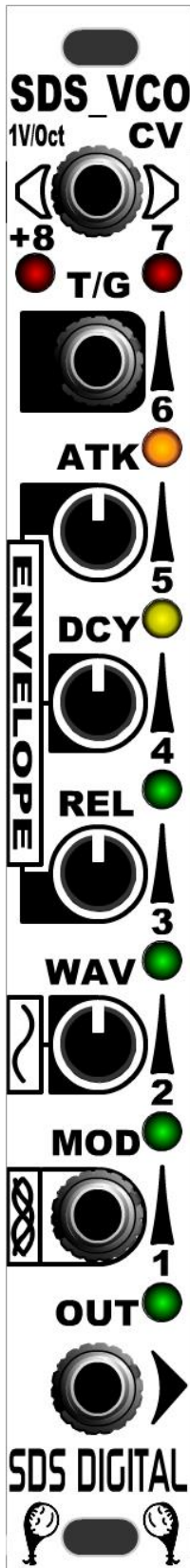


SDS_VCO DIY INSTRUCTIONS

Thankyou for your purchase of the fantastic SDS_VCO DIY kit!
First, make sure all of the parts are in the kit:



SEMICONDUCTORS:

- 1 * PIC18F46K22I/P PREPROGRAMMED PROCESSOR
- 1 * MCP4921 8 PIN DAC CHIP
- 2 * TL084 QUAD OP-AMP CHIPS
- 1 * LM13700 VCA CHIP
- 1 * (AN)1117-5.0 VOLTAGE REGULATOR CHIP
- 2 * 1N4104 (OR SIM) RECTIFIERS, ONE AXIAL, THE OTHER SMD
- 1 * 1N4148 SMALL SIGNAL GLASS DIODE
- 2 * BAT54S DUAL SCHOTTKY DIODES (SMD)
- 1 * MMBT3904 NPN TRANSISTOR (3 * MMBT3904 IF MIDI BOARD)

RESISTORS:

- 9 * 510 OHM 603 SMD 1%
- 7 * 1K OHM 603 SMD 1%
- 7 * 10K OHM 603 SMD 1% (10 * 10K IF MIDI BOARD)
- 6 * 11K OHM 603 SMD 1%
- 5 * 100K OHM 603 SMD 1%
- 4 * 47K OHM 603 SMD 1%
- 3 * 4.7M OHM 603 SMD 1%
- 3 * 30K OHM 603 SMD 1%
- 2 * 75K OHM 603 SMD 1%
- 2 * 4.7K OHM 603 SMD 1%
- 1 * 12K OHM 603 SMD 1%
- 1 * 13K OHM 603 SMD 1%
- 1 * 150K OHM 603 SMD 1%
- 1 * 220KOHM 603 SMD 1%
- (2 * 100 OHM SMD 603 1% IF MIDI BOARD)

CAPACITORS:

- 9 * 1uF 50V
- 4 * 220pF 50V
- 3 * .01uF (10nF) 50V
- 1 * 10uF 25V
- 1 * 22pF 50V
- 1 * 24MHZ CRYSTAL (THROUGH HOLE)

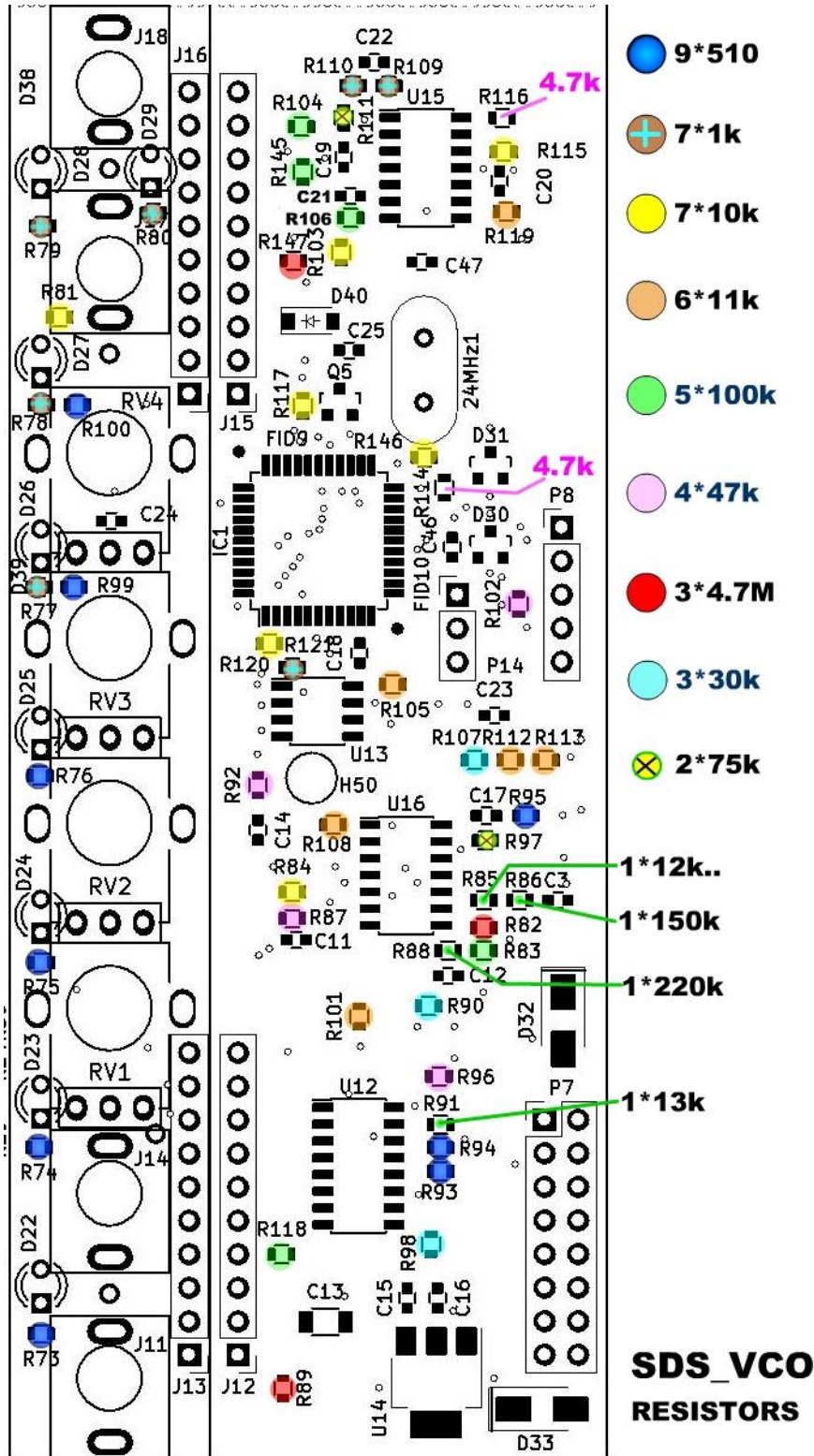
LEDS:

- 4 * GREEN LEDS
- 2 * RED LEDS
- 1 * AMBER LED
- 1 * YELLOW LED

HARDWARE:

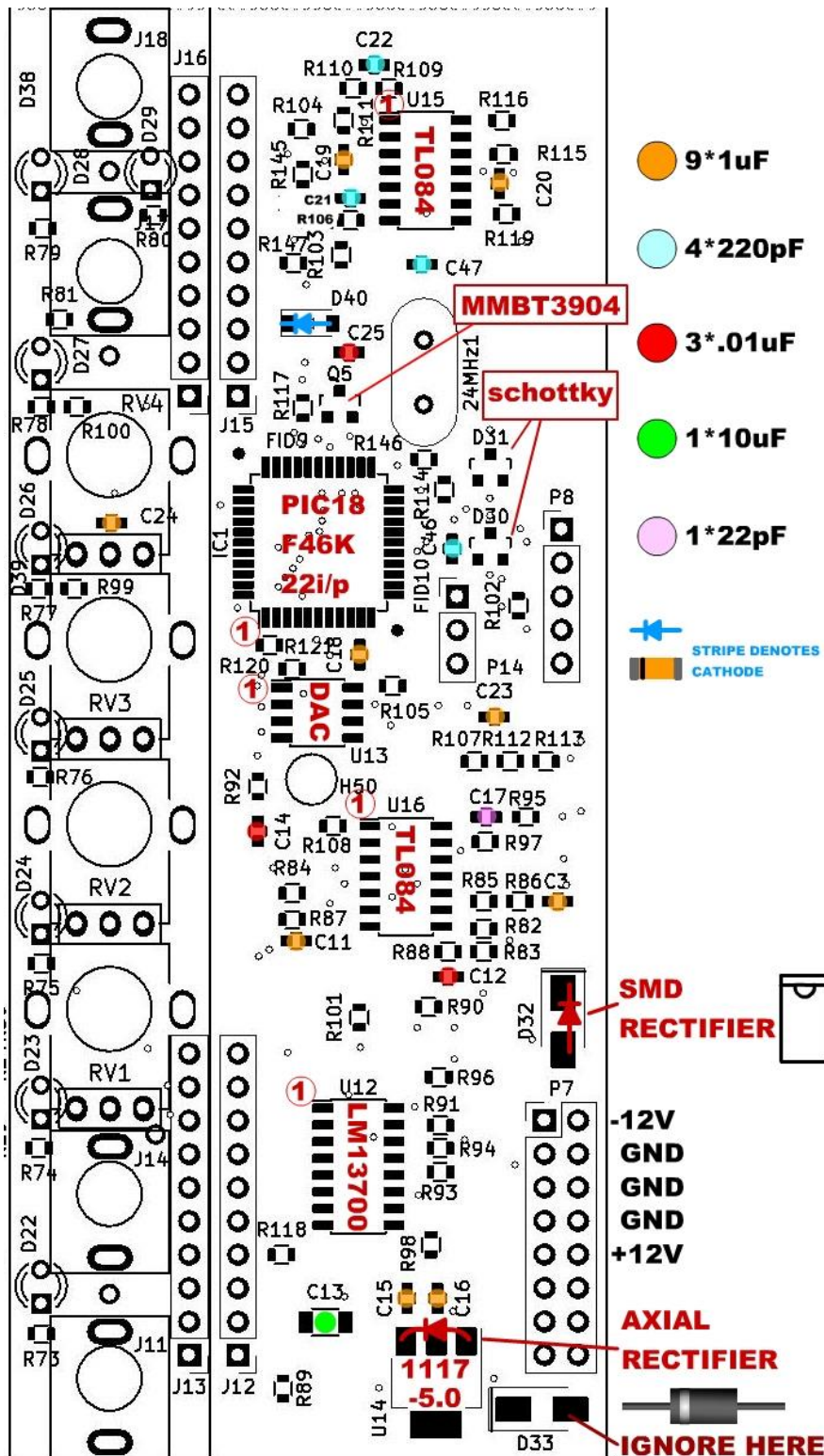
- 2 * 10 PIN ANGLED HEADERS (+ 1 * 3 PIN HEADER IF MIDI BOARD)
- 1 * 16 PIN MALE BOX HEADER
- 4 * 10K ALPHA POTS
- 4 * PANEL MOUNT MONO JACKS W/NUTS
- (1 * TRS 3.5MM JACK IF MIDI BOARD)
- 2 * PC BOARDS + PANEL (+MIDI BOARD IF WAS INCLUDED)

First let's start with the main board and mounting the 52 SMT 603 resistors:
 Each color/pattern denotes position of resistor as there are no designations.
 It may be useful to print this up.



When soldering the small 603 resistors, make a bead on 1 pad for each resistor of the same value, then hold the resistor in place with tweezers (spring closing are best) and move into position over the pad, and perhaps a bit past it to leave the opposite pad exposed some. I count the resistors 1,2,3.. as I'm beading and soldering the second pads.

Next, add the 18 capacitors as shown:



Once all of the caps are mounted, move to the chips.

*Note the (1) denotes chip orientation. Double check! +Remember to discharge your static charge!
 Start with the PIC18F46K22 as it is the hardest. I usually cover all of the pins with paste, put a bit of solder on the tip and once the chip is aligned, solder just on pin. Pressing down on the chip to solder an opposite pin ensures good contact. Re-do the first pin while pressing down the chip. The rest of the pins will suck up solder as they are touched with a minimal amount. Usually 3 or 4 pins can be done at a time with the solder reserves on the tip.

Chips cont...

The rest of the chips are standard SOIC (1.27mm) pitch so go on pretty easily. I still use solder paste anyway.

Once the 5 chips are in place, solder on the regulator and it's tab. Go light/quick on heating the tab as these things are somewhat heat sensitive, and, while they will still operate, the voltage can be off by up to .3V (usually on the negative side) if it's really cooked!

Diodes:

There are 4 different types of diodes, the schottky's are dual diodes in SMD package that is almost identical to the MMBT3904 transistor so don't get them mixed up!

Again bead one lead on each of the 2 triple pads (D30, D31) and move them into place. Make sure to inspect these well (with a loup) as they are the only real barrier of protection (from high voltage modular antics!) for the sensitive microprocessor inputs.

1N4148 glass diode:

Make sure the band is oriented the right way. This is a cylindrical shaped SMD so if you plan on hot air leveling, don't bump the board as these can roll right off into the carpet below!

The Rectifiers:

D33

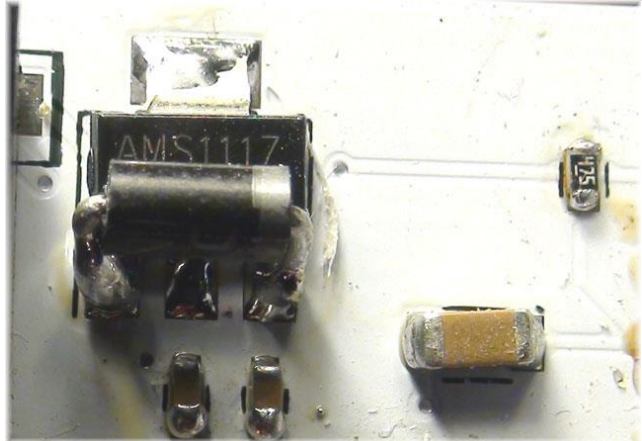
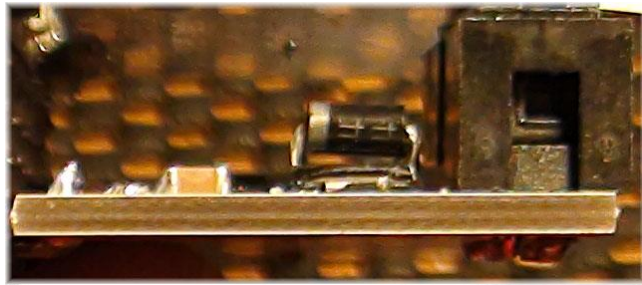
The original header for this module was a bare header rather than a box header, but the first thing I did with the prototype was hook it up backwards, frying the lot!
(Had no rectifiers in yet)

The keyed box header ensures this won't happen, and adds a safety measure to save PSU's, rectifiers, etc., but covers the pads for one of the original rectifiers.

The new position for this rectifier (D33), now an axial, is over the regulator's pins on and 3 as shown in this view from the bottom edge of the board.

The lower picture is the view with the board upside down.

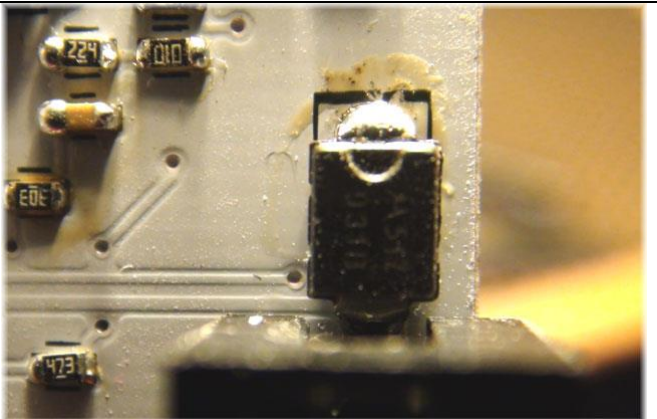
Again be careful with the heat, although not as sensitive as the regulator's tab.



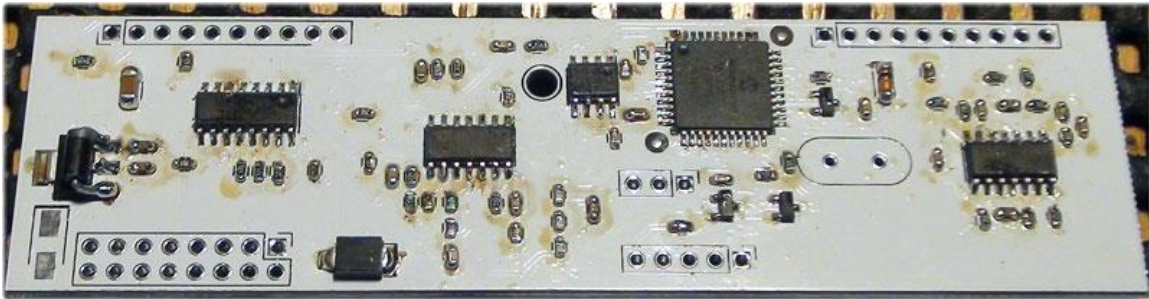
D32

The SMD Rectifier *must* be mounted before the header. Depending on which style of case, the rectifier will have an indented cup, as shown, or a stripe to show polarity.

When mounting it, make sure to slide it over away from the header footprint some, but leaving enough pad to still solder to.



The board at this point should look as it does in the photo below:



The flux can be cleaned off using alcohol and a toothbrush (that's the problem with white PCB's!)

Header:

Mount the crystal (on the component side), MMBT3904 transistor Q5, and the 16 pin header to finish up the main board.

The header *can* be mounted off of the end of the board if you want to use a regular PSU ribbon (with retainer intact) and have enough space beneath the module (case deeper than 5 cm).

If you choose this "end mount" method, be sure not to scrape the white coating off (pretty hard to do!) while pushing it on to the end of the board, as this is your isolator.

A small cut piece of paper can be wrapped around the edge of the board first as an additional barrier, but as the board is 2mm thick, so it's a very tight fit.

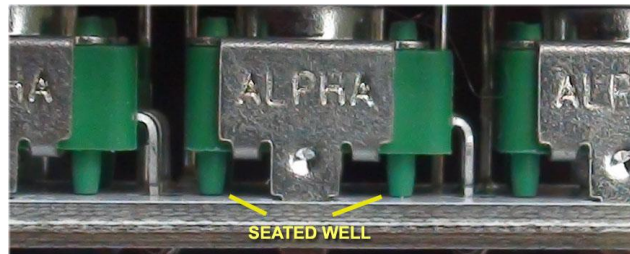
Panel board:

Now the main board is finished, and SMD components are on the panel board, the panel assembly can be completed.

First mount the pots, with only one support leg soldered so they can be moved if needed.

Try to flush them to the board as close as possible.

The "legs" under the pots are a good indicator



Put all 4 jacks into position. Note that one of the jacks must have it's ground lead bent to reach the hole, so will end up slightly crooked.

Now put on the face panel and nuts onto the jacks, tightening them up just enough to still be able to move them. The idea is to make sure the pots aren't binding on the edges of the holes, and the jacks aren't out of position enough to cover LED or header holes.

Once everything is aligned, undo the nuts and remove the face panel to prepare for the LED's.

LED's:

All of the LED's are oriented with the long lead into the round pads, while the shorter leads go into the square pads. I just recite "long-round, short square" which works!



Left Red LED:

Only one LED needs to be prepared before inserting. The Left top Red LED must jut over a mm or 2, so bend both leads about 5mm down to about 15 degrees, then correct by bending the opposite way near the head. This will ensure the LED doesn't look "cockeyed" once in place.

Drop all of the LED's into their holes starting from bottom, 4 green's, one yellow, 1 amber, then the straight red, and the bent left red.

Put the panel back on and lightly tighten the nuts on the jacks, then flip the whole thing to pop in the LED's. The LED's will tightly snap into their panel holes when pushed up with a fingernail.

Solder 1 lead of each LED first to check they are all sticking through nicely, then finish their other leads.

Almost Done!

One of the trickiest parts of DIY-ing this module is getting the proper angle and alignment to the main board.

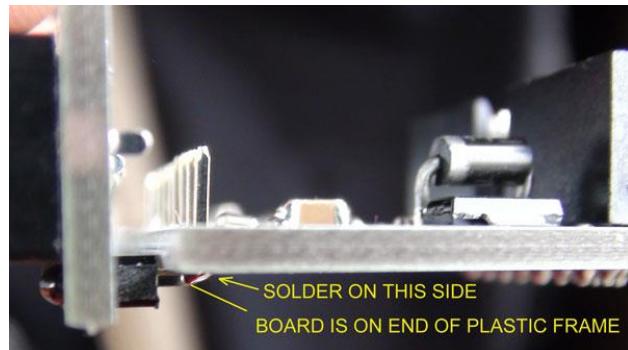
Angle Headers:

The short pins on the angle headers must be attached to the face panel first, long pins inward. They should be seated very flatly.

Although I will have inspected the angled headers, I could miss one, so it's imperative to do the following check before any soldering:

Insert the long pin's side of the headers into the main board and visually check that the board clears the plastic when pressed together. If they don't clear then the board won't be in the correct position.

Follow instructions below the following if they don't clear.



Start with attaching the headers to the panel board, but only the pins on the ends so they can be moved. Flush up the plastic header frame.

Insert the main board to make sure it looks as the photo above.

Header-fix:

If the board is hung up on the header frame, then, with the end pins still soldered, carefully push down all of the other non-soldered pins.

Once they are all down almost flush with the board, solder them all.

Now push the plastic header frame back flush, then, using the soldering iron, push down the first 4 pins that were soldered.

The main board will now fit as in the photo above.

Join Boards:

At first glance, the boards appear perfectly right angled, but the main board is actually angled down some. The idea is to angle it down enough that the box header pins are even with the panel edge. This ensures there will be clearance with a "retainerless" PSU ribbon to an adjacent module, case wall, or another SDS_VCO. Any flat surface will do for this.

Solder the outside pins from the "up" side, check, then solder them all from the "bottom" side.

Power-up:

Before applying power, take a loup or very strong magnifier and take a few minutes to inspect your solder work for destructive shorts.

Good places to pay attention to are:

- 1) TL084 chips center pins top & bottom as these are +/-12 volts.
- 2) Regulator pins
- 3) D30 & D31 dual schottky diodes pins
- 4) All of the microcontroller pins. Generally not a danger, but s**t happens!

As the PIC18F46K22I/P has already been flashed with a firmware, there's no need to do this, which is a good thing if you don't have a PICkit 3 programmer kicking around!

Go ahead and power up!

The LED's will dance around, showing you are successful, but now it's time to calibrate.

Calibration:

The module will more than likely need to be calibrated. This is normally factory set, but as you are the factory, it has become your job. ;)

- 1) Power down the module and set WAV knob fully left (CCW) (as if to select wave#0.)
- 2) Find a reliable accurate voltage source for 2.50 volts, be it a pot w/cap, signal generator etc.
- 3) Find a DMM meter to check the voltage source above
- 4) Unplug everything from the SDS_VCO's jacks (I know you'll already have stuff in them!)
- 5) Power up the module and within 12 seconds, wiggle the ATK knob to enter calibration mode.
*Leave the ATK knob turned up, as turning it fully down will exit this mode.
If the LED's look like a bar ever diminishing lower, you waited too long, cycle the power again.

MOD CV centering:

- 6) Adjust the WAV knob until all LED's are off, then back up half way between all off, and the first green LED. This can be tricky so check the "distance" between LED 1 & 2 to get an estimate. It should be just above the All off threshold in any case

VCO CV zeroing:

- 7) Plug your 2.5 volt source into the VCO CV (top)
- 8) Turn DCY knob fully up (CW)
- 9) Slowly turn it downwards. The LED's will follow your movement.
Keep turning until all LED's are off.
*Note that sometimes everything is perfect so all LED's will be off with DCY fully up, in which case, just leave it that way, fully up.

Exit & Save:

- 10) Once you are confident everything is set properly, turn the ATK knob fully left to exit & save.

Done!

If your SDS_VCO will also have a MIDI expansion board, please see SDSVCOMIDI-DIY.pdf at <http://www.freshnelly.com/sdsvco/SDSVCOMIDI-DIY.pdf>

The firmware at the time of this document is V1.00, so you can check the website at <http://www.freshnelly.com/sdsvco/sdsvco.htm> for possible updates or alternates.

* Firmware updates are accomplished with a downloaded .mp3 file played into the VCO CV (top) jack at full volume of your phone, mp3 player etc.

** If using a phone, make sure ringers, alerts, & alarms won't interfere with the audio at all!

Firmware update instructions will also be on the site, but pretty similar to the calibration.

>>Power up the module, but wait longer than 12 seconds.

>>Turn the WAV knob to select wave # 0. Wiggle the ATK knob to enter audio FWUD mode.

>>Before the time-out indicated by the falling LED bar, the audio FW file must be started.

>>Watch der blinkenlites for a while until they stop and the start-up Splash happens.

Done!

Happy VCO'ing!

Sandy Sims, SDS Digital 2017

Owner's manual: http://www.freshnelly.com/sdsvco/0-SDS_VCO_usersMan.pdf