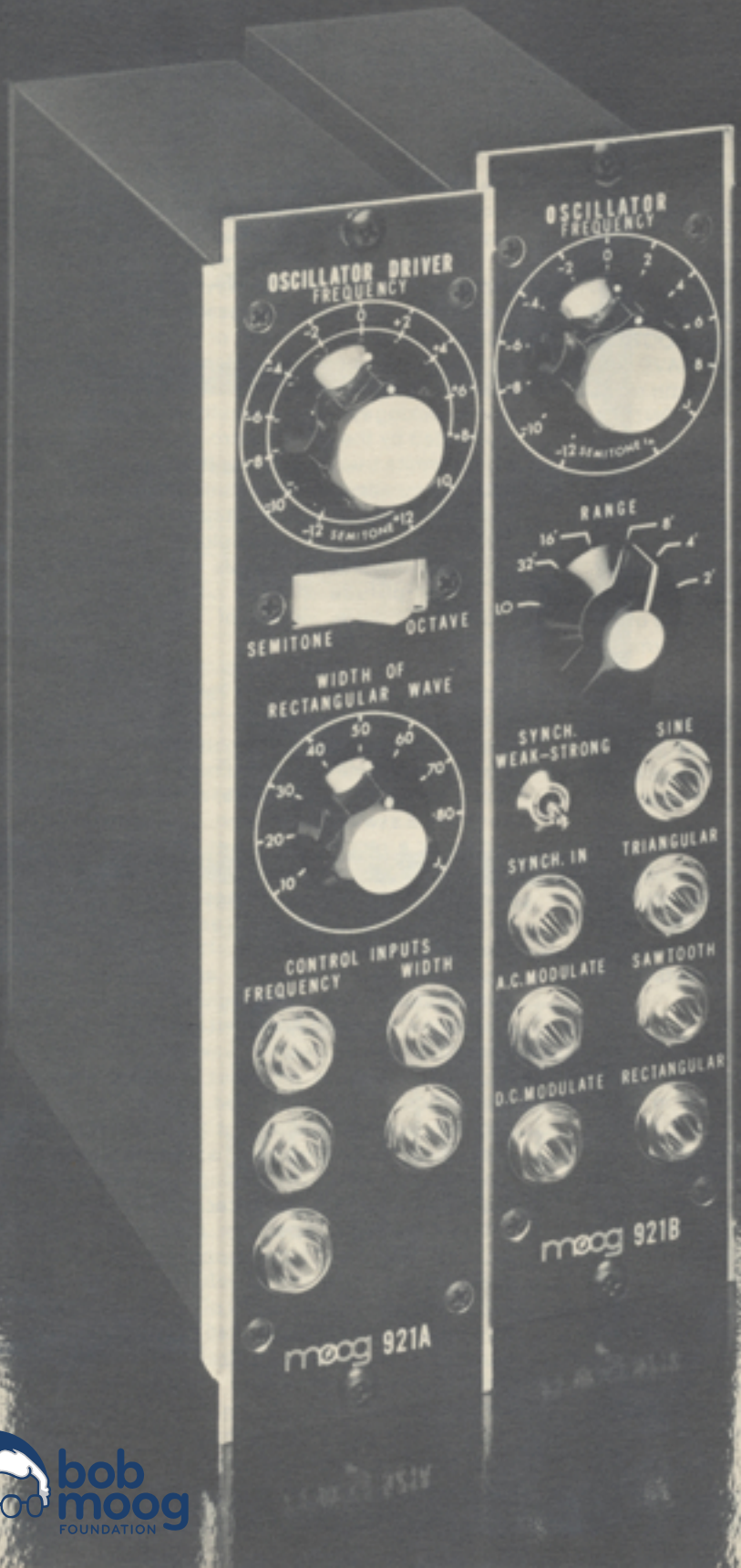
921A OSCILLATOR DRIVER
921B VOLTAGE CONTROLLED OSCILLATOR



The 921A Oscillator Driver/921B Voltage Controlled Oscillator system generates periodic waveforms over a frequency range of 1 to 40,000 cycles per second. It produces sine, triangle, sawtooth, and rectangular waveforms simultaneously. The frequency of all waveforms can be modulated by exponential and linear voltage control; the rectangular waveform width can also be voltage controlled. The 921B Voltage Controlled Oscillator has phase-lock synchronization capability. Typical applications include audio signal generation and control signal generation for modulation of other signals.

- **Outstanding frequency stability over a wide ambient temperature range**
- **Frequency range from 1 to 40,000 Hertz**
- **Fixed level sine, triangle, sawtooth and variable width rectangular waveforms available simultaneously**
- **Exponential and linear frequency modulation capability**
- **Phase-lock synchronization capability**
- **Compatible with existing Moog modules**

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CONTROL PANEL FEATURES:

One 921A Oscillator Driver provides master control functions for any number up to 12 of 921B Voltage Controlled Oscillators. On the 921A panel, the FREQUENCY control varies the frequency of all associated oscillators over a span of either 2 or 12 octaves, as selected by the SEMITONE-OCTAVE switch. The WIDTH OF RECTANGULAR WAVE control sets the ratio of the positive pulse width to the total cycle width, from 5% to 95%. Three CONTROL INPUT jacks permit voltage control of the FREQUENCY and the two CONTROL INPUT jacks control rectangular waveform WIDTH of all associated oscillators. Signals connected to either set of jacks are electrically summed.

On the 921B Voltage Controlled Oscillator panel, the FREQUENCY control operates within a span of two octaves. The RANGE switch selects one of five octave steps, plus one low range. All waveforms are available simultaneously at their designated output jacks. Linear frequency modulation of each individual 921B oscillator is provided at the AC MODULATE and DC MODULATE control input jacks. A blocking capacitor at the AC MODULATE jack eliminates any DC offset of the control signal; these two inputs are otherwise identical. Phase-lock synchronization of a 921B oscillator's frequency to some multiple or sub-multiple of a reference oscillator's frequency is provided by applying the reference oscillator signal to the SYNCH IN jack. The SYNCH switch selects WEAK or STRONG phase-locking functions, with the center position defeating the synchronization.

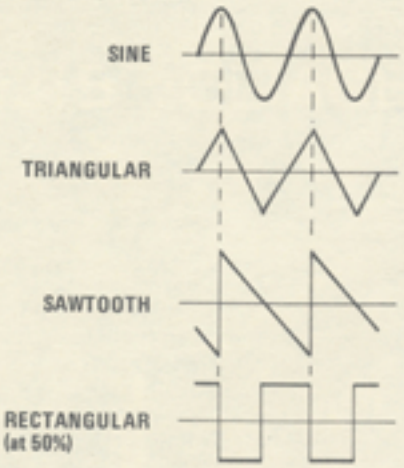
MUSICAL APPLICATIONS

The 921A Oscillator Driver/921B Voltage Controlled Oscillator system is extremely versatile in audio signal generation applications. Four basic timbres are available at the fixed level outputs. The frequency can be modulated by other signals to produce discrete pitch changes, vibratos, trills, glissandi, and many other musically interesting effects. Furthermore, simultaneous frequency modulation of more than one 921B oscillator can be accomplished by the 921A controls and input signals, or individual frequency modulation of each 921B oscillator is possible. The register of a melodic line can be instantly and accurately changed in octave steps during its performance.

The extremely wide span of voltage control permits a continuous frequency sweep from subaudio to beyond the limits of human hearing. Voltage control of the rectangular waveform width provides dynamic contouring of this waveform's timbre not possible by any signal processing module. Phase-lock synchronization of two or more 921B oscillators produces "beat free" intervals throughout the audio range, provided that all oscillators in the phase-locking system are simultaneously frequency modulated by the same control signals. This capability permits true additive synthesis of waveforms, with the number and amplitude of partials determined by the choice of constituent waveforms and the number of oscillators employed. Such a system can be configured to provide precise contouring of the amplitude of each constituent partial, providing a large variety of timbre modulation resources.

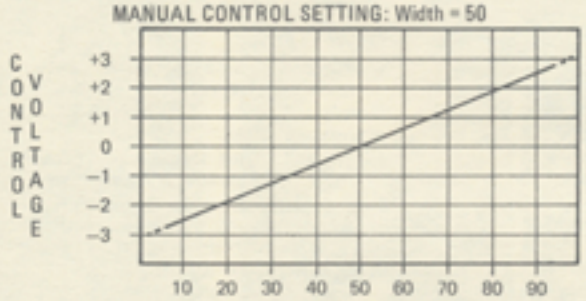
The 921A Oscillator Driver/921B Voltage Controlled Oscillator system has varied applications as a control signal generator. The four waveforms provide different repetitive patterns for frequency modulation of one or more voltage controlled oscillators. In the subaudio range, a sine can produce a vibrato, a sawtooth can produce a repeating glissando, or a rectangular waveform produce a trill. The repetition rate of any of these effects can be changed by manual or voltage control. Mixing of two or more waveforms produces many other repetitive frequency change patterns. These control signals are equally useful for amplitude and spectrum modulation of audio signals when used with a Voltage Controlled Amplifier(s) and Voltage Controlled Filter(s). A sawtooth waveform providing an amplitude envelope produces a sharp, staccato articulation of the processed sound. The highly accurate octave switching of the RANGE control can provide tempo changes in a 2:1 ratio. Amplitude modulation "panning" of a single audio signal between two channels can be accomplished in four different patterns. Spectrum modulation effects such as "wah-wah" type resonances can be controlled by any of the four waveforms, or any combination thereof. The versatility of the 921A Oscillator Driver/921B Voltage Controlled Oscillatory system, coupled with its superior frequency range and stability, establishes a new standard in voltage controlled oscillators.

WAVEFORM SYNCHRONIZATION; FIXED LEVEL OUTPUTS:



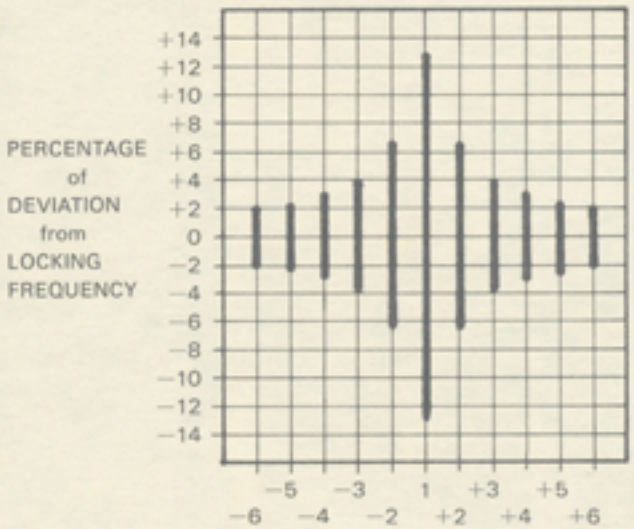
CONTROL VOLTAGE VERSUS RECTANGULAR WAVEFORM WIDTH:

MANUAL CONTROL SETTING: Width = 50



PHASE-LOCK SYNCHRONIZATION STRENGTH:

REFERENCE = Sawtooth, 200 Hz, 1.8V p-p

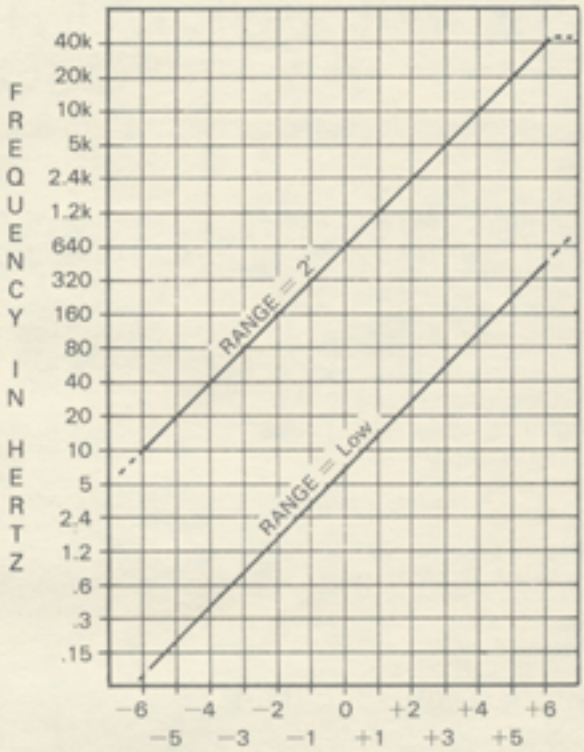


CONTROL VOLTAGE SCALING, FREQUENCY MODULATION:

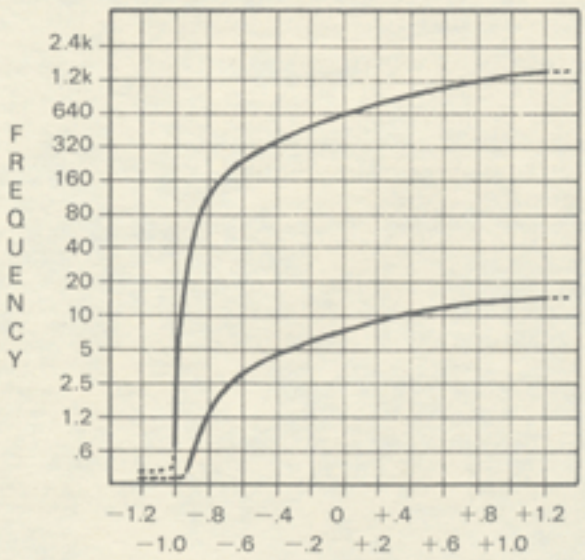
MANUAL CONTROL SETTINGS:

(921A) Frequency = 0
(921A) Scale Switch = semitone
(921B) Frequency = 0

EXPONENTIAL RESPONSE INPUTS (921A):



LINEAR RESPONSE INPUTS:
(921B—DC Modulate)



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921B VOLTAGE CONTROLLED OSCILLATOR

ELECTRICAL SPECIFICATIONS: 921A OSCILLATOR DRIVER

The 921A generates two control voltage outputs for 921B oscillators—one for pitch and one for rectangular wave duty cycle. These outputs appear only at the connector fingers and are fed to all the associated 921B oscillators via the wiring harness. The 921A consists primarily of two precision linear adders.

FREQUENCY CONTROL INPUTS

Number: Three (summed)

Input Impedance: 100K ±1%

Input Matching: Better than 0.1%

MANUAL FREQUENCY CONTROLS

Span Switch: Sets span of frequency control to either ±6 octaves or to ±12 semitones

Frequency Knob: Lowers Frequency Control Output at the rate of 500 mV for each octave increase in setting.

FREQUENCY CONTROL OUTPUT (Pin 5)

Scale Factor: (−0.500) x (Input Sum)

Output Impedance: 0.005 ohm (max)

Output Current Capability: At least ±4 ma (typically ±10 ma sufficient to drive 12-921B oscillators ±8 octaves)

Output Range: +9V to −3V (−18 to +6 octaves)

Quiescent Output Level (FREQUENCY control set to 0, all inputs = 0): 0 Volts

RECTANGULAR WIDTH CONTROL INPUTS

Number: Two (summed)

Input Impedance: 100K ±1%

MANUAL RECTANGULAR WIDTH CONTROL

Rectangular Width Knob: Duty cycle adjustable from 5% high (CCW) to 95% high (CW). Each 10% increment on knob decreases output 0.3V below that level established by the input sum.

RECTANGULAR WIDTH OUTPUT (Pin 6)

Scale Factor: (−0.250) x (Input Sum)

Output Impedance: .0025 ohm (max)

Output Current: At least ±4 ma (Sufficient to drive 12-921B oscillators)

Output Range: +9 to −3V

Quiescent Level (Duty cycle = 50% and both inputs = 0): −1.5 Volts

MECHANICAL SPECIFICATIONS

Panel Size: 8-3/4" high x 2-1/8" wide

Depth Behind Panel: 6"

Rear Connector: Printed circuit card fingers 3.359" wide. Mates with 22 pin connector (.156" centers)

Pin Assignments:

(1) +12.00 Volts Input (10 milliamps regulated to 0.01%)
(2) Ground
(3) −6.00 Volts Input (10 milliamps regulated to 0.01%)
(5) Pitch Control Voltage Output
(6) Rectangular Width Control Voltage Output
(7) Ground Reference for Pins 5 and 6
(10) Rect. Width Control Node (Zin = 0.25 ohm max) (Voltage at Pin 6 decreases 50 millivolts per microamp fed into Pin 10)
(11) Ground for Pin 10
(12) Frequency Control Node (Zin = 0.5 ohm max) (Voltage at Pin 5 decreases 25 millivolts per microamp fed into Pin 12)
(13) Ground for Pin 12

SHORT CIRCUIT PROTECTION

All front panel outputs or inputs may be shorted to +12 volts, ground or −6 volts indefinitely.

ELECTRICAL SPECIFICATIONS: 921B OSCILLATOR

921B oscillators operate in banks of 1 to 12 controlled by a single 921A oscillator driver. The modules in a bank interconnect via harness wiring routed among their rear connectors. A 921B may be operated independently (supplied with D.C. power only) but its usefulness will be limited.

FREQUENCY RANGE

Guaranteed: 1 Hz to 40 kHz

FREQUENCY CONTROL INPUTS

D.C. Modulate: Input changes the oscillator frequency according to the equation:
F = Fo (1+Vm); −1 Volt ≤ Vm ≤ +1 Volt (approximately)
Fo = unmodulated frequency
Vm = modulating voltage in volts

A.C. Modulate: Equation same as above except input signal is rolled off below 5 Hz to eliminate D.C. offset of input signal.

MANUAL CONTROL INPUTS

Range Switch: Changes oscillator frequency in steps of 2:1 (octave steps) with 0.1% accuracy. Last step to LO is about 2-1/2 octaves.

Frequency Knob: Adjusts frequency ±12 semitones

RESPONSE OF 921B TO 921A CONTROL VOLTAGES

Frequency: Rises one octave for each 500 millivolt *decrease* of voltage to Pin 5. (The 921A-921B *combination* has an overall response to +1 octave/volt.

Frequency Scale Factor Accuracy: Better than 0.1% (921A-921B combination) 30 Hz to 15 kHz

Frequency Control Input Impedance: 5K ±1%

Rectangular Width: (At Pin 6 of 921B) Duty Cycle = −33% (Vin); −3 ≤ Vin ≤ 0
IE: When Vin = −3V Duty Cycle = 100%
When Vin = OV Duty Cycle = 0%
(921A-921B combination has an overall duty cycle scale factor of +8%/volt)

Rectangular Width Input Impedance: 75K

SYNCHRONIZATION

Nominal Input Level: −4dBm (output of another oscillator)

Mode Switch: Center position defeats synchronization. STRONG position causes oscillator to lock onto harmonic or subharmonics of synchronization signal. WEAK position reduces locking strength by a factor of four.

Lock In Capability: 921B will lock onto at least the first six harmonics and subharmonics of a synch input signal. The 921B frequency controls may be displaced ±1% at the 6th harmonic without loss of locking.

OUTPUTS

Number: 4 — Sine, triangular, sawtooth, and rectangular waveforms

Nominal Level: −4 dBm (approx. 1.3 volts peak to peak)

Nominal Output Impedance of Sine, Triangular and Sawtooth Waveforms: 1K ohm

Rectangular Output Drive: 0.5 milliamps source or sink. Minimum load resistance = 2.5K ohm (four audio input jacks)

Centering: All waveforms are centered around zero volts.

MECHANICAL PACKAGE

Panel Size: 8-3/4" high x 2-1/8" wide

Depth Behind Panel: 6"

Rear Connector: Printed circuit card fingers 3.359" wide. Mates with 22 pin connector (0.156" centers)

Pin Assignments:

(1) +12.00 Volts Input (40 ma regulated to 0.01%)
(2) Ground
(3) −6.00 Volts Input (40 ma regulated to 0.01%)
(5) Pitch control voltage in
(6) Rectangular width control voltage in
(7) Ground reference for Pins 5 and 6
(8) Pitch Summing Node (Zin = 0.10 ohm max) One octave/−50 microamps
(9) Sine Output
(11) Triangle Output
(12) Rectangular Output
(16) Sawtooth Output

SHORT CIRCUIT PROTECTION

All front panel inputs or outputs may be shorted to +12 volts, ground, or −6 volts indefinitely.

bob moog FOUNDATION

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