

M103B MOTM-300 UltraVCO (modified version)

FUNCTION DESCRIPTION

The M103B UltraVCO is a modified version of the famous MOTM-300 UltraVCO module (Synthesis Technology). It features new 'frontend' controls to fit the Moog 921B VCO frontpanel characteristics but with much more accurate components. For example the front panel frequency control is made of a 360 deg. span precision potentiometer that gives a +/-2% linearity with 1,000,000 rotations lifespan compared to the original Allen-Bradley carbon type with a linearity of 20%. The original Moog DC & AC Modulate jacks have been changed to accommodate 1V/oct and linear frequency modulation inputs. Also the RANGE rotary switch now features a 32' instead of 'LO' setting. The VCO core & outputs are from the MOTM-300 UltraVCO schematic. No modifications have been made in the MAIN VCO circuits to keep the specs as they should be. Even the VCO core PCB has been redrawn faithfully to keep the all the circuit specs. Only the inputs & control circuits have been added/changed to make both controls and FREQUENCY pot drive the MOTM-300 VCO accurately.

The M103B module is a voltage controlled oscillator which runs associated with one M103A oscillator driver through internally wired connections (via PCB AMP connectors). The M103A driver can drive up to three M103B VCO modules via its 3 rear connectors giving 1V/oct CV & PWM control voltages to the VCO's.

The FREQUENCY vernier has a +/- 12 semitones span. In addition the RANGE switch can take the FREQUENCY setting from down to 32' to up to 1' in 1 octave steps. When an external CV is connected to the 1V/oct input, this disconnects the inner freq CV connection from the M103A driver freeing the VCO to be used alone. A 'shorting' signal pulse (to the ground) connected to the SYNC input synchronizes the VCO frequency with the incoming pulses. A WEAK/STRONG SYNC type can be selected thru the use of a front panel switch.

The VCO features 4 different waveforms: SINE, TRIANGULAR, SAWTOOTH & RECTANGULAR. All these waveforms are 10vpp in amplitude.



The printed circuit board

The PCB has been designed to fit behind a 1U Moog style front panel. It is a double side board 4.25" X 5.5" and is mounted using 4-40 1.5" hexa standoffs to keep accessible all the onboard trimmers. All the parts are through hole types. Power is connected by use of a 6 pins 0.156" Molex type connector. The PCB has 4 mounting holes, one on each corner.

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For precision and lasting reliability a voltage reference IC is used for accurate and stable voltage reference for the FREQUENCY vernier span VR100. U9 is a high precision voltage reference IC that gives a stable +5.00volts. This voltage reference drives the R102,VR102,R103 precision resistors chain. VR102 adjust the overall voltage span that the FREQUENCY vernier will use and is adjusted at +1.100vdc then buffered by a precision opamp MXL1013(U10A).

Front panel potentiometer FREQUENCY cursor's voltage is buffered by IC MXL1013(U10B). This buffered voltage gives +0.550vdc at FREQ center position on IC U10B pin7. On the CV summing bus made by U4B pin6 this voltage must be canceled out at center position with the use of an inverting buffer generating -0.550vdc at U11A pin1. This is done by inverting the previous +1.100vdc and dividing it by 2, then summing it on the CV bus. This gives 0.00vdc at FREQUENCY vernier center position on the summing bus. VR101 (freq offset) is used to set the M103B 'resting' centered 0vdc frequency at lower C note of 65.41hz on 8' RANGE position. Its voltage is summed on the CV summing bus.

Finally SW2 RANGE switch is a 6 position rotary selector that selects 6 different 1.00vdc taps from 0.00vdc to +5.00vdc derived from U9 voltage reference IC. The voltage chain is made of 5 very high precision 1k00 0.1% resistors. By moving the switch a span ranging from 32' to 1' can be selected. Its cursor's voltage is buffered by IC MXL1013(U11B) then connected to the CV summing bus.

The inner CV connector H2 is physically positioned to be easily connected to one of the three adjacent M103A VCO driver connectors (H2,H3,H4). This connector receives both 1V/oct and PWM control voltages. J5 1V/oct input jack routes H2's CV voltage through its normally closed switch to the summing bus. When an external incoming CV voltage is connected to the J5 jack this disconnects the CV's path from the M103A driver and 'frees' the M103B to be used alone with the incoming CV. R45 connects this 1V/oct CV to U4B pin6 summing bus. J6 LIN FM jack receives any external control voltage to be used for linear freq. modulation. H2's PWM signal goes to R14 and U2B pin6 to modulate the VCO's rectangular wave pulse width from 10-90%.

**The rest of the circuit is basically made of Synthesis Technology's MOTM-300 UltraVCO design and parts. For Copyright reasons I cannot show neither explain the inner working of the VCO core. Please contact & buy the complete PCB and PDF documentations for any further details on the module.
You can get the kit here: http://bridechamber.com/MOTM_300.html**

Adjustments and trimmings:

The following is the adjustment procedure for all PCB trimmings:

- Connect a frequency counter or a very accurate tuner to the Rectangular wave output jack.
- Connect a very precise voltage source like a 1V/oct (+/-0.1%) keyboard or one of the M100 MIDI interface 1V/oct output to the M103B 1V/oct input.
- Adjust VR102 SPAN trimmer to get +1.100v on pin#1 of U10A MXL1013. Now U11A pin#1 should read -0.550v.
- Set RANGE switch to 16' position, play the lowest C note of the keyboard (0.00vdc) and adjust front panel FREQ knob to get a 'tuned' frequency reading on the freq counter or tuner. It doesn't matter what note you get.. A,B,C,D,E,F,G would do but try to get NO FLAT or SHARP note here... easier!
- Play the most right C note on keyboard (+5.00vdc) and adjust R59 1V/oct trimmer to get the same 'tuned' note you got with the FREQ knob before but 4 octave higher. You will have to readjust FREQ knob and R59 many times to get the 4 octaves difference needed. Be patient.
- When R59 looks good on the previous pitch readings play the Middle C note (+2.00vdc) and rotate the RANGE switch steps one after the other from 32' to 1' checking the note accuracy and make the final 'fine tuning' adjustments on R59 for a maximum keyboard-VCO 1V/oct SPAN.
- Because of the VCO sawtooth core's trigger usec. pulse width most VCO's show an increasing FLAT pitch response on their higher freq range. For the best SPAN linearity you will need to select R50 for HIGH FREQ tracking. Values ranging from 1.5 to 3.3megs can be tried. 1.6meg 1% 50ppm resistors have shown to be a good choice. (please note that when replacing this resistor you will have to do the R59 1V/oct trimming procedure again.. but it's worth it !). Doing so I've been able to get a 7 octaves span with accurate linearity From 32' RANGE position, second keyboard C note to 1', 4th C note.
- VR101 trimmer adjusts the 'resting' VCO frequency when nothing is connected to the 1V/oct jack. Disconnect any connected CV voltage from the 1V/oct jack. Place the FREQ knob to the front panel's ZERO position, place the RANGE switch to 8' position. Adjust VR101 to get 65.41hz (C note on the tuner) on the rectangular output jack.
- All needed trimmings done !

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Jean-Pierre Desrochers
ArcEnSon

ELECTRONIC SPECIFICATIONS

POWER CONNECTOR

PIN ASSIGNMENTS

1	-15V
2	A GND
3	A GND
4	+15V
5	D GND
6	+5V

Panel Size: Single width 2.125" w x 8.75" h.

Controls:

Frequency pot range semitones: +/-12

Range rotary switch span: 32',16',8',4',2',1'

Waveform input levels: -13V to +13V

Waveform output levels: 10V peak to peak

All output impedances: 1000ohms, nom.

Frequency Span: 0.1Hz to 30Khz, nom.

Frequency stability: Less than 0.1% error
@ 4Khz in 24hrs

FM modes: Exponential & linear (DC coupling)

1V/oct input impedance: 100k +/-1%

LIN FM input impedance: 475k +/-1%

SYNC switch: Soft or Hard sync. selectable

SYNC input impedance: Soft:10k Hard: 47k

SYNC type: shorting pulse to GND

Waveform outputs:

Sine, Triangular, Sawtooth, Rectangular

Power:

+15V @ 40mA,

-15V @ 30mA,

+5V @ 0mA.

