

ZEROSCILLATOR TESTING PROCEDURE 2.2

August 7th 2008 “ZO” = Zeroscillator (thru-zero FM Quadrature VCO)

This 2.2 is an updated version of the ZO Testing Procedure 2.1 document and includes the new trimpot calibration procedures for the advanced user as well as more detail on subjects covered previously.

This text is recommended reading for every Zeroscillator user, and we'd like to take this opportunity to thank you for your choosing Cynthia ® brand electronics, and to welcome you to the new and exclusive club of “Analog FM Synthesis Capable” Synthesists growing worldwide!

You will need two other oscillators and an envelope generator to fully test a ZO. (These external oscillators are referred to as the "Modulation VCO" and the "Auxiliary VCO"). These procedures are identical for all formats.

Sections in the text below labeled, “(Advanced User!)” should only be actually attempted by those technically inclined souls using an oscilloscope, (and in several cases, possessing the confidence and ability to re-calibrate the 1/volt to the Octave keyboard tracking trimpots on their Zeroscillator).

1. Listen to the Triangle Wave Output of the Zeroscillator directly and be certain that no other plugs or cables are patched into the Zeroscillator. (If you have an oscilloscope, then it is helpful to also ~watch~ this same waveform that you are listening to...)

Leave the Big TUNING Knob somewhere near the middle of it's travel...

2. Set BIAS, RANGE, and THRU-ZERO Switches into the upright position, (please fasten your seat-belts :) and center the MORPHASE Switch.

3. TEST: TEN-TURN TUNING KNOB & RANGE SWITCH

Turn the big knob and listen for the pitch to change accordingly.
Take the pitch to the highest extreme of approximately _____ HZ.
Do the three-positions of the RANGE Switch work?

(Without a scope there may be some doubt about the low ranges actually doing anything or not as the ZO becomes subsonic. To verify subsonic operation, simply patch the Triangle Out of the ZO into the exponential input of some other audio VCO, and listen to it in order to hear if the ZO is

modulating in LFO mode or not. (After this, please remember to return to the initial set-up by listening to, (and watching) the ZO Triangle Output again).

Try the TUNING Knob at the lowest extreme, approximately _____HZ.

4. TEST: LOW FREQUENCY SYMMETRY (Advanced Procedure!)

Low Frequency Triangle Symmetry may be checked by tuning the ZO to the very lowest pitch possible, (Switches Up!) and observing the Triangle Wave Output on a scope. The apex of the triangle should be centered with left & right slopes being of equal proportions.

[ALERT: ADJUSTMENT CAN CHANGE 1V /OCTAVE CALIBRATION]

The adjustment for this is the long multi-turn trimpot on the CORE Board CYN109-A , (the central PCB in the 3-card sandwich). It is the only trimmer located on that board, and the adjustment may be made by eye.

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5. TEST: BIAS SWITCH (Linear FM Summing Bias)

The BIAS Switch Up and Down settings should have an effect on lowering the pitch in two different increments when it is tried under the standard set-up conditions of Lines #1 and #2 above.

NOTE: it is totally normal to hear ~nothing~ when the BIAS Switch is in the Center Position, (known as "zero bias", "bias off", or "bias free" operation).

Odd behavior is also possible when the BIAS Switch is at Center Off and there is no LIN FM Input present, such as ~noise generation~ by the ZO!

If you have a voltmeter, then with no Linear FM inputs measure the voltage on MOD OUT. It should be about 1.0V with the BIAS switch to HIGH, zero volts in the middle, and about 0.2V (200 millivolts) on BIAS LOW.

6. TEST: LEDES, BIAS, LINEAR SUMMING, THRU-ZERO OPERATION

With the ~BIAS Switch Centered~ and the RANGE and THRU-ZERO Switches UP, you should hear nothing... Until you plug the (sine recommended) output of a separate Modulation VCO into the LIN FM Input Jack, and open-up the LIN FM Knob above it... Suddenly you should have sounds that get wilder and ever more extreme - the more you turn it up!

At this point the RED ~and~ the GREEN LEDs should be going wild bouncing back & forth - based upon the speed of your separate modulating oscillator, (Switching this external VCO between AUDIO/LFO rates etc)...

Now, if you ever wonder, "What's so special about all this `through-zero' capability, eh?" (Well, now try turning-off that THRU-ZERO Switch and just listen to half of all that marvelous fun go away!) Ouch!

Please confirm that even the GREEN LED goes dark when the Thru-Zero Switch is turned-off. Ok, Now please return your THRU-ZERO Switch to it's proper place of rest in the Upright Position so that all is groovy once again!

7. TEST: DYNAMIC LINEAR FM INPUTS & VCA

Please Return to the Initial Set-up Conditions above in lines number 1 & 2.

Listening to the Triangle Output, patch one external Modulating audio VCO into the DYNAMIC AC Coupled Input Jack, (the gray banana jack on Modcan A-series format indicates AC-Coupled type inputs). Turn the LIN FM Knob all the way off, or CCW, (Counter Clockwise).

Now patch your second, or "Alternate" VCO into the FM INDEX INPUT Jack and open up the FM INDEX knob full. You should find that the Zeroscillator pitch or frequency is being modulated by your Modulation VCO, while the ~Depth~ of that modulation is being controlled by your other Auxiliary VCO.

Switch these two external VCOs respectively into different Audio/LFO Range combinations for tremolo effects, or (cool nasty!) amplitude modulation grunge.

8. TEST: LINEAR FM SYNTHESIS

With the above arrangement from Test #7, please plug your external Envelope Generator into the FM INDEX Jack instead of that second external Auxiliary VCO... By Firing your Envelope Generator, you should be hearing a great variety of new exciting types of metallic FM sounds emerging from your modular!

Just as tiny little changes to a couple of variables in a Mandelbrot fractal graphic equation are able to effect massive changes throughout the resulting universe it creates... So too are the timbres of FM synthesis wildly altered by simple changes in the frequencies of both Modulator and Carrier and the Index of the Depth of that modulation). The size of your wood block, gong or glockenspiel should mutate dynamically with small frequency and FM Index knob changes to both your Modulation VCO and Zeroscillator!

Now change your Audio rate INPUT SIGNAL from going into the DYNAMIC ~AC~ Input Jack, to now using the DYNAMIC ~DC~ Input Jack instead. Suddenly these sweet FM sounds are sounding a bit vulgar or klangorous, and as you patch your Input Signal back and forth between the Dynamic AC and DC Coupled Input Jacks - you can begin to hear a unique and subtle difference between them and that use of the Dynamic AC Input Jack results in sounds that are generally considered more pleasing or far more "musically useful" than if using the Dynamic DC input. (Of course you can use them all!)

NOTE: in all but the banana jack versions of Zeroscillator, there is a dotted line connecting the DYNAMIC AC Input to the LINEAR FM Input and Knob. This is usually at rest in the fully off or CCW position, however some classic FM Synthesis types of patches require a controlled amount of bleed-through, and the dotted line on the panel indicates a Switching Jack at the LINEAR FM Input that disconnects this controlled bleed-through ability when a jack is inserted into the LIN FM Input.

If you experience no change from the results of your Envelope Generator settings, be sure that the LIN FM Knob is fully off, (or the bleed-through will override the effect of the envelope).

9. TEST: RING MODULATOR (Four Quadrant Multiplier)

Unplug the Envelope Generator and plug that second Auxiliary VCO back into the FM INDEX Input Jack and open up said such knob above the jack,

ClockWise, (CW). Now listen to the MOD OUT Jack instead of the Triangle Wave Output...

Putting both of your External Modulation and Auxiliary Oscillators into their AUDIO Ranges should give a resulting frequency output at the MOD OUT Jack. Both inputs should have a say in the resulting output frequency of a Ring or Balanced Modulator, so twiddling the FREQUENCY Knobs of ~each~ of your two External Audio-Range VCOs should have an effect on the resulting output pitch of the Ring Modulator, (technically this design is a Four Quadrant Multiplier).

Flip these VCOs alternately between Audio/LFO mode, and you should experience tremolo and amplitude modulation types of effects.

NOTE: Remember that this test #9 should have NOTHING to do with the core of the Zeroscillator. You are now just listening to and testing the RING MODULATOR ~independently~ without even involving the Zeroscillator circuit that the Ring Modulator is mounted inside of, (it may take a while for this distinction to really sink in!)

10. TEST: RING MODULATION NULLING

Listen to the output labeled MOD OUT and place an External Audio VCO (sine) into the FM INDEX Input Only, (no dynamic FM inputs). Open up the FM INDEX Knob and you really shouldn't hear much unless you go over to your studio amp and crank it way wayyy up in order to hear any whining.

Now unplug the External VCO from the FM INDEX Input Jack, and plug it into the DYNAMIC AC Input Jack, (Gray banana on Modcan A format)... and repeat the above. If only ~one~ of these FM INDEX or DYNAMIC AC Input Jacks are used at any time, then you shouldn't hear any whining from the External Modulation VCOs - unless you crank the MOD OUT volume way, wayyyyy up, (careful, you could blow your speakers or your ears :)

11. CALIBRATION: Ring Mod Crosstalk Nulling (Advanced Procedure!)

(Advanced Users may eliminate balanced modulator crosstalk by adjusting trim pots VR202 & VR203 labeled X-NUL and Y-NUL respectively for either the DYNAMIC AC or FM INDEX Jack inputs to be tested, and located on the top CYN109-C Modulator/ Power Board. (Never plug signals into both LIN INDEX and either DYNAMIC FM Inputs simultaneously if testing the

four quadrant nulling, and be sure to listen only to the MOD OUT doing so).

12. EXPONENTIAL MODULATION

Listen to the Triangle Wave Output.

Plug your External Audio Rate VCO into the EXPO IN Jack and turn up the modulation knob. Flip your External VCO into LFO Range and back to audio and listen for the output of the ZO to react.

Leave your VCO in Audio Range and now unplug it from the EXPO IN jack and plug the signal alternately into one, and then the other 1 Volt to the Octave Input Jacks, and the resulting pitches to the ear should be identical regardless of which jack is used. (This sub test is for "1V/Octave Input resistance matching", and naturally is not necessary on Zeroscillator formats with only a single 1V/Oct Input)

13. TEST: PWM (Pulse Width Modulation)

Please Return to the Initial Set-up Conditions above in lines number 1 & 2.

Listen to the output marked or labeled with a square wave or PULSE wave jack.

Plug a slow LFO Waveform (or a fast one, why not?) into the PWM Input Jack and turn the PWM Knob back and forth. You should hear the resulting phase changes in the audio output. We made this Pulse Width Modulation Knob much more full-ranged than most, as you can take the PWM all the way from full silence at once extreme - through 50%- all the way to silence at the other extreme. This allows natty, buzzy sonic textures, simply not possible with some other oscillator designs, to exist right at the bitter edge of extreme PWM.

(Question: "Um, Why don't I hear a PULSE Output?"

Answer: "Try turning the PWM Knob!")

14. TEST: WAVEFORM SAFARI

Please Return to the Initial Set-up Conditions above in lines number 1 & 2.

This is a good time to listen to all of the other Zeroscillator waveforms! Listen to the SINE Wave Output, it should sound a little bit more muted, or just a little softer than the TRIANGLE Wave Output, (because it has fewer harmonics).

(Advanced users can observe the SINE Output on a scope adjusting both SINE SYMMETRY and SINE DISTORTION Trimmers VR622, & VR621 located on the top modulator board CYN109-C diagonally opposite the power connectors). We highly recommend adjusting the sine wave to the ear, so ultimately in this case a scope is actually not necessary for this particular calibration...

Brace yourself for a louder sound now and switch now to the two Sawtooth Outputs, (many more harmonics and thus rather raspy!) While one of these Sawtooth or Reverse Sawtooth outputs ~sound~ the same, they of course do not ~modulate~ the same. Flip the RANGE switch of the ZO into LFO mode and modulate and listen to another oscillator using these SAW Waves and one should make swoopy UP glissing type sounds, while of course modulating that external VCO with the other SAW Output should now make swooping DOWN types of pitches instead of up going ones).

15. TEST: SAWTOOTH SYMMETRY (Advanced Procedure!)

Please Return to the Initial Set-up Conditions above in lines number 1 & 2.

If you see an obvious kink in the sawtooth waveform on an oscilloscope then adjust Trimmer VR641, (labeled SAW TRIM and located on the edge of CYN109-B the bottom waveshaping circuit board in the three-board sandwich) until the saw waveform angle is corrected to the eye.

16. TEST: QUADRATURE (Advanced Procedure!)

Please Return to the Initial Set-up Conditions above in lines number 1 & 2.

Turn both the MORPH_A and the MORPH_B Knob to full CCW or closest to the TRIANGLE Icon next to the knob.

Have look at the MORPH_90 Output on a scope and adjust trimpot VR501, (labeled QUADRATURE and located on the end of CYN109-B the bottom PC board in the three-board sandwich). Play "pin the top on the mountain" with the trimpot until the triangle looks complete to the eye.

17. TEST: QUADRATURE MORPHING

Please Return to the Initial Set-up Conditions above in lines number 1 & 2.

Listen to the MORPH_90 Output with the MORPHASE Switch centered. The MORPH_B side knob should continuously alter the shape and the amplitude of the waveform. Plug an LFO range waveform from your External VCO into the MORPH_B Modulation Input Jack and open the knob to see and hear your control voltage having an effect on the resulting MORPH_90 Output. Listen, (and watch on your scope) the MORPH 270 Output jack also...

Now Flip the MORPHASE Switch either way to Off-of-Center. The effect of the external voltages should stop, (unless you try turning the Morph Knob on the other side... the MORPH_A Knob! Flip the MORPHASE Switch to see the difference in knob rotations, L-to-R vs. R-to-L... A control voltage into the MORPH_A Input Jack now will start the morphing again, and you can test this by trying these changes now while listening to either the MORPH_0 or MORPH_180 Jacks too.

18. TEST: VARI-SYNCH

Please Return to the Initial Set-up Conditions above in lines number 1 & 2.

Open the VARI-SYNCH Knob all the way CW.

Insert an External Audio VCO signal into the VARI-SYNCH Input Jack and sweep your External VCO up in pitch until the ZO has a very strong sonic reaction to it. At this point, turn the VARI-SYNCH Knob down, and if the resulting harmonics jumps disappear, well then Vari-Synch is working fine!

19. TEST: TIME REVERSAL

With nothing in the VARI-SYNCH Input Jack, please take the above external VCO and plug it into the TIME REVERSAL Input Jack. If the Zeroscillator jumps suddenly up in pitch or phase, then it's working! (For fun, Catch the zero crossing with a camera on your scope!)

20. CALIBRATION 1/Volt to the Octave (Advanced Procedure!)

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Right! Use your own method of choice here, or contact us for the purchase of a Cynthia brand custom electronic Octa-Volt® Calibrator Tool useful for calibrating all brands of exponential One-Volt-to-the-Octave type Oscillators.

After the unit in question has been powered-up in a consistent environment for at least 20-minutes, adjust multi-turn trim potentiometer VR303, (labeled 1V and located on CYN109-C, the board with the power connector at the top of the three PCB sandwich) until you achieve correct 1v/Oct keyboard tracking.

Congratulations you are done testing and calibrating your new-fangled Zeroscillator type gadget!

Best Wishes!

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