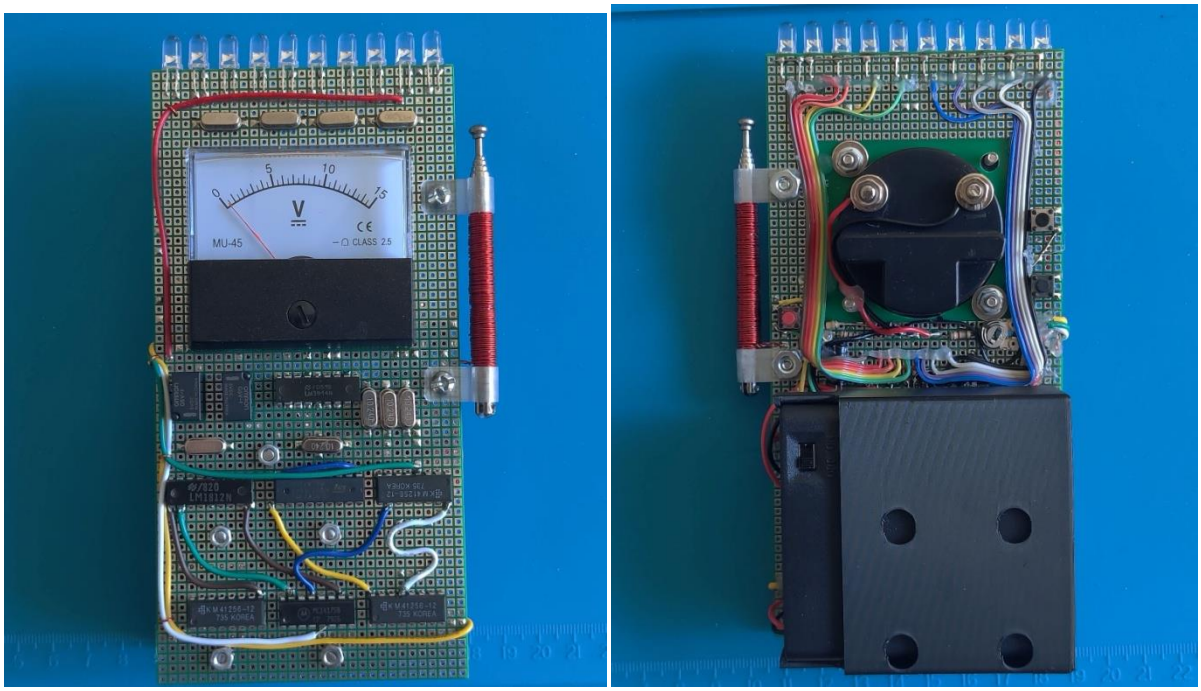
10 LED EMF Meter Build

Contents

Description

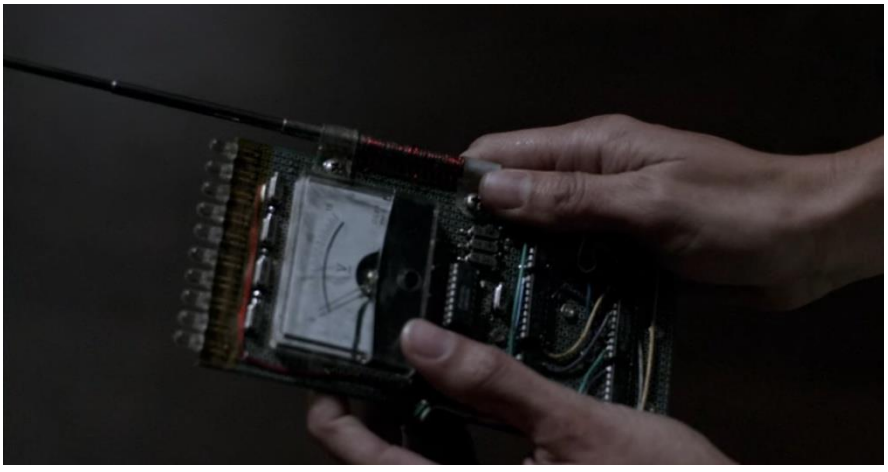


Assembled EMF Meter – 10 LED

Printed Circuit Board

Front

Back



This document describes the assembly of the 10 LED EMF Meter which was made to be a replica of the one used in the Supernatural TV series. This version is based on Olivia's meter from season 4 episode 2.

Olivia's EMF Meter (S4 E2 2:22)

This is a prop only EMF meter that can manually create EMF events by pressing the program/test button or run a selection of pre-programmed sequences.

Board Details

- PCB Dimensions: 79 mm x 158 mm
- 4 AA batteries to provide 6v with power
- Meter is a DC 0-15 volt
- 10 LEDS in BAR mode
- 9 non-functional crystals
- LM3914 IC – functional
- 6 random IC's, non-functional
- Right side mounted antenna, cosmetic
- 2 low voltage signal relays, non-functional
- Volume Up/Down buttons
- Test/Program button for creating EMF events
- ATTiny85 to control the meter deflection and DFP sound board
- SD card with sound files

Parts List

See the 10 LED EMF Board BOM for a detailed list of parts and part suppliers. A link to Github is provided in the references section at the end of this document.

Pre-Assembled Boards

This board is currently hand built on perfboard using point to point solder connections. Thus pre-assembled boards will be very limited.

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. 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.

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

PCB Assembly

- PCB assembly can be completed in any order.
- This is a perfboard assembly and you will need to use the schematic for all the point to point connections. I've included a copy of my layout guide for functional and non-functional part placements.
- There is also an image of the board assembly with the battery pack removed so you can see a suggested layout.
- Since the battery supply is only 6v a LDO 5-volt regulator of at least 500ma will be needed to power the ATTiny85 and DFPlayer module.
- The position of the ATTiny85 should allow it to be removed easily for reprogramming. Suggest a socket be used.
- The position of the DFPlayer should allow easy access to the SD card. Also, the speaker will need to connect to this part and attach to the back of the battery holder or a different location.
- Hot glue any wire connections for added support.

Antenna, Coil Assembly and Mounting

A coil of wire is wrapped around a telescopic antenna. 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. You will need to drill holes into the PCB for the antenna to be mounted. Then align the P-clips to the hole positions 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. You can start/end the wrap from either end.

- 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.
    - Mount the antenna/coil using P-Clips. 3D files are also available for printing these.
- You can solder the wire ends to one of the perfboard pads to make it look functional.

Attach Speaker

- Connect the speaker to pins 6 & 8 of the DFPlayer module. I suggest the speaker be hot glued to the back of the battery pack holder but you may see other options.

Mounting Battery Pack

- Use the AA battery pack holder as a drilling template to drill 4 holes into the PCB for mounting. Look at the reference layout for proper positioning.
- 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 to attach to the PCB.
- Use either 4-40 or M3 screws to mount the battery pack holder with a minimum of 8-10mm standoffs. I've provided some 3D files a 4-AA battery pack holder so they can be mounted to this board.

Mounting Meter

- The DC meter is mounted in the cutouts/holes provided in the PCB.
- Connect the meter wires noting the proper polarity.

Adding Cosmetic Wires

- The available images for this meter are limited. I've made some guesses as to wiring for the meter front. All wires are non-functional except for the top red wire so placement is at the builder's discretion. The top RED wire was used to provide LED + power. See "Assembly Images" for suggested wire routes.

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 same files are used for the EMF Meter Build and they are available from that folder under /mp3). The link is in the references section at the end of this document.

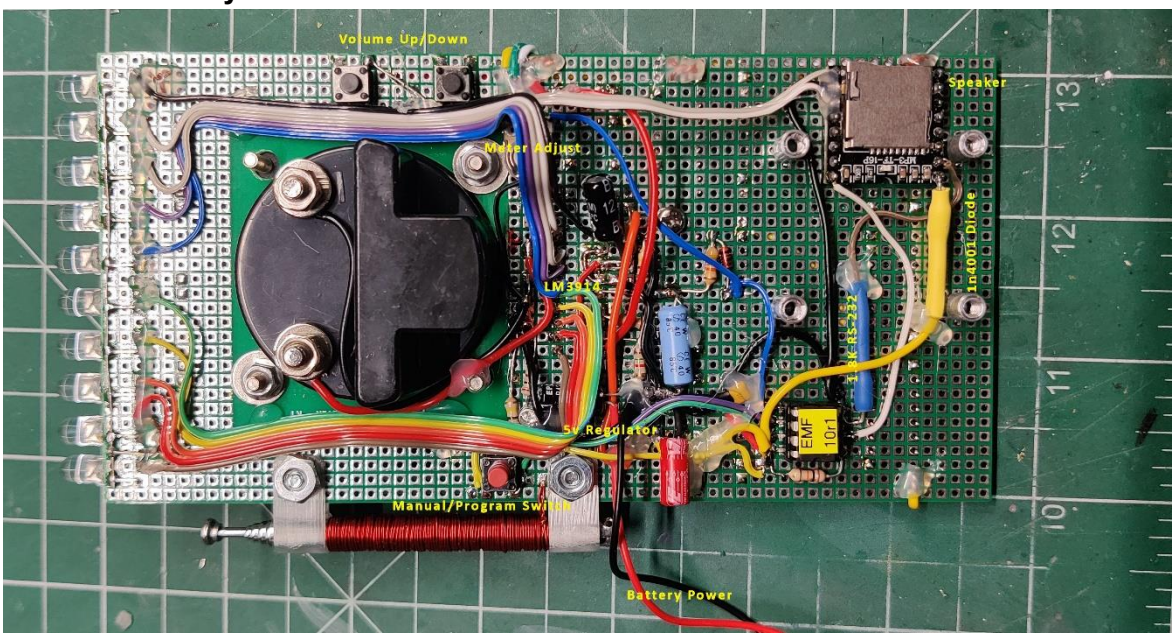
File Name	Define Name	Function
0001_emf start.mp3	EMF_TONE_START	Initial start up when a signal is detected or test button pressed
0002_emf low short.mp3	EMF_TONE_LOW	Used for mid-point signals that are neither high or low
0003_emf steady short.mp3	EMF_TONE_STEADY	Not used
0004_emf steady long.mp3	EMF_TONE_STEADYL	High tone when signal reaches maximum
0005_emf steady end.mp3	EMF_TONE_END	Signal going back down to off
0006_emf power up.mp3	EMF_POWER_UP	Used for initial setup/power on.

EMF Meter Adjustments and Power Up

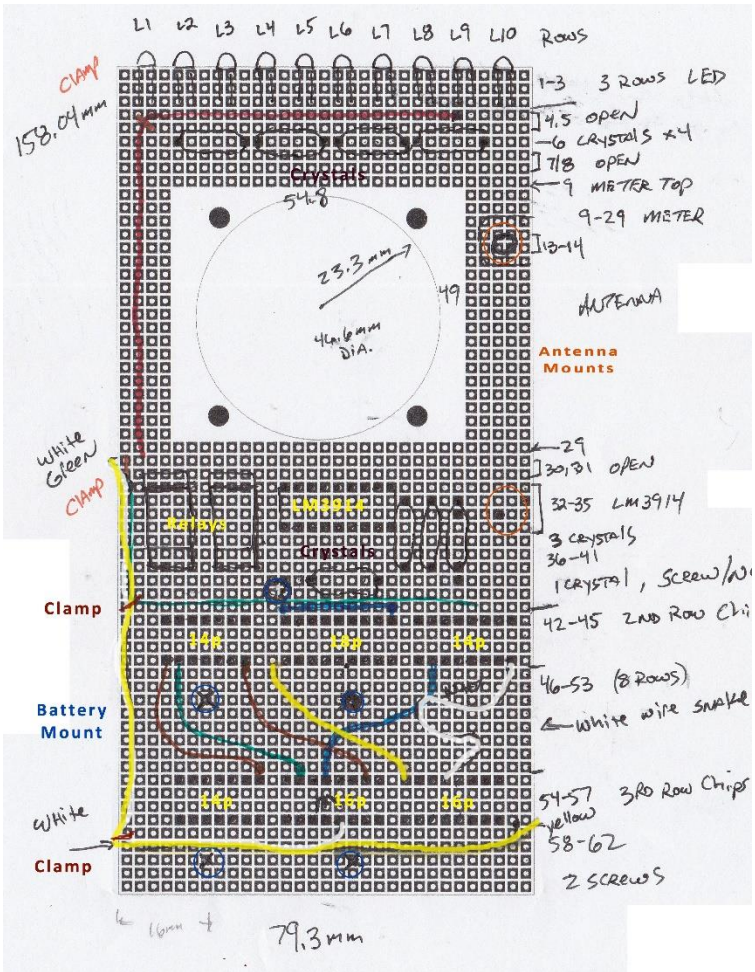
1. Before powering up the meter check for any shorts by doing an ohm measurement across the +/- battery connector.
2. Adjust the meter potentiometer to the midpoint.
3. Insert SD card with audio files in to the DFPlayer.
4. Install the AA batteries and flip the power pack switch on.
5. With in a second you should see the meter briefly deflect and a sound from the DFPlayer.
6. Press and hold the Test/Program Button and you should see the LEDS and VU Meter deflect and some sound effects. While keeping the button pressed adjust the meter potentiometer until all 10 LEDS are on.
7. Using a long button press you can manually make EMF events.
8. A quick button press will cycle through the pre-programmed EMF event sequences. An LED will light when a programmed sequence is running.
9. While pressing the Test/Program button check that the Volume Up/Down buttons are functional.
10. Removing the AA battery pack from the holder is easiest by gently pulling the locking tabs away from the battery pack and shaking the meter a few times to let gravity release the battery back. You should now be able to slide the pack out completely.

Assembly Images

Partial Assembly – Meter Back



Perfboard Layout



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	Includes both build and user guides

Disclaimer

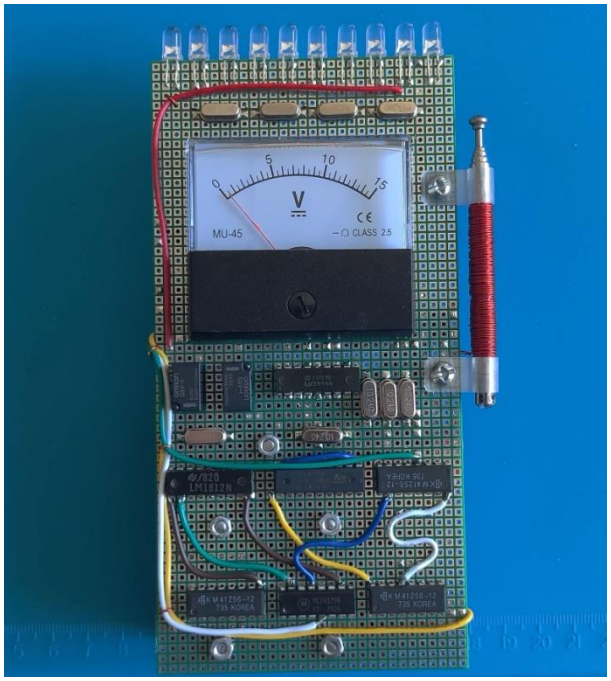
This information is provided “as-is” with no representation or warranty of any kind whether express or implied. However, I’ve tried to make this document (as well as the supporting videos) as useful and accurate as possible. If you find something that is incorrect or confusing, please let me know as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

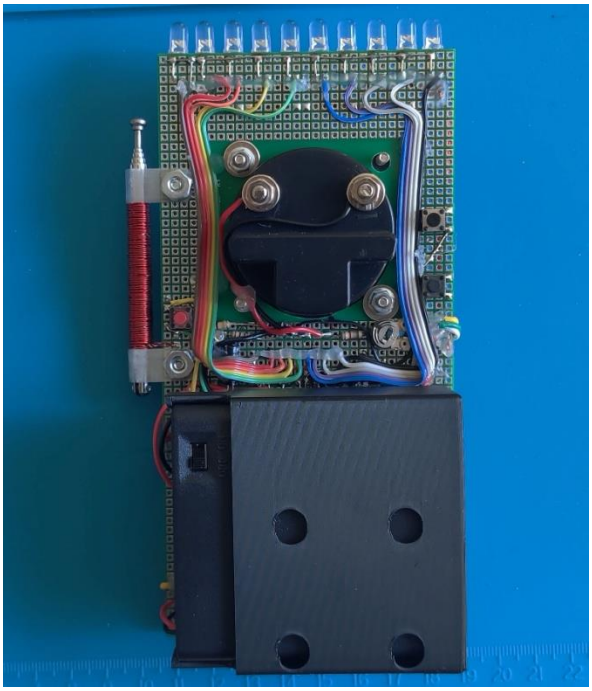
This meter is for entertainment purposes only and there is no representation as to the accuracy of the meter readings.

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

Legal note

10 LED EMF Meter User Guide





Olivia's EMF Meter (S4 E2 (2:22 min)

This meter is based on Olivia's meter from season 4 episode 2 of the Supernatural TV series. This is a prop only EMF meter that can manually create EMF events by pressing the program button or it can run a selection of pre-programmed sequences.

Meter Details

- PCB Dimensions: 79 mm x 158 mm
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- 10 LEDS in BAR mode
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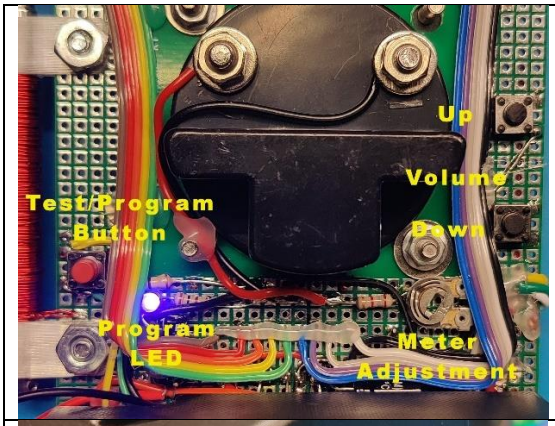
- LM3914 IC – functional
- 6 random IC's, non-functional
- Right side mounted antenna, cosmetic
- 2 low voltage signal relays, non-functional
- Volume Up/Down buttons
- Test/Program button for creating EMF events (5 Pre-programmed events included)
- ATTiny85 to control the meter deflection and DFP sound board
- SD card with sound files (Included in attached bag when shipped)

Meter Operation

If you purchased an assembled unit then all adjustments have already been made and a programmed SD card has been included. 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 pack in so the power switch is facing out and the clasps are at the edges of the pack. Slide in until in 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.
- You should see the meter deflect briefly and the EMF detected sound played.
- Use the Test button to force an EMF event by long pressing the Program/Test button.
    - A quick button press will cycle through the pre-programmed EMF event sequences. A blue LED will light when a programmed sequence is running.
- There is a VOLUME UP and DOWN to control the meter sound.
- Review the remaining sections for adjustments of the meter.
- This meter was designed as a novelty item

Meter Settings

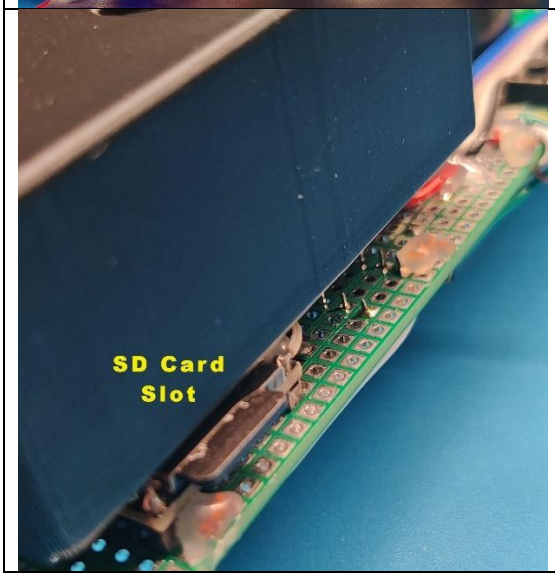


Left Back Side of Meter

Test/Program Button (Red)

- Long press will create EMF sounds and meter deflections
- Short press cycles through pore-programmed EMF sequences.

Program LED (Blue) – This LED indicates that one of the pre-programmed sequences is running.



Right Back Side of Meter

Volume Control (Black)

Up/Down – Used to control the volume level of the meter sound

Meter Adjustment – Adjust the maximum meter deflection. CW decreases deflection.

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.

Pre-Programmed Sequences (Cycles through 1-5 with each button press)

1. Single High/End - Start, High 1.4 seconds, Low
2. Highs,Lows,End - Start, High 1 second, Low, End, Start, High 1 second, Low, End
3. High,Low,High,End - Start, High 1.5 second, End, Start, low, High 0.5 second, Higher 2 seconds, End
4. Single Mid/Low/End - Start, Low, Mid, End
5. Lows/End - Start, Low1, Low2, End, Pause 0.5 seconds, Start, Low1, Low2, End

SD Card (Sound Files, MP3)

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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

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