Glitch-Injecting Power Station Assembly Instructions

Document Number: TR-5-2015

Document Version: 1.0

Table of Contents

List of Figures

Associated Documents

- Glitch-Injecting Power Station
  https://app.box.com/s/h6hduum93j4b92od4bcjj0iu5l6eijrm
  - TN9.1.4 Glitch-Injecting Power Station User Guide.pdf
- Glitch-Injecting Power Station Enclosure
  https://app.box.com/s/3t0ocapifd397d3udhj0hixm7s6bv9nj
  - Glitch-Injecting Power Station End Panels.pdf

1 Introduction

This document will step you through the assembly of the Glitch-Injecting Power Station. You should begin by reading "TN9.1.4 Glitch-Injecting Power Station User Guide" to familiarize yourself with the power station. You will use section **3 Setting Up the Glitch-Injecting Power Station** of the user guide to test the power station.

2 Required Tools and Supplies

2.1 Circuit Board Assembly Tools and Supplies

ESD safe workspace: Many of the parts used are static sensitive. You must use an ESD safe work surface, a static strap, an ESD safe parts tray, and an ESD safe soldering station.

Temperature controlled ESD safe soldering station: Many of the parts can be damaged by excessive heat. You should use a temperature controlled ESD safe soldering station adjusted to match the requirements of your solder.

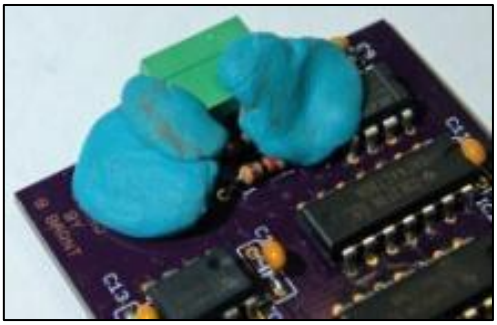
Electronic safe solder: Use solder safe for use with electronic components.

Flux cleaner: Used to clean the board if you use rosin core solder that requires cleaning.

ESD Safe Nylon Brush: Used with the flux cleaner to clean the board.

Clear RTV silicone sealant such as Permatex 80050: Used to secure the VR1 heatsink.

Moldable poster tack such as Elmer's E1531: This is a convenient way to hold components such as the connectors tight to the board for soldering. It is adhesive enough to hold the component in place but can be removed with without leaving a residue. An example is below:



2.2 Enclosure Tools and Supplies

Label maker such as the Brother PT-D200: Used to create unit and serial number labels.

0.25" (6mm) black on white labels such as the Brother TZe211: Used to create the serial number labels.

0.35" (9mm) black on white labels such as the Brother TZe121: Used to create the unit labels.

Laser Printer: Used to print enclosure end panel labels.

Clear flat spray lacquer such as Testors Dullcote: Used to waterproof labels.

81/2" x 11" label sheets such as Avery 8165: Used for end panel labels.

Heavy duty metal hobby knife handle such as the X-Acto Number 6: Used to hold the chisel blades.

3/8" chisel blade such as the Excel 20017: Used to cut the connector sides.

1/2" chisel blade such as the X-Acto H0859 #18: Used to cut the connector sides.

Small hammer: Used to punch the holes for the connectors.

Drill with #32 drill bit: Used to drill the end panel holes for the LEDs.

Needle files: Used to clean up the connector cutouts and LED holes.

#4 x 1/4" self-tapping screws similar to McMaster-Carr 92295A100: Used to mount the circuit board.

Philips screwdriver: Used to install the circuit board and enclosure screws.

Small flat screwdriver: Used to tighten the wires in the connector plugs.

1/8" red heatshrink tubing: Used to mark the positive lead of the AC supply.

Heat gun: Used to shrink the heatshrink tubing.

3 pin plug (Digikey ED2876-ND) to plug into 3 pin connector: Used to connect to the input of the power station.

6 pin plug (Digikey ED2879-ND) to plug into 6 pin connector: Used to connect to the output of the power station.

3 Circuit Board Assembly Steps

3.1 Install the Resistors, Inductors, and Rectifier

Install the components in the order listed below the figure.

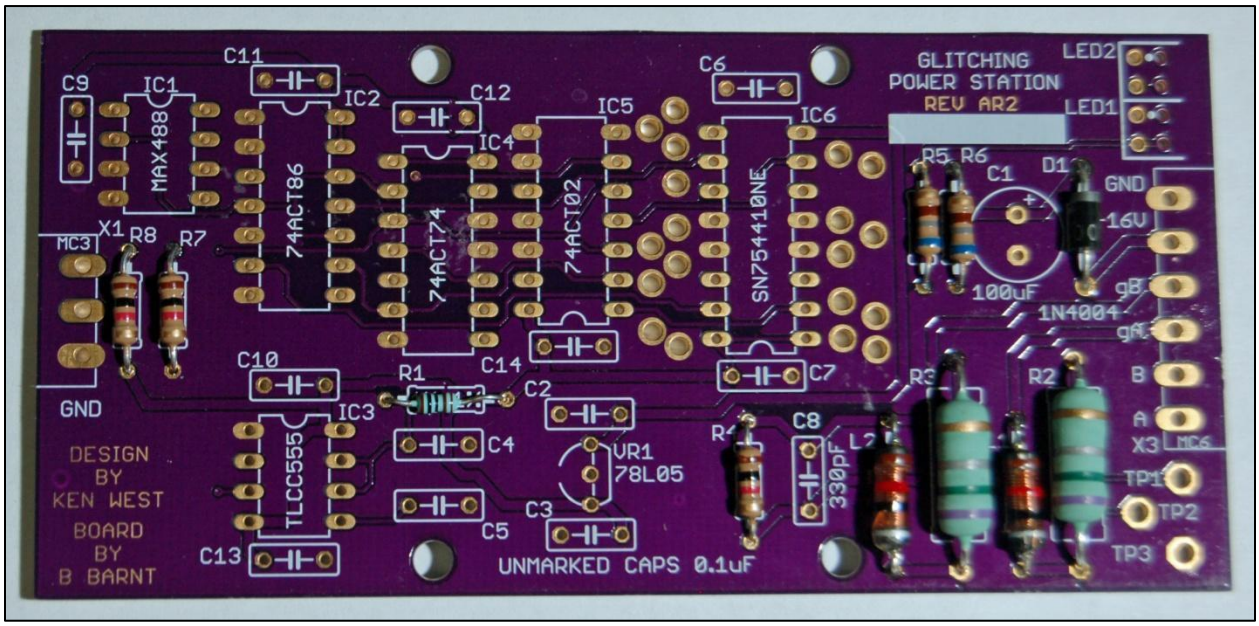


Figure 1: Resistors, Inductors, and Rectifier

Installed	Qty.	ID	Value	Tol.	Wattage	Color Code
☐	1	R1	1K	1%	1/4W	Brown-Black-Black-Brown-Brown
☐	2	R2, R3	0.75Ω	5%	1W	Violet-Black-Silver-Gold
☐	3	R4, R7, R8	1K	5%	1/4W	Brown-Black-Red-Gold
☐	2	R5, R6	680Ω	5%	1/4W	Blue-Gray-Brown-Gold
☐	2	L1, L2	12µH	10%	1.4A	Brown-Red-Black-Silver

☐ Install 1N4004 rectifier D1. Make certain to orient D1 as shown.

3.2 Install the Capacitors

Install the capacitors in the order listed below the figure.

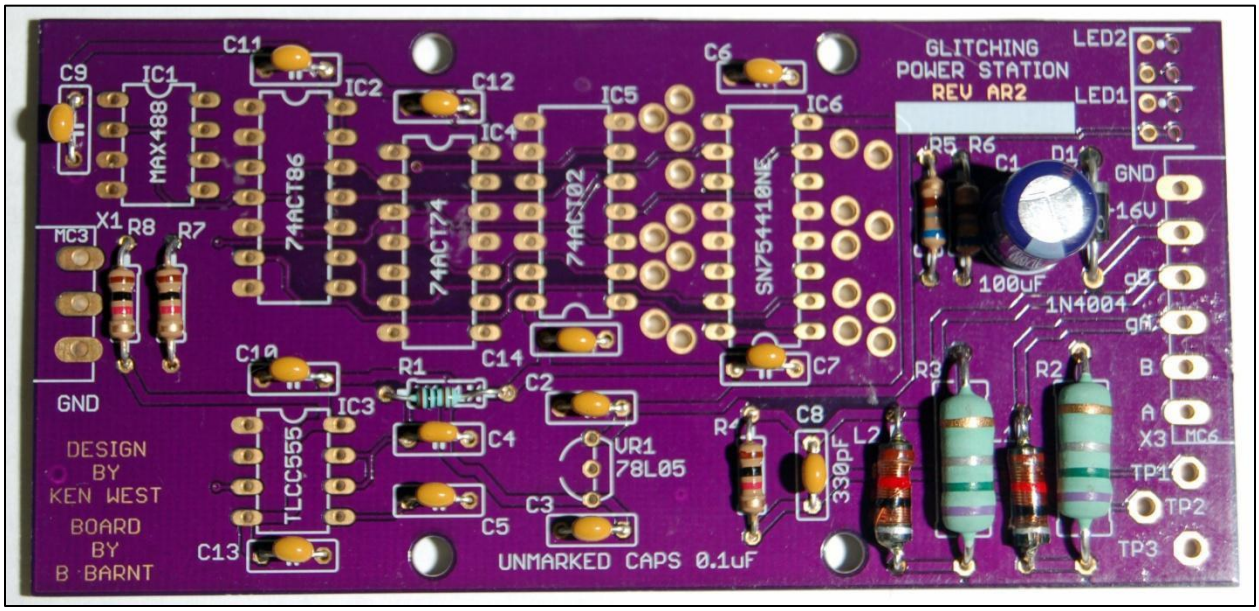


Figure 2: Capacitors

Installed	Qty.	ID	Value	Tol.	Voltage	Case Marking
☐	1	C4	1000pF	1%	50V	102
☐	1	C8	330pF	5%	100V	331
☐	11	C2, C3, C5-C7 C9-C14	0.1µF	10%	50V	104

☐ Install 100µF electrolytic capacitor C1. Make certain to orient C1 as shown.

3.3 Install the +5 Volt Regulator

Install Voltage regulator VR1 in the order listed below the figure.

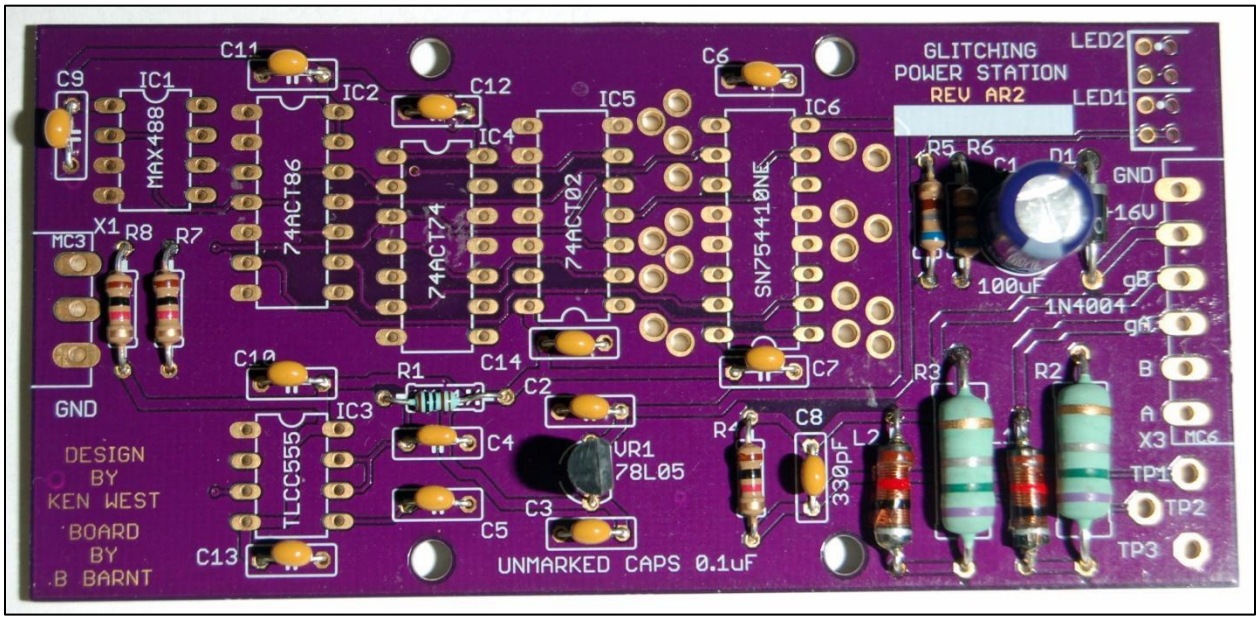


Figure 3: VR1 Voltage Regulator

☐ Install Voltage Regulator VR1. Make certain to orient VR1 as shown.

☐ Do these steps to verify VR1 is working properly:

1. Set a current limited supply to +15 Volts and a current limit of 5mA. Leave the power supply output off for now.
2. Temporarily connect the power supply between the +16V pin and the GND pin of 6 pin connector X3 on the right end of the board.
3. Activate the power supply output and immediately test the current draw. It should be less than 1mA. If the current draw is too high, immediately turn off the power supply and troubleshoot the board.
4. If the current draw is correct, Test the Voltage across C9 in the upper left hand corner of the board. The Voltage should be within 5% of 5 Volts. If the Voltage is incorrect, immediately turn off the power supply and troubleshoot the board.
5. If the +5 Volt supply Voltage and current are correct, continue installing components.

3.4 Install the Integrated Circuits

Install the integrated circuits in the order listed below the figure.

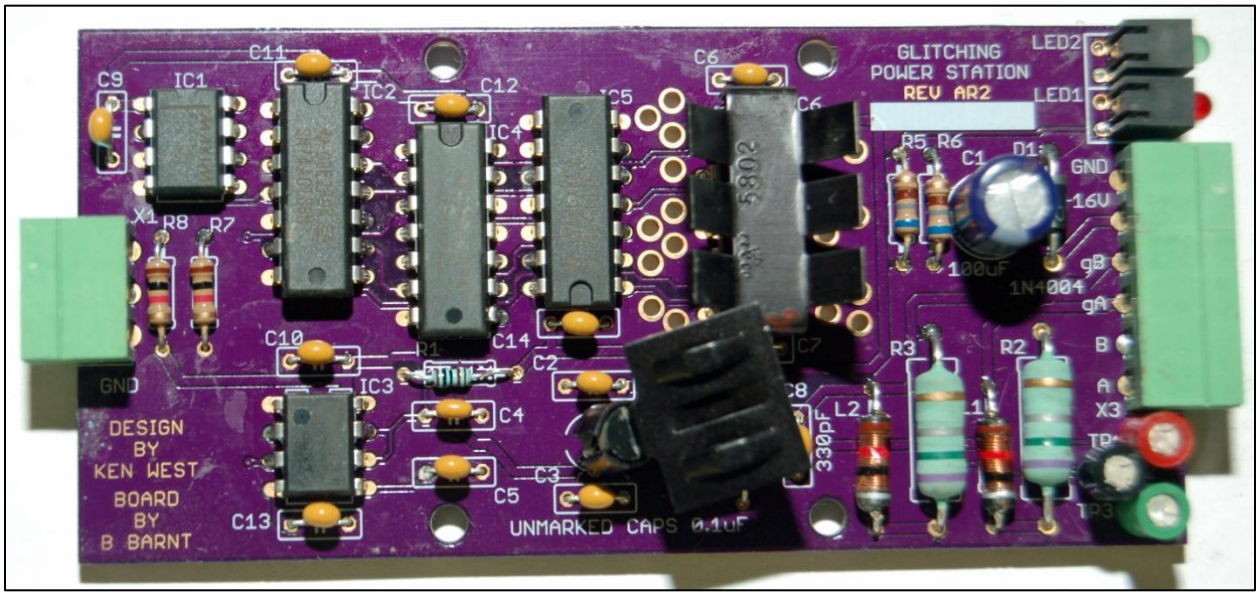


Figure 4: Integrated Circuits

☐ Install a MAX488 at IC1 with pin 1 up as shown.

☐ Install a 74ACT86 at IC2 with pin 1 up as shown.

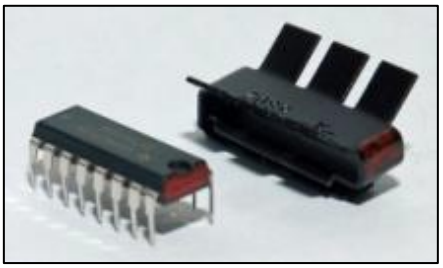
☐ Install a TLC555 at IC3 with pin 1 up as shown.

☐ Install a 74ACT74 at IC4 with pin 1 up as shown.

☐ Install a 74ACT02 at IC5 with pin 1 **down** as shown.

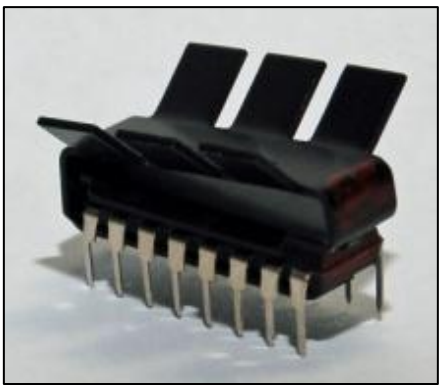
☐ Install the heatsink on the SN754410NE (IC6) by following these steps:

1. Using a flat bladed screwdriver, apply a thin layer of heatsink compound on the top and bottom surfaces of IC6. Be careful not to wipe away the heatsink compound in the following steps.
2. Place IC6 so that pin 1 is toward you. Place the heatsink so that the open end is oriented the same direction as IC6 pin 1 as shown in the picture below:



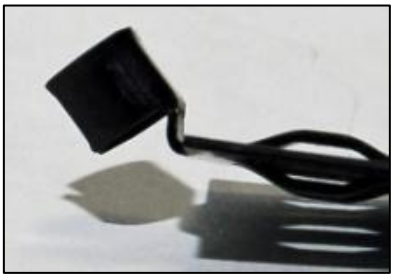
Note: There is a drop of red paint on the IC6 pin 1 end and the open heatsink end for clarity in the above picture.

3. Slide the heatsink onto IC6 until it clicks into place as shown in the picture below:



☐ Install IC6 with attached heatsink with pin 1 **down** as shown. The IC6 pin 1 tab is difficult to see with the heatsink attached. Make certain that the open end of the heatsink in pointing **down**.

☐ It is necessary to bend the VR1 heatsink clip to about 45° to clear the top of the case.
Bend the VR1 heatsink as shown in the picture below:



☐ Using a flat bladed screwdriver, apply a thin layer of heatsink compound to the vertical surfaces of VR1. Be careful not to wipe away the heatsink compound in the following steps.

☐ Slide the heatsink onto VR1 until the top of the clip is even with the top of VR1.

☐ Gently bend the VR1 heatsink down and twist it counter clockwise until the upper right corner of the heatsink is near the lower left corner of the IC6 heatsink as shown in Figure 4 above. Vibration of the VR1 heatsink when the unit it shipped or handled could eventually break off the wires on VR1. You will apply a drop of flexible silicone sealant to attach the VR1 heatsink to the IC6 heatsink in a later step.

3.5 Install the Test Points and Connectors

Install the integrated circuits in the order listed below the figure.

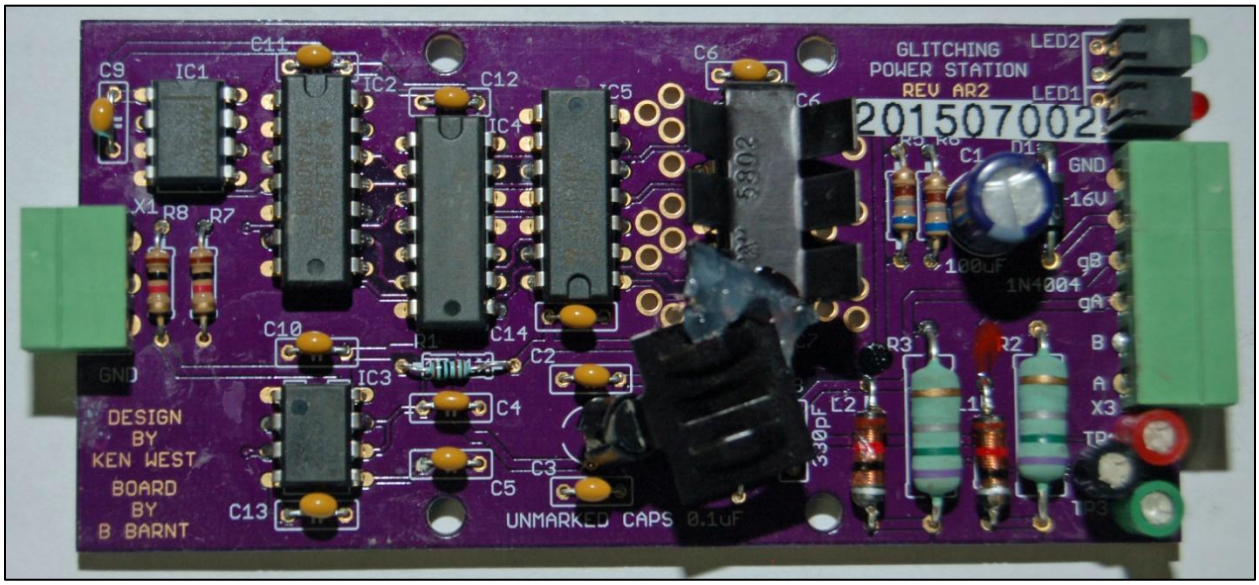


Figure 5: Test Points and Connectors

☐ Install the red test point into TP1 as shown. Make sure it is seated and vertical.

☐ Install the black test point into TP2 as shown. Make sure it is seated and vertical.

☐ Install the green test point into TP3 as shown. Make sure it is seated and vertical.

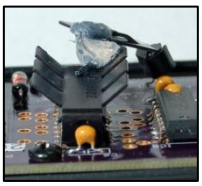
☐ Install the 3 pin connector at X1 as shown. Make sure it is seated.

☐ Install the 6 pin connector at X3 as shown. Make sure it is seated.

☐ Attach the serial number label to the board by following these steps:

1. Choose the serial number for this circuit board. The format is YYYYMMNNN where YYYY is the year (e.g. 2015), MM is the month (eg. 07), and NNN is the build count for build year and month. For example, the serial number for the 2nd board built during July (07), 2015 would be **"201507002"**.
2. Use the ¼" (6mm) width label tape to print out the serial number.
3. Cut the label to fit in the serial number space in the upper right corner of the board and attach the label.

☐ Apply a drop of drop of clear RTV silicone sealant such as Permatex 80050 between the IC6 heatsink and the VR1 heatsink as shown below. This will cushion the VR1 heatsink against shocks.



4 Enclosure Preparation

4.1 Prepare and Attach the Enclosure Labels with the Label Maker

Create the labels shown in the table below:

Created	Label Size	Text Size Frame Type	Sample Text	Description
☐	0.25”	Small Rounded Box	SN: 201507002	Serial Number to match circuit board serial number
☐	0.35”	Large Rounded Box	NMRA	Organization
☐	0.35”	Small Rounded Box	GLITCH-INJECTING PWR. STA.	Unit Name

☐ Attach the Organization and Unit Name label to the top of the unit as show in the picture below:

Figure 6: Enclosure Top Labels

☐ Attach the Serial Number label to the bottom of the unit as show in the picture below:

Figure 7: Enclosure Bottom Label

4.2 Prepare the Enclosure End Panels

Prepare the enclosure end panels as shown in the figure below:

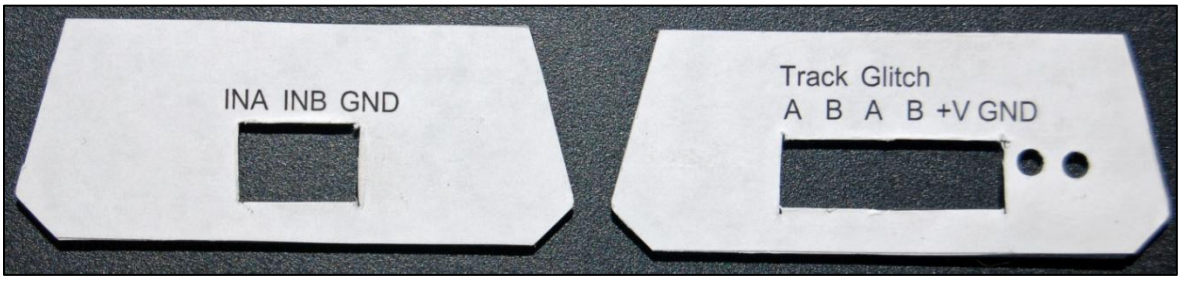


Figure 8: Enclosure End Panels

☐ Use the laser printer to print out the end panel labels in the following file. Make certain to print it at a scale factor of 100%. Print the end panel labels on the 81/2" x 11" label paper.

- Glitch-Injecting Power Station End Panels.pdf
  https://app.box.com/s/p97lf8i1if8fi1ozyq7o7lwlm9kmjb9d

☐ Apply 2 coats of clear flat spray lacquer to the labels to make them waterproof. Let the labels dry overnight.

☐ Cut out the label for each end of panel label. One label will be for the 3 pin input connector and the other label will be for the 6 pin output connector and the 2 LEDs.

☐ Carefully apply a 3 pin label to one end panel and a 6 pin label to the other end panel.

☐ Use the 3/8" chisel point blade to punch out the vertical sides of the 3 pin and 6 pin connector cut outs.

☐ Use the 1/2" chisel point blade to punch out the horizontal sides of the 3 pin and 6 pin connector cut outs.

☐ Use a #32 drill bit to drill the two LED holes in the 6 pin end panel.

☐ Use the needle files to clean up any chafe from the connector cutouts and the LED holes.

5 Final Glitch-Injecting Power Station Assembly

Complete the Glitch-Injecting Power Station following the steps below.

- ☐ Remove the 4 screws from the bottom of the enclosure, and open the enclosure.
- ☐ Put the 4 self-adhesive feet in the depressions in the enclosure bottom.
- ☐ Place the 3 pin end panel over the 3 pin connector on the circuit board and the 6 pin end panel over the 6 pin connector on the circuit board.
- ☐ Place the circuit board in the enclosure bottom being careful to fit the end panels into the slots at the ends of the enclosure bottom.
- ☐ Secure the circuit board with the 4 #4 x 1/4" self-tapping screws.
- ☐ Place the enclosure top on the enclosure bottom and secure it with the 4 screws removed earlier.
- ☐ Plug a 3 pin plug into the 3 pin connector. Plug a 6 pin plug into the 6 pin connector.

The completed unit should look like the figure below:

Figure 9: Completed Glitch-Injecting Power Station

6 Prepare the AC Supply

Do these steps to prepare the AC supply 15 VDC output leads as shown in the figure below:

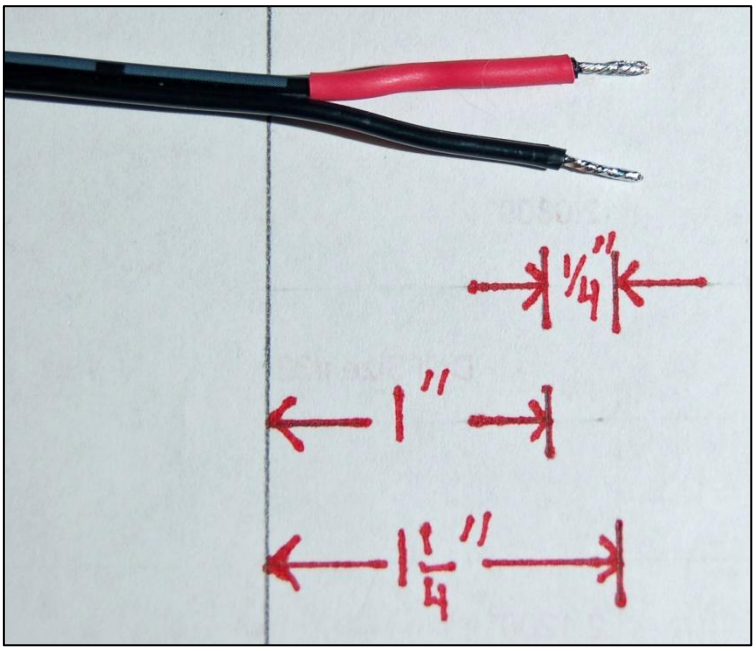


Figure 10: AC Supply Wire Preparation

- ☐ Cut off the barrel connector on the 15 VDC output.
- ☐ Split the output wires apart for 1-1/4".
- ☐ Strip 1/4" from both leads and tin the wires.
- ☐ Place a 1" length of red heatshrink tubing on the positive lead. The positive lead is denoted by a dashed white stripe. Use the heat gun to shrink the tubing.

7 Initial Glitch-Injecting Power Station Test

These steps come from the following document:

- TR-4-2015 Glitch-Injecting Power Station User Guide

☐ Follow section **3 Setting Up the Glitch-Injecting Power Station** to connect the Glitch-Injecting Power Station to the Sender V3 System and test the normal and glitch-injecting outputs with the manual tests.

☐ Make certain the Glitch-Injecting outputs Glitch A is connected to the Right Rail and Glitch B is connected to the Left Rail of the decoder.

☐ Start the SEND.EXE to run the automated test series using the following command:
`send`

☐ The automated tests take approximately 20 hours to complete. Verify that all the tests have passed.