CARE & FEEDING OF THE PLAN B MODEL 15 VCO

The following procedure outlines the steps required to calibrate your Plan B Model 15 Complex VCO. It is recommended that this be done on a monthly basis to assure your oscillators are in proper adjustment.

Periodic calibration of Voltage Controlled Oscillators (VCOs) used in the generation of music is essential to assure they are operating to their fullest potential. This is true of any analog VCO, regardless of manufacturer. The trimpots required to adjust these precision instruments into spec do, over time, go out of adjstment. There are many reasons for this - change of seasons, change of PSU driving the VCOs - and especially true if your instrument is frequently used for live performance.

I mention a monthly check - this is being conservative. If you find that after the first few months your VCOs are still in cal, then back off the calibration to every two months and so on. Its impossible to forcast the interval that works for each of you because all of each and every user's operating conditions vary.

Step One - The Right Tools for the Job.

Most important rule in doing any job - make sure you've got the correct tools to do it correctly. The following may require a small investment on your part, but the rewards will pay off immediately. The tools you'll need for this cal are in two groups:

1) 1V/OCT ADJUSTMENT

A) Adapter power cable

B) Small straight-blade screwdriver -or- (preferred) a plastic trimpot adjuster - commonly referred to as a 'tweeker'

C) A reference electronic keyboard (such as a digital device or virtual analog instrument)

D) Good set of ears!

2) WAVESHAPE ADJUSTMENZTS

A) Adapter power cable

B) Small Philips-head screwdriver -or- (preferred) a plastic trimpot adjuster - commonly referred to as a 'tweeker'

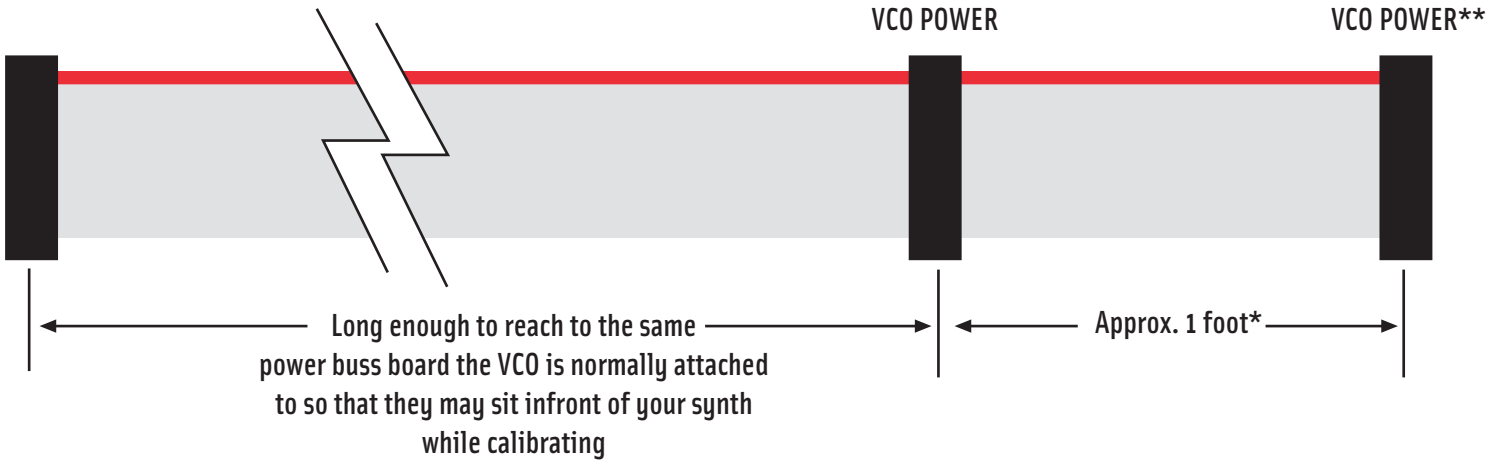
C) Oscilloscope

D) Good set of eyes!

Notes:

Make yourself a Doepfer-type flat power cable long enough so that you can easily sit your VCO upright, out of the cabinet and you can do this while the VCO is powered by the same PSU used in the cabinet it came from. If you have more than 1 M15, it's best that you make one that will allow two or them to be powered at once....there's a reason for this (next page)!

The Power Cable Diagram:



* = This distance is be long enough to two VCOs may be connected at the same time comfortably -meaning it's easy to reach all controls and 1V/oct trim pots

** = Only required if you have two or more VCOs

Making your cable:

The parts required to make this cable should be available at any electronics store. What you'll need is:

A) A length of **16 conductor flat cable** - see above (make sure it's they type with a COLORED BAND - usually but not always red which indicates PIN 1 orientation. The red band is needed so you don't do the **big stupid*****. Cable is also available in a rainbow colored arrangement I suggest you avoid this and go with the gray with single colored band. Keep it simple - on your ears and on your eyes.

B) Either two or three **IDS-16 female ribbon connectors**.

To make your cable, cut it to length and slip the IDS connectors through the flat cable so that it's teeth are on one surface and it's clamp is on the other. Some PDS connectors will also come with a third part - a stress relieving bracket. You don't need this for this application. Instead, do what we do with them - save them up all year, wrap them in a gift box and give them to the electronics store you bought them from as an XMAS gift!

Once your connector is positioned where you want it and it's sitting straight (perpendicular to the cable - not cocked or crooked), apply soft hand pressure and close the connector so that the teeth begin to bite into the ribbon cable. Do this enough so that it stays in position. You can't apply enough pressure manually to complete the crimp, don't try - for this you need a table vise or a tool especially made for crimping these connectors on.

Once the connector is held in place - place it in the jaws of a vise so that you may now close and lock the two ends onto the cable firmly. Don't overdue it - apply just enough pressure to get them firm and then one little touch after that. Some will click when they are locked, some won't. If you don't have access to either a vise or a crimp tool, then use a pair of pliers - but be careful! You want even pressure along the full length of the connector or it will not crimp correctly. Also: flat sides for flat surfaces - don't attempt to make a good crimp on the flat surfaces of the IDS connector with a tool that doesn't have a flat surface for it to rest against.

***** - The big stupid - connecting power on your Model 15 backwards. It's a mistake you'll only make once, as the VCO will not be operating afterward!**

One more thing about your power cable - why three connectors?

If you have more than one Model 15, it's best to set them up two at a time and bucket brigade them as they are cal'd. This not only assures your calibrating each to a reference - but also to each other. How many times have we done this - one VCO at a time, they all sound great and we think they track perfectly, just to get them all back into the system to find they are slightly detuned from one another? By setting them up two at a time - meaning connecting and calibrating them in pairs, you can check them against each other (and not the reference frequency) once the set up is completed. Do this in such a way that you cal VCO1 and 2 first, then remove VCO1, replace it with VCO3, cal it and test against VCO2, remove VCO2, get VCO 4, cal it and compare against VCO3 and so on.

2) POWERING YOUR UUT'S (Units Under Test)

Before you begin, know that making your power cable is much more time consuming than the actual calibration you need the cable for. Being a triangle core VCO, the Model 15 does not have to concern itself with high frequency compensation as do saw core VCOs which require that a mutli-step process be repeated again and again to dial in accuracy. The 1v/octave cal of a Plan B VCO is much easier.

1) Connect the power cables to the modules - **MAKING SURE PIN 1 (RED BAND) is correctly oriented.** (see figure 1)

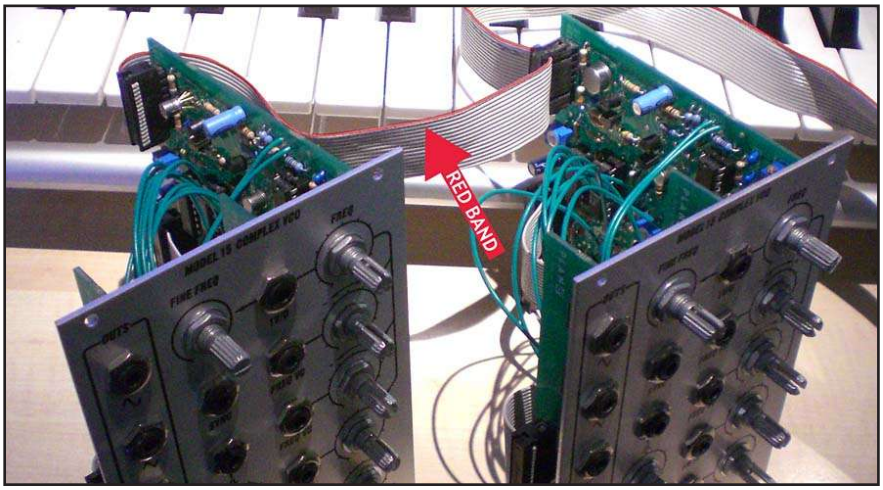


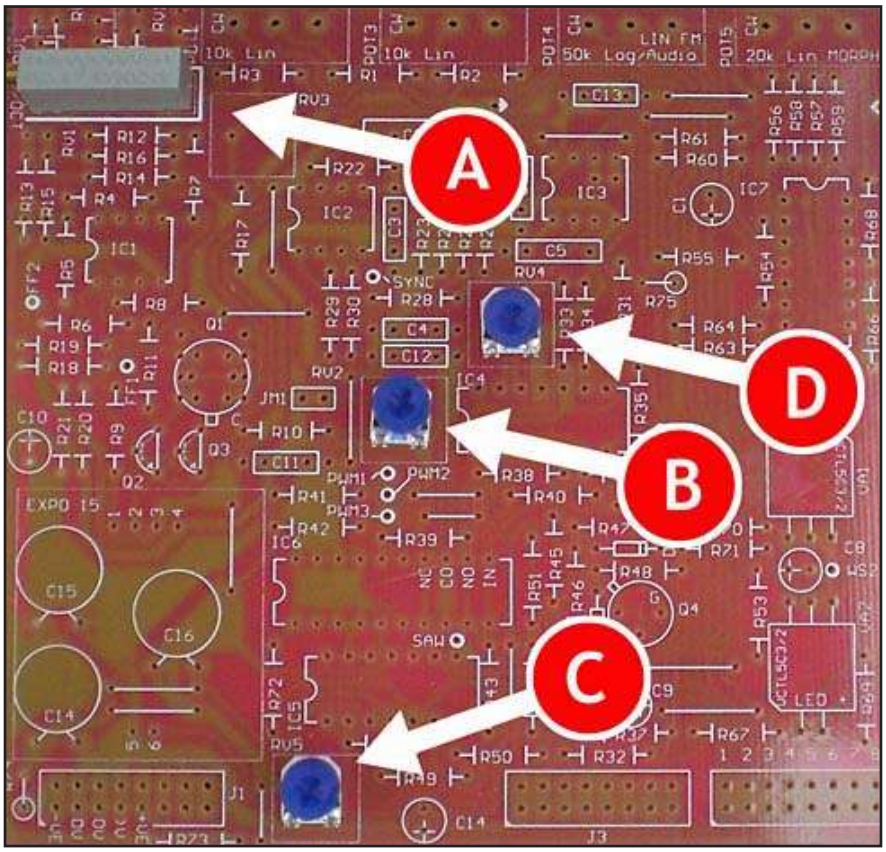
Figure 1 - connecting the power to your REV. 1.XX Model 15s. Note the daisy-chained power

VERY IMPORTANT NOTE: FIGURE 1 SHOWS TWO REV. 1 MODEL 15'S. ON REV.2 MODEL 15'S (ELECTRONICS MOUNTED PARALLEL TO THE FACEPLATE) **THE POWER IS CONNECTED WITH THE RED BAND DOWNWARD** (REVERSED FORM HWERE IT IS SHOWN IN THIS DIAGRAM.

2) Connect the other end of the power cable to the same power buss board that they are normally powered by - **MAKING SURE PIN 1 (RED BAND) faces towards THE -12 VOLT END.**

3) LOCATION OF TRIM POTS WHICH WILL BE ADJUSTED IN THIS PROCEDURE

After your power is connected, the next thing you'll need to know is the location of the various trim pots you'll be adjusting. Figure 2 (next page) gives you a map or those locations for both Rev 1.xx and Rev. 2 XX model 15 VCOs. In some cases, there may be more trim pots on the VCO's than notated in this procedure. DO NOT ADJUST ANY TRIM POTS NOT HIGHLIGHTED IN THE FOLLOWING DIAGRAM.



LEGEND:

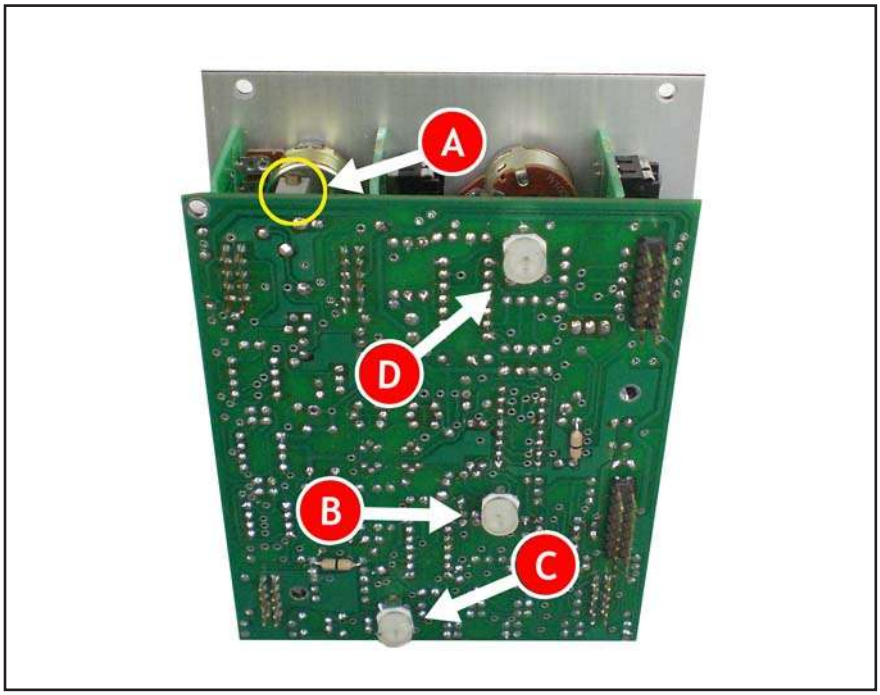
A = 1 VOLT PER OCTAVE ADJUSTMENT POT

B = TRIANGLE SYMMETRY ADJUSTMENT POT

C = SINE PURITY ADJUST

D = RAMP SYMMETRY POT

Figure 2A – Locations of trim pots in Rev 1.XX Model 15's



LEGEND:

A = 1 VOLT PER OCTAVE ADJUSTMENT POT

B = TRIANGLE SYMMETRY ADJUSTMENT POT

C = SINE PURITY ADJUST

D = RAMP SYMMETRY POT

Figure 2B – Locations of trim pots in Rev 2.XX Model 15's

2) CALIBRATION PROCEDURE (THE EASY PART)

As trimpots on VCOs go out of adjustment over time, so do the trimpots on the power supplies that run them. Therefore it's best to cal your VCOs while powered by the PSU they will connected to in the system. This assures they are calibrated to the same supply voltage they will see in their working environment. Before you do this:

1) Make sure you are powering your Model 15's with the same power supply they will be powered from once remounted in your synthesizer

2) Make sure the VCOs you are calibrating are on for at least ten minutes before you perform these tests.

3) Perform these tests in a comfortable room-temperature environment with little to no air flow (don't attempt to cal a synth module with an air conditioner, heater or fan blowing in over them.

A) FIRST CALIBRATION: 1 VOLT PER OCTAVE TRACKING ADUSTMENT

A1) Connect a 1v/oct standard CV into the **1v/OCT** input of your Model 15. For best calibration, this should come from the output of a midi to CV converter because you're going to need a reference signal (that form either a midi or VA instrument) to set up the 1V/Oct tracking.

A2) Make a patch by which you can simultaneously hear the output of your VCO and that of preferably either a VA softsynth or some Type of digital instrument - something you know is in calibration. (there's no use calibrating to a false reference). Configure this ref. to a RAMPWAVE which BYPASSES ANY FILTERING, EFFECTS or PROCESSING. A RAW WAVEFORM IS REQUIRED.

A3) With your Model 15 sounding continuously in the speakers, play and hold a C1 on your midi keyboard. While sustaining that note, tune your Model 15 so that it is in tune with the pitch coming from your reference (digital) instrument. This is probably the most critical part of this test. Take your time, tune carefully for the minimum amount of phasing.

A4) Play and hold a C4 on your midi keyboard. Using a plastic pot tweeker tool (see diagram 3), turn the 1 volt/octave trim pot (labeled A in diagrams 2A and 2B) until the pitch form your M15 and your digital reference tone are tuned.

A5) Once they are in tune, play notes in-between C1 and C4 to verify tracking. If they don't, then repeats steps A2 and A4 until they do.

A6) Now play and hold a C5 on your reference instrument and repeat the trim pot tuning performed in A4. Once you're there, repeat the process with a C6, C7, etc...until you've reached the maximum usable calibrated range the Model 15.

A7) If you a adjusting more than one Model 15, repeat steps A2 through A6 - **but replace your digital reference with a Model 15 you have already adjusted.** You need to make sure your VCOs are tracking with each other. This is why their power is daisy-chained with a single power cable and why you need to calibrate them all while running off the same PSU each will be while mounted in your synthesizer.

So go down the line of every Model 15 you're adjusting, and use the previous one as the reference tone for the next, down the line until they are all tracking not only to 1v/octave...but to each other.

Note: This calibration procedure does not require, nor should it involve a scope, frequency counter, electronic tuner or any other test equipment used for measuring period or frequency outside of what was provided to you by nature...your ears. Our reasons for this are simple: You do not use these devices while making music, nor does your audience while listening to you make music. Your ears are all that's needed, and therefore all that required for this calibration. These test devices will give you readings which may make you think your VCO are not functioning properly. While a perfectionist may argue that this constitutes a faulty, sub-standard musical instrument, we feel that all these devices will do is verify the obvious - that you're adjusting the tracking of a musical instrument, not a piece of lab gear. Your results will not be perfect. If you wish to use test equipment to verify this, feel free. However, your results will tune the tracking of your M15's so that they are musical, phat and payable. There's a big big difference between these two extremes.

Figure 3 - Using a placstic pot tweeker to adjust the 1 volt/octave trim pot of a Rev 1.xx Model 15

The remainder of these calibrations are not essential, but preferred. They will require the use of an oscilloscope to perform.

B) SECOND CALIBRATION: TRIANGLE WAVE SYMMETRY.

The Model 15 is a triangle core VCO, therefore, it is important that the Triangle Wave is properly adjusted. While this will make no difference if you're adjusting the tracking, it will effect the purity of the other waveforms available (Sine, Ramp, Square)

B1) Tune your UUT (Unit Under Test) to approx 1,000 cycles (1KhZ). Absolute accuracy is not required. Plus and Minus 5% of 1K is fine.

B2) Connect the TRIANGLE WAVE output of your Model 15 to an oscilloscope so that you see the waveform on the screen. Connect the SCOPE'S GROUND to the Power Supply ground you're powering your Model 15 form. TO do this, simply run another patchcord from your Model 15, and attach an alligator test cable FROM THE RING (GROUND) portion of the open end of the patch cable TO THE GROUND INPUT OF THE SCOPE -or- ATTACH THE ALLIGAZTOR GROUND CLIP PROVIDED ON YOUR SCOPE PROBE to eh GROUND RING of the open end of the patch cord you're using for ground connection.

B3) Before you make any adjustments, ground the scope input channel your using and adjust the vertical centering so that ground (no signal) is at the vertical midpoint

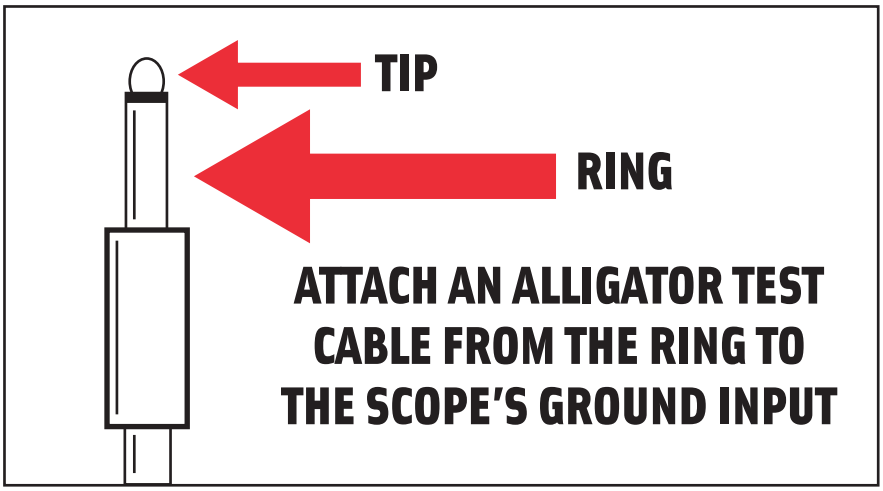


Figure 4 - Connecting the ground reference forom your VCO to the Scope

B4) Using a plastic Pot Tweeker, adjust the TRIANGLE SYMMETRY trim pot (labeled B in diagrams 2A and 2B) of your Model 15 until it is centered around the ground point of your scope. Use figure 5 (see next pages) as a reference.

B) THIRD CALIBRATION: SINE WAVE PURITY.

B1) Remove the scope probe from the Triangle Output used in Cal. 2 and re-insert it into the SINE WAVE OUTPUT of your UUT.

B2) Again verify your vertical centering of the trace on your screen by grounding the input and moving the VERTICAL CENTERING pot on your scope until the trace rests at the Vertical Midpoint. Verify your VCO is tuned to approx 1kHz.

B3) Using a Plastic Pot Tweeker, adjust the Sine Purity Trimpot (labeled C in diagrams 2a and 2b) so that the upper arch and the lower arch (the PEAK and TROUGH) of the sinewave are equal - use Figure 6 (next pages) as a reference.

C) FOURTH CALIBRATION: RAMPWAVE SYMMETRY

C1) Remove the scope probe from the SINEWAVE Output used in Cal. 2 and re-insert it into the RAMP OUTPUT of your UUT.

B2) Again verify your vertical centering of the trace on your screen by grounding the input and moving the VERTICAL CENTERING pot on your scope until the trace rests at the Vertical Midpoint. Verify your VCO is tuned to approx 1kHz.

B3) Using a Plastic Pot Tweeker, adjust the Rampwave Symmetry Trimpot (labeled D in diagrams 2a and 2b) so that the two ends of each half of the ramp wave meet (butt against one another i.e., come in contact with one another) at ground. Pay close attention to Figure 7 as a reference. It is possible to adjust your ramp 90 degrees out of phase by making the wrong ends of each half butt against one another. moving the trim pot the full extent of it's travel will quickly give you an indicaiton of which is the correct alignment. Use FIgure 7 as a reference.

MOUNTING YOUR VCO'S BACK IN OUR SYNTHESIZER

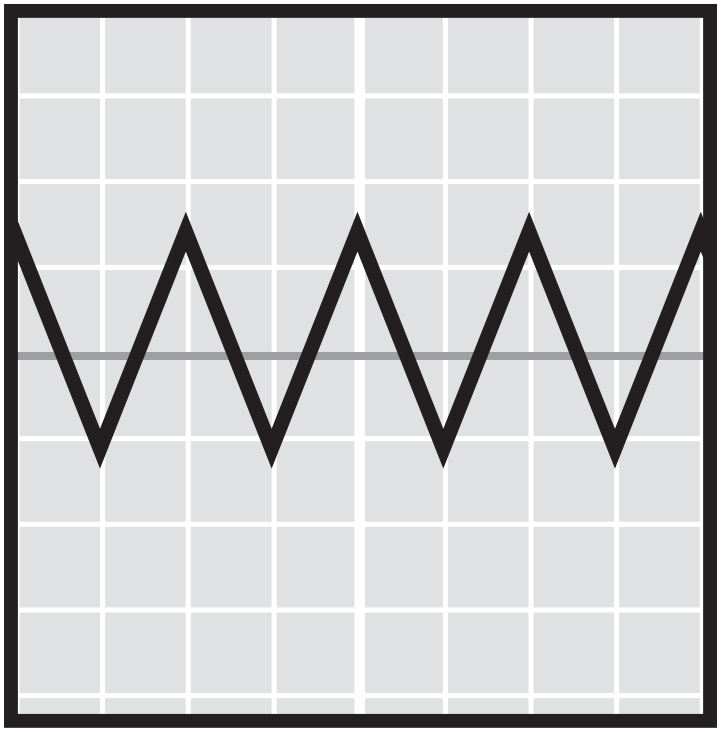
Congratulations - you're now set our Model 15s back to factory specs and saved yourself the postage and time it would have cost you to send it to us to do the exact same thing! Once all of them are adjusted, now it's time to remount the VCOs into your cabinet. Please be careful doing this. Bumping them, or accidently changing the settings of the pots you just adjusted will require that you do the whole process again. You should be especially careful not to lay a Model 15 Rev. 2 against a table top with the faceplate up because it will rest against the pots you just adjusted and they will go out of adjustment - guarunteed. If you must rest them, do it face down so they rest on the panel knobs. Use a towel or another soft object to pay them on as not to damage the knobs.

Make sure you connect the power correctly to each VCO when you're putting it back in the rack!

PLAN B

FIG. 5: CALIBRATION No.2 – TRIANGLE SYMMETRY

GOOD

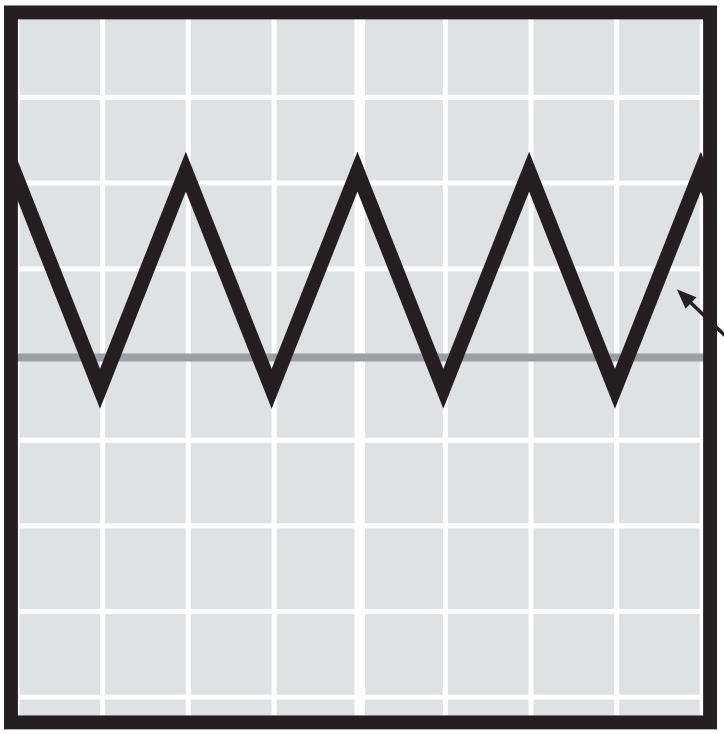


0 VOLTS

ADJUST TRIMPOT RV2 "TRI ADJ" SO THAT TRIANGLE WAVE IS SYMMETRICAL TO GROUND (0 VOLTS)

HORIZONTAL SCALE = 2V/DIV
VERTICAL SCALE = .5 MS/DIV

BAD



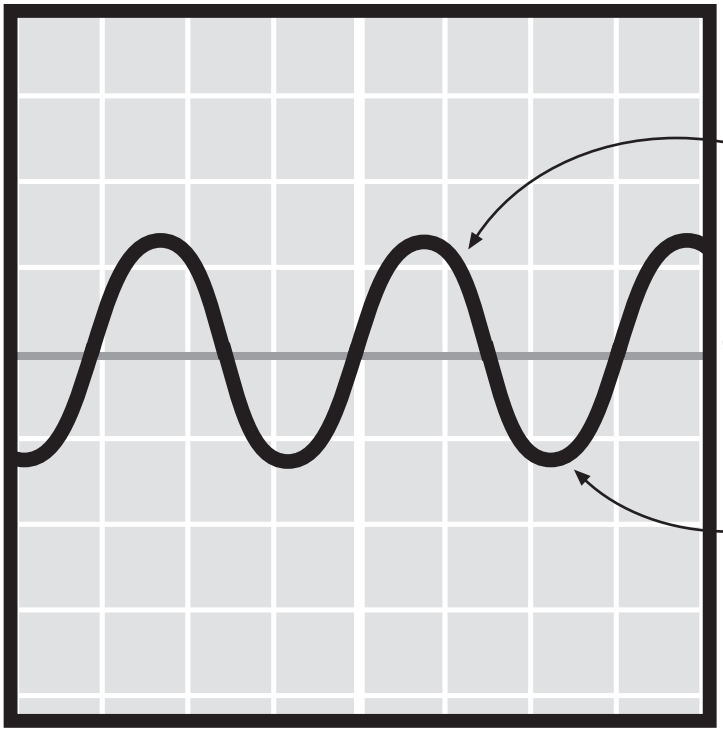
0 VOLTS

TOO FAR ON THE HIGH END – NOT SYMMTRICAL AROUND GROUND

HORIZONTAL SCALE = 2V/DIV
VERTICAL SCALE = .5 MS/DIV

FIG. 6 : CALIBRATION No.3 SINE SHAPE (PURITY)

GOOD

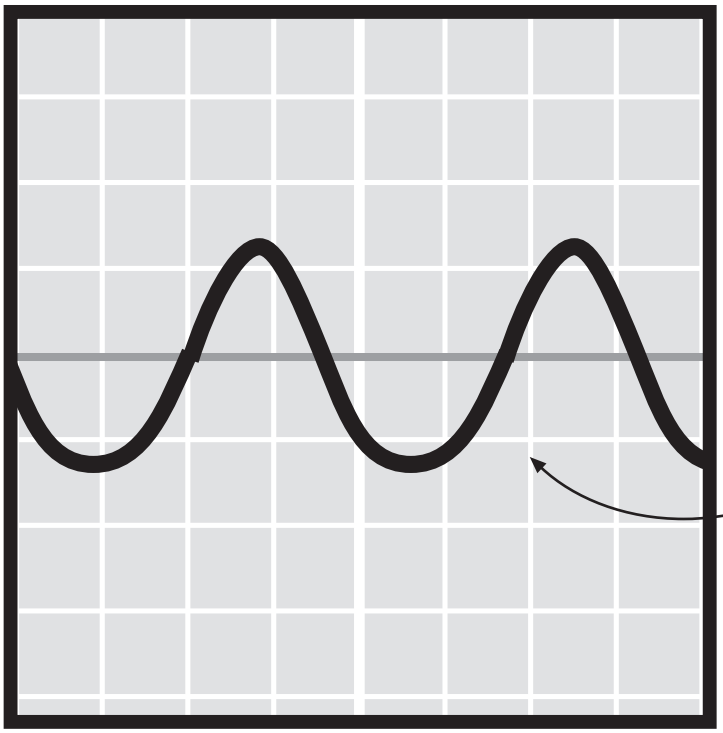


0 VOLTS →

ADJUST TRIMPOT RV5 "SINE ADJ" SO THAT THE ARC OF THE PEAK AND TROUGH ARE EQUAL

HORIZONTAL SCALE = 2V/DIV
VERTICAL SCALE = .5 MS/DIV

BAD



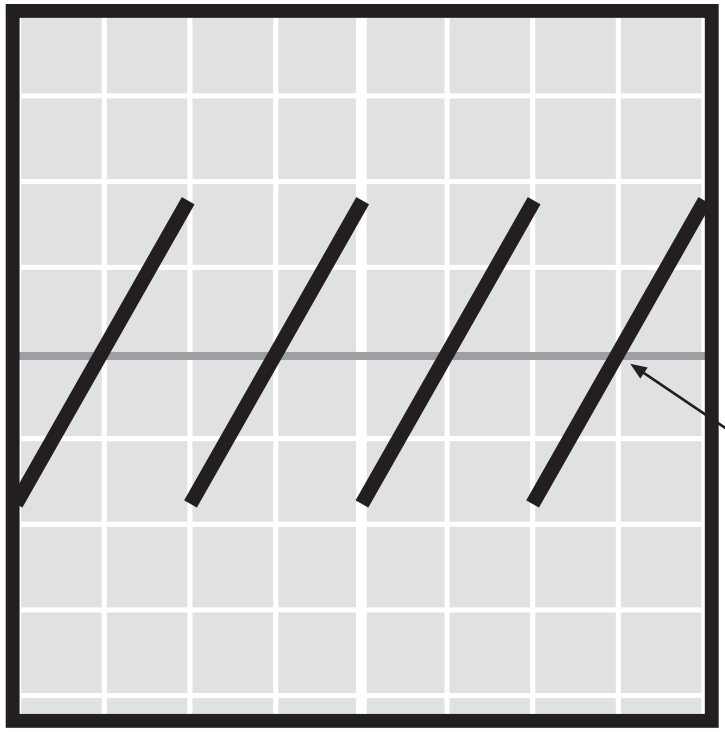
0 VOLTS →

ADJUSTED TOO FAR ON LOWER END – PEAK IS NARROWER THAN TROUGH

HORIZONTAL SCALE = 2V/DIV
VERTICAL SCALE = .5 MS/DIV

FIG. 7 : CALIBRATION No.4– RAMP WAVE SYMMETRY

GOOD

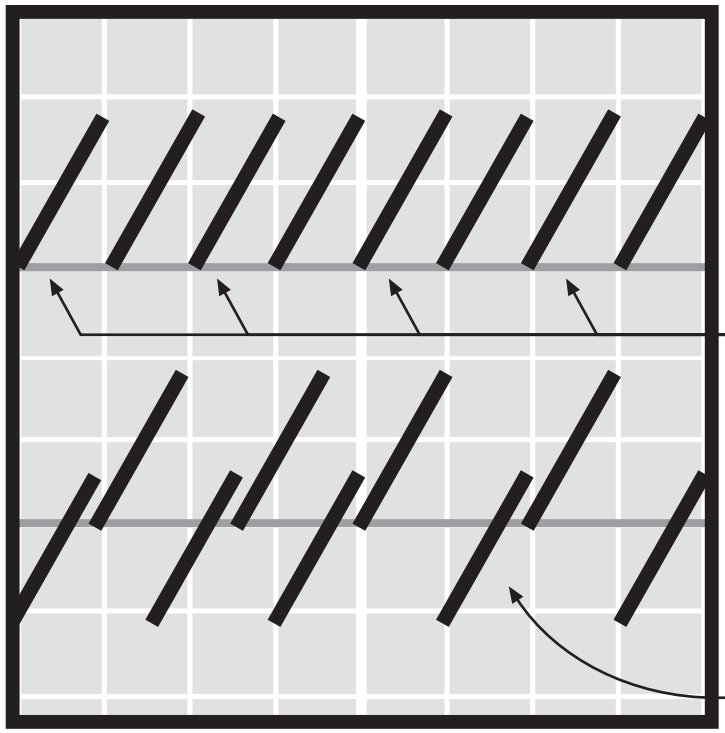


0 VOLTS

ADJUST TRIMPOT RV4 "SAW ADJ" SO THAT POSITIVE AND NEGATIVE ENDS MEET

HORIZONTAL SCALE = 2V/DIV
VERTICAL SCALE = .5 MS/DIV

BAD



0 VOLTS

NEGATIVE SIDE GROSSLY OFFSET – WAVE APPEARS OK, BUT NEGATIVE END IS ACTUALLY 90° OUT OF PHASE (TOO HIGH) AND IS DOUBLING BASE FREQUENCY.

0 VOLTS

NEGATIVE SIDE SLIGHTY OFFSET – DOES NOT MEET WITH POSITIVE END

HORIZONTAL SCALE = 2V/DIV
VERTICAL SCALE = .5 MS/DIV