Tode-SIOST

Hardware Development

Tode Side-IO Screw Terminals [#SIOST]

by TGit-Tech [http://www.tgit-tech.com]

Build Version: 212Q / Last Updated: 2021-11-26

Table of Contents

1. Introduction

The Tode System

- Tode-RC = Handheld Remote Control Models
  - Model #AMP Arduino Mega Pro (No RF Module)
  - Model #AMPE32T30 Arduino Mega Pro + Ebyte E32-433T30D (1W/30dbm) RF module
  - Model #AMPE32T20 Arduino Mega Pro + Ebyte E32-433T20D (250mW/20dbm) RF module
  - Model #AMPXBEE Arduino Mega Pro + Digi XBee RF Module

- Tode SideIO = Input/Output Stations
  - Model #SIOST Tode SideIO with Screw Terminals
  - Model #SIOAP Tode SideIO with Aviation Plugs

Manuals

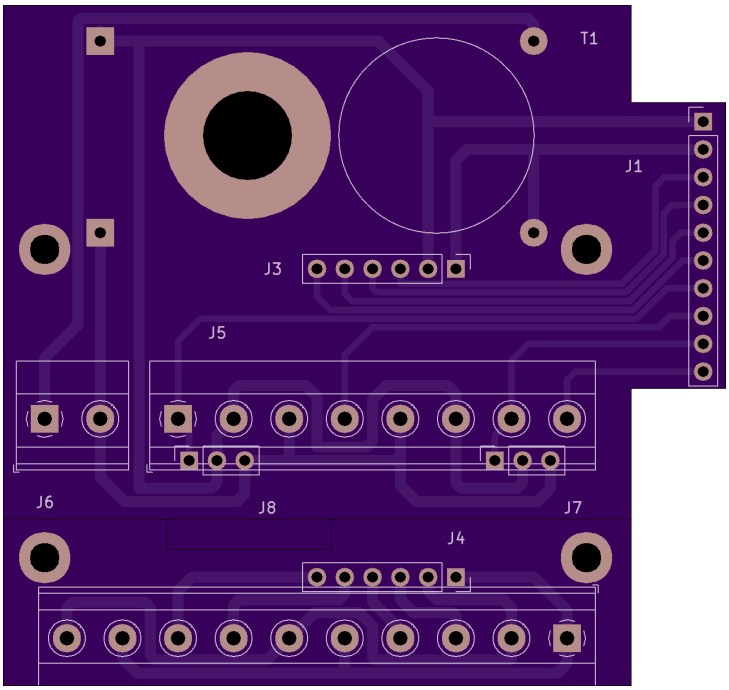
- User Manual Operator Instructions including Setup and Wiring
- Hardware Development How to build the hardware including detailed circuit diagrams
- Firmware Development How to adjust and create firmware for the Tode

The Tode System is liscensed under the MIT Liscense. It's hosted on Github.com at:
https://github.com/TGit-Tech/Tode-RC

2. Bill of Materials (BOM) $12

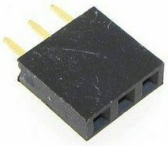
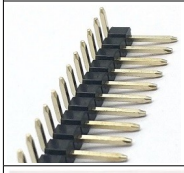
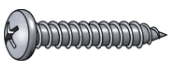
2.1 Parts $7

- ✔ LM2596 DC-DC Step Down Power Supply Module
  - Power In: 3Vdc to 40Vdc
  - Power Out: 1.5Vdc to 35Vdc (adjustable)
  - Load Amps: 2A to 3A (10W)
  - Dimensions: 44mm x 22mm x 12mm (high)
  - Temp Rng: -40C to 85C
  - Pricing: ~ $0.50/each
  - https://www.aliexpress.com/item/32668330319.html



- ✔ SideIO #SIOST PCB
  - Manufacturer: Oshpark.com
  - Pricing: $6.38/ea
  - Batch Price: $127.60 per 20

2.2 Supplies $2

	QTY: **(2) 1x3P Female Pin Headers** Dupont 2.54mm-Pitch *For Relay Plug-In* @$0.10/ea = $0.20		QTY: **(10) 1x2P Screw Terminal** 5.08mm Pitch @$0.10/ea = $1.00
	QTY: **(1) 1x10P 90º Male Pin Header** Dupont 2.54mm-pitch *For Side-IO Plug* @$0.10/ea = $0.10		QTY: **(1/2-Sheet) Adhesive Shipping Label** @$0.04/sheet = $0.02
	QTY: **(256 sq-in) Clear Craft Plastic** Grafix Clear Craft Plastic 0.02 thick *For SIOST-Cover.stl Windows* 8" x 8" (Pack of 4) = $9.17 256sq-in / $9.17 = $0.358/sq-in		QTY: **(2) #2-56 x 1" Machine Screws.** *For PSCover, Screw-Terminal Stack* @$0.05/ea = $0.10
	QTY **(2) #2 x 1/4" Sheet Metal Screws.** *For SIOST-KBHood.stl* $0.05/ea = $0.10		QTY **(3) #2 x 5/8" Sheet Metal Screws.** *For SIOST-KBCover.stl & SIOST-Cover.stl* $0.05/ea = $0.10

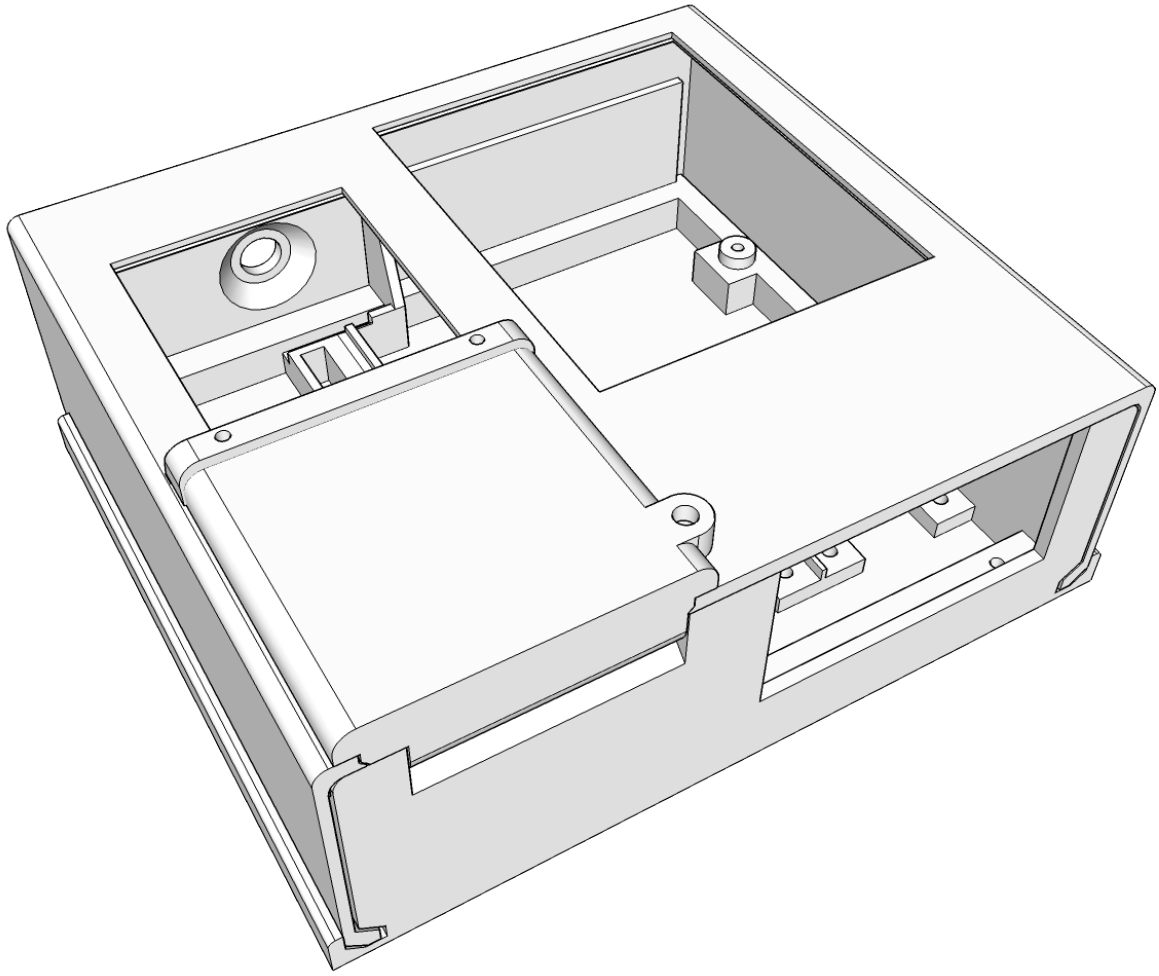
3. 3D-Prints $3

✔ 3D Print the Following Files in Folder: /3DPrints/stl

File Name	Grams	Cost $0.02/g	Time	Power & Use $0.01/hr	Total Cost
SIOST-Base.stl	59-grams	$1.14	10h 22m	$0.04	$1.25
SIOST-Standoff.stl	5-grams	$0.10	36m	$0.01	$0.12
SIOST-PSCover.stl	4-grams	$0.08	27m	$0.01	$0.10
SIOST-KBCover.stl	8-grams	$0.12	1h 21m	$0.01	$0.14
SIOST-KBHood.stl	2-grams	$0.04	0h 20m	$0.01	$0.05
SIOST-Cover.stl	40-grams	$0.82	5h 35m	$0.03	$0.90
SIOST-CableEntry.stl	12-grams	$0.24	1h 30m	$0.01	$0.26

- Pricing at $20/per 1KG Roll

Assembly Diagram



4. PCB Assembly

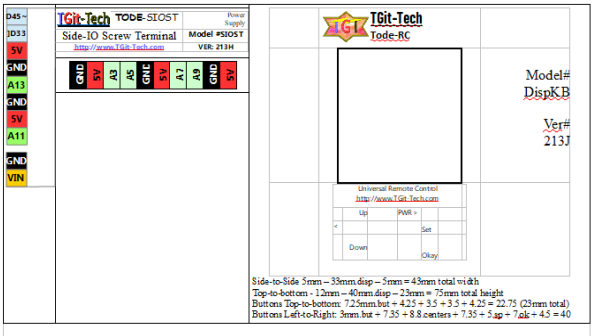
Printed Circuit Boards can be either ordered from a Custom PCB Manufacturer or created with a CNC Router.

- ✔ Custom Manufactured PCB
  - ○ Benefits - Custom PCB manufacturing is by far the better approach.
    - ▪ Copper through holes provide better connection
    - ▪ A Silk Sscreen for better corrosion resistance
    - ▪ Far easier to solder
  - ○ Common Custom Manufacturing Businesses
    - ▪ https://oshpark.com/
    - ▪ https://jlcpcb.com/
    - ▪ https://www.pcbway.com/orderonline.aspx
    - ▪ https://www.customcircuitboards.com/
    - ▪ https://custompcb.com/
- ✔ CNC Routed PCB
  - ○ Benefits
    - ▪ Generally cheaper by a couple dollars
    - ▪ Instant product (No shipping/manufacturing wait time)
    - ▪ Good for designing phases; not good for finished design production.

4.1 Preparation

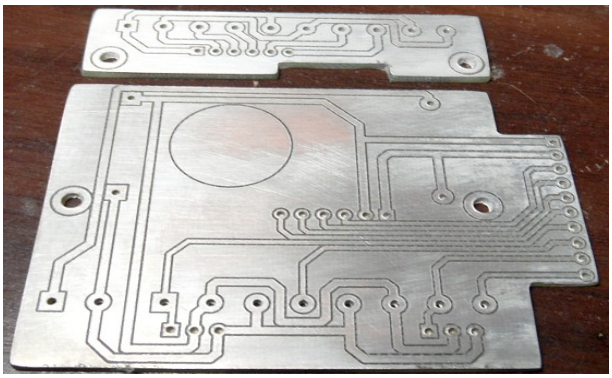
4.1.1 Print the Tode-SIOST Stickers

- ✔ File
  - ○ FOLDER = /docs/
  - ○ FILE = Stickers.odt
- ✔ Best results from a Color Laser Printer
- ✔ Use 1/2-Sheet Self-Adhesive Shipping Label Paper



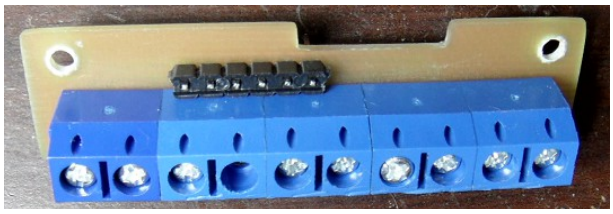
4.1.2 Obtain SIOST PCB(s)

- ✔ Purchase or Make the Design File at (2-pcs in one file)
  - ○ FOLDER = /kicad/SIOST/SIOST/output/
  - ○ GERBER FILE = SIOST-F_Cu.gbr
- ✔ CNC Routing
  - ○ CNC File = SIOST-F_Cu.gbr.nc
  - ○ CNC Settings: Z-Down: -0.045, Speed: 45mm/s
  - ○ CNC Isolation Bit = Pyramid 0.2mm Tip 45-deg
  - ○ Hole Sizes = 0.9mm, 1.0mm, 2.7mm (1.0 is plenty tight for ST)



4.2 Assembly

4.2.1 Top-PCB Terminals & Pin-Header

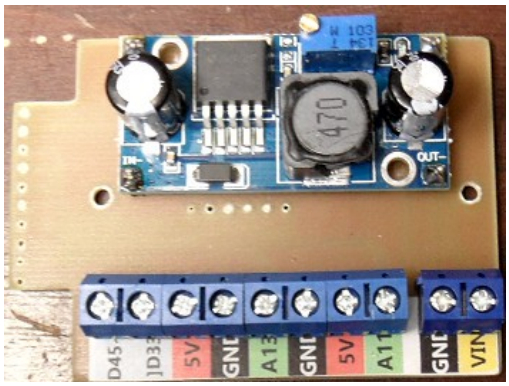


- ✔ Attach 10-Screw Terminals to the Top-PCB
  - ○ Use 5.08mm Pitch Screw terminals merged together
- ✔ Solder on a 6P Male Pin Header as shown
  - ○ push Male Pin headers flush with holder before soldering

4.2.2 LM2596 Power supply

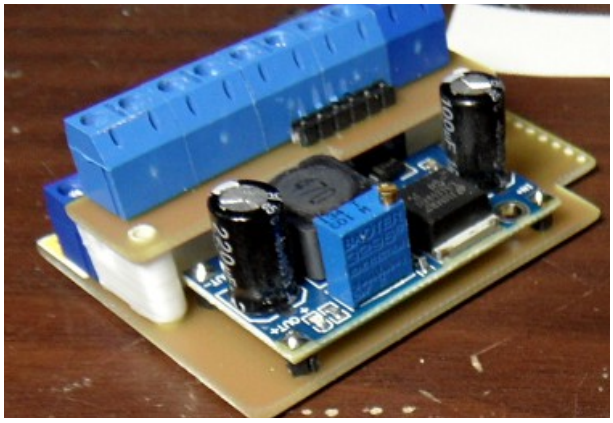
- ✔ Using (4) 1P Male Pin Headers
  - ○ Insert one 1P Male Header to each location on the bottom-PCB
  - ○ Slide the Power Supply Module onto the Pins and hold straight
  - ○ Solder the Pins to the Power Supply and the PCB.

4.2.3 Terminal Labels & Terminals



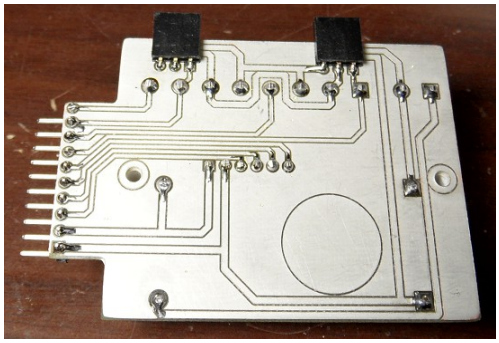
- ✔ Cut-Out the Terminal Labels from the Labels Sheet
- ✔ Stick it where the holes align with each Terminal Hole
- ✔ Install and Solder the Left-8 and Right-2 Screw Terminals
  - ○ NOTE: The right 2 screw terminals are seperated.

4.2.4 Header 6PF for Top-PCB



- ✔ Plug a 6P Female Plug [6PF] onto the Top-PCB Male Header
- ✔ Place the Top-PCB Standoff below the LM2596 Power Module.
  - ○ LOCATION = /3DPrints/stl
  - ○ FILE = SIOST-Standoff.stl
- ✔ Place Top-PCB onto the Bottom-PCB with plug pins through holes
- ✔ Solder the back-side of the Bottom-PCB at plug pins.

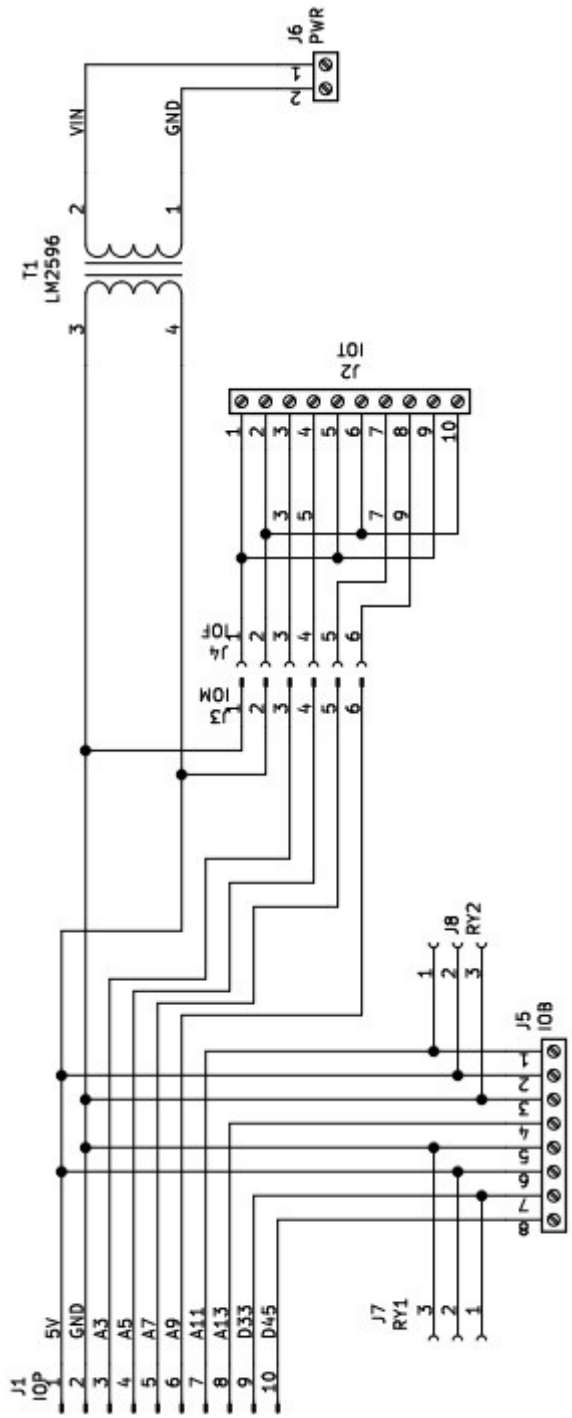
4.2.5 Headers (2)3PF for Relays & 10PM Angled Side-IO Header



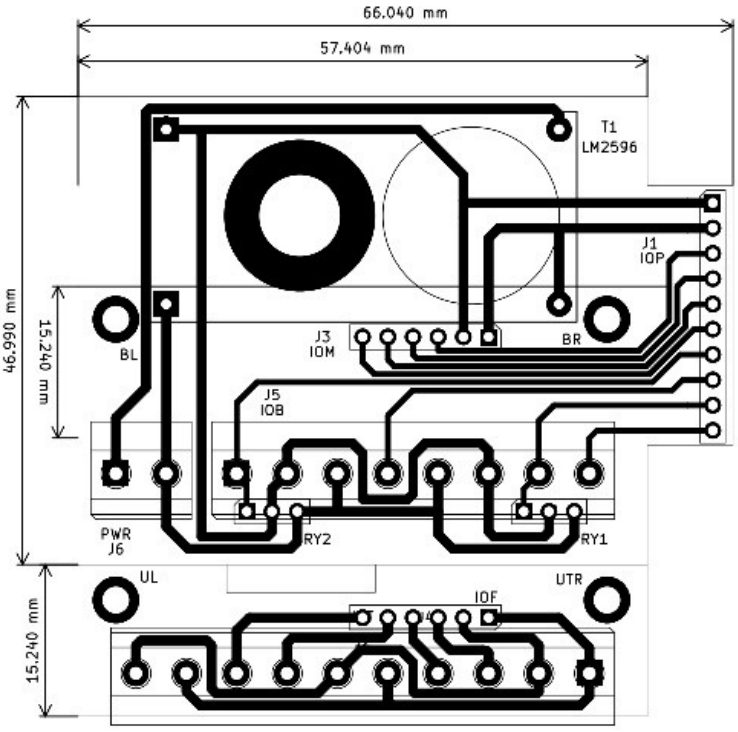
- ✔ Solder 90-Degree 10P Header to Left Wing as shown.
- ✔ Bend pins to 90-Degree on (2) 3P Female Headers and solder to backside of PCB as shown.

4.3 Schematic & Layout

SCHEMATIC



LAYOUT

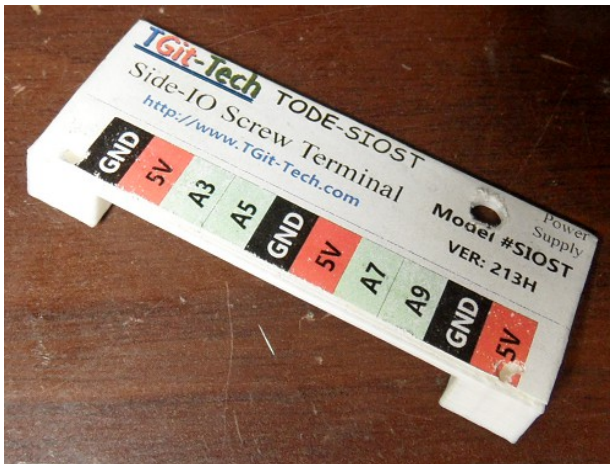


T1	LM2596 DC-DC Power	
J1	IO-Plug	1x10P Male 90
J3	Top-PCB Plug-in	1x6P Female
J4	Top-PCB Plug-in	1x6P Male
J5	Screw Terminals	1x10 Screw Terminals
J6	1x2P Screw Terminals	
J7	Relay #1 Plug-In	1x3P Female PH
J8	Relay #2 Plug-In	1x3P Female PH

5. Final Assembly

5.1 Final Assembly Steps

5.1.1 Power Supply Module Cover

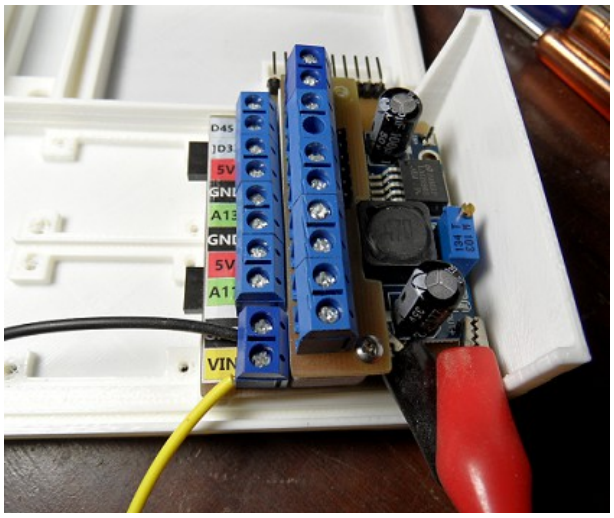


- ✔ Cut-Out the Top Terminal Label and Title Sticker
- ✔ Cut to fit the Power Supply Module Cover
  - ○ LOCATION = /3DPrints/stl
  - ○ FILE = SIOST-PSCover.stl
- ✔ Cut out Top-Right Hole by "Power Supply" text

5.1.2 Screw PCB-Assemblies into SIOST-Base

- ✔ Using (2) #2-56 x 1" Machine Screws Fasten the Assembly
- ✔ Stack
  - ○ PSCover
  - ○ Top-PCB
  - ○ Standoff
  - ○ Bottom-PCB
  - ○ SIOST-Base
    - ▪ LOCATION = /3DPrints/stl/
    - ▪ FILENAME = SIOST-Base.stl

5.1.3 Power & Adjust the Power Supply Module



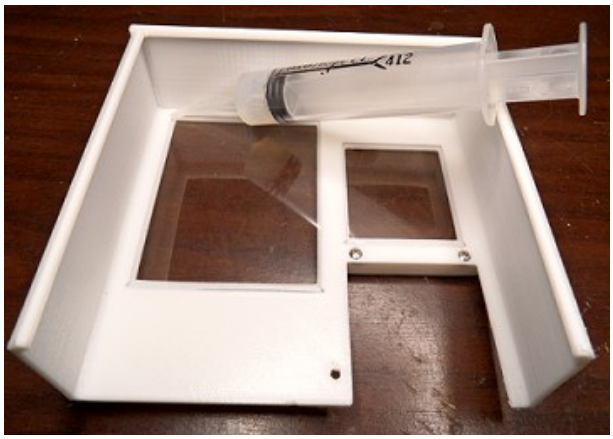
WARNING: Never Attach Tode until Power Supply is Set to 4.9Vdc

- ✔ Hook up a DMM Volt Meter to the Output Pins of the Power Supply
  - ○ Wire up an adjustable DC Power Supply to VIN & GND Terminals
  - ○ Input Voltage should be able to range from 7.5V to 30Vdc
  - ○ Adjust the Blue-Pot till Voltage Out is always 4.9Vdc
  - ○ Apply Hot-Glue to Blue Pot to keep it static

5.1.4 Install Cover Window Plastic

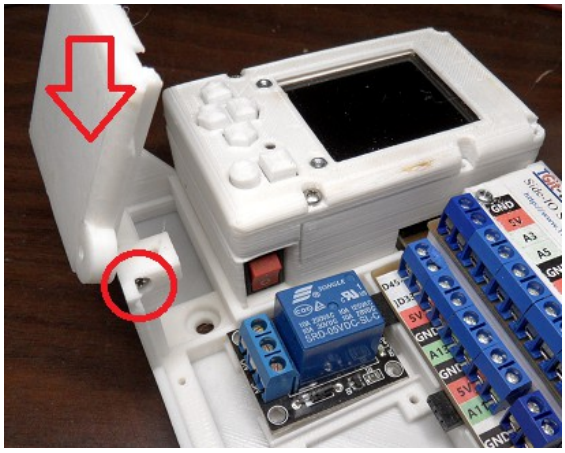
- ✔ Cut (2) Clear Plastic squares
  - ○ 38mm x 42mm for Tode-Display Window
  - ○ 56.5mm x 70mm for IO-Screw Terminals Window
- ✔ Trim to Fit
  - ○ Slide each into the SIOST-Cover.stl Case in appropriate spots
  - ○ Trim with scissors for precise fit.
- ✔ Seal Seams with Clear Adhesive Silicone
  - ○ Using a MonoJet 412 syringe suck up adhesive
  - ○ Them apply to inner seam conservatively (No finger spread)

5.1.5 Install KBHood



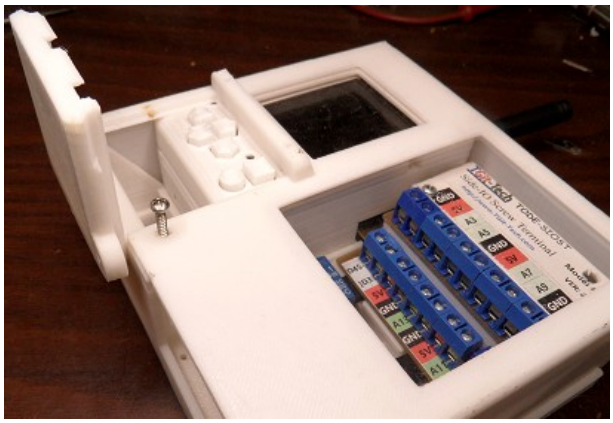
- ✔ Using (2) #2 – 1/4" Sheet Metal Screws
  - ○ Attach SIOST-KBHood.stl to face with grooves meshed
  - ○ Tigthen the screws; make sure screw tops are flush with inner face.

5.1.6 Install KBCover, Tode & Relays (Optional)



- ✔ Using (2) #2 – 5/8" Sheet Metal Screws
  - ○ Place KB Cover as shown and Left and Right screws holes (in red)
  - ○ Tighten screws just enough to allow a tight flipping of KBCover.
- ✔ Plug a Tode into the SIOST as shown.
- ✔ Attach Relays (optional) as shown.

5.1.7 Install SIOST-Cover



- ✔ Slide the SIOST-Cover with Windows from top down as shown.
  - ○ The SIOST-Cover Back edges should slide down in slots of Base
- ✔ Fasten with (1) #2-5/8" Sheet Metal Screw (shown half in @middle)
  - ○ NOTE: This screw can be used to keep the KBCover closed by screwing it through the KBCover after closed.
- ✔ Screw in the Antenna to the Tode-RC.
- ✔ Include Cable Holder Brackets with Assembly