: all switches should be off.***

SD Card (Sound Files, MP3)

The sound files are stored in a folder named /mp3 on the SD card. Six files are available but only five are used in the program for the EMF meter. This table lists the files, functionality, and associated code define. The sound files are available in Github. The link is in the references section at the end of this document.

File Name	Define Name	Function
0001_emf start.mp3	EMF_TONE_START	Initial startup when a signal is detected or test button pressed, 0.238s
0002_emf low short.mp3	EMF_TONE_LOW	Used for mid-point signals that are neither high or low, 0.238s
0003_emf steady short.mp3	EMF_TONE_STEADY	Short high tone - Not used
0004_emf steady long.mp3	EMF_TONE_STEADYL	Long high tone when signal reaches maximum, 1.435s
0005_emf steady end.mp3	EMF_TONE_END	Signal going back down to off, 0.282s
0006_emf power up.mp3	EMF_POWER_UP	Used for initial setup/power on (5 LED)
0007_emf power up.mp3	EMF_CHARGE_UP	Used for initial setup/power on (10 LED)

ICSP Header



The ICSP connector follows this layout which is the same used for Arduino boards. There are a number of YouTube videos showing various methods for programming including using UNO or Nano boards as an AVR In System Programmer using the ArduinoISP sketch.

I also offer a soft touch programming cable to eliminate the ICSP header and connect directly to the board.

References

- **Github: Development board documentation, schematics, and related files.**
  - **https://github.com/JohnnyElectronic/EMF_Meters/**
- **YouTube: Board assembly and project videos that are related to this project.**
  - **https://www.youtube.com/@Johnny_Electronic**

Disclaimer

This information is provided “as-is” with no representation or warranty of any kind whether express or implied. However, I’ve tried to make this document (as well as the supporting videos) as useful and accurate as possible. If you find something that is incorrect or confusing, please let me know as I would like to make the correction so others will not have the same issue.

This meter is for entertainment purposes only and there is no representation as to the accuracy of the meter readings.

Feel free to email me any time for issues you may have with this build.
johnnyelectronic1@gmail.com