

921 VOLTAGE CONTROLLED OSCILLATOR

CONTROL PANEL FEATURES:

All manual frequency controls are located in **Section (1)** of the panel. The **SCALE** switch selects the span of the **FREQUENCY** control, which can be either 2 or 12 octaves. The **RANGE** switch selects one of six octave steps. The **COARSE RANGE** switch selects either **AUDIO** or **SUBAUDIO** ranges, with considerable overlap.

Section (2) of the panel contains controls and jacks for the auxiliary outputs. The **AUXILIARY OUTPUT WAVEFORM** switch selects one of six waveforms, graphically depicted on the panel. The **AUXILIARY OUTPUT LEVEL** control varies the output amplitude from 0 to 8 volts, peak to peak. The selected waveform appears at both the "+" (normal), and "-" (inverted) output jacks beneath.

All fixed level outputs are available at individual jacks in **Section (3)** of the panel.

FREQUENCY CONTROL INPUT jacks, in **Section (4)** of the front panel, allow up to three control signals to determine the deviation from the basic oscillator frequency set by the manual controls in section (1). Signals connected to these inputs are electrically summed.

Section (5) contains the manual control and control input jacks for modulation of the rectangular waveform width. The **RECTANGULAR WIDTH** control varies the ratio of the positive section to the total cycle from 5% to 95%. Signals connected to the **WIDTH CONTROL IN** jacks are electrically summed, and determine the deviation from the basic waveform width set by the manual control. The combination of manual and voltage control, however, will not change the rectangular width beyond the specified control range.

The waveform clamping control and trigger input jacks are located in **Section (6)** of the panel. The **CLAMPING POINT** control specifies the clamping point within the waveform's total cycle; either a V or S trigger signal activates the clamping action. The clamping action occurs instantly, setting the waveform to the specified point in its cycle, from which it continues its characteristic pattern.

MUSICAL APPLICATIONS:

The 921 Voltage Controlled Oscillator has many audio signal generation applications. Four basic timbres are available at the fixed level outputs, and can be selected instantly at the auxiliary outputs. These basic timbres can be frequency modulated by other signals to produce discrete pitch changes, vibratos, glissandi, and many other musically interesting effects. The register of a melodic line can be instantly and accurately changed in octave steps

during its performance. Voltage control of the rectangular width provides dynamic contouring of this waveform's timbre not possible by signal processing. The extremely wide span of voltage control permits a continuous sweep from subaudio to beyond the limits of human hearing.

Applications of the 921 Voltage Controlled Oscillator as a control signal generator are even more varied. In the subaudio range, the fixed level

outputs provide four different repetitive patterns for frequency modulation of one or more voltage controlled oscillators; the modulatory effect can furthermore be initiated at a specific pitch by a clamping trigger. A vibrato, for example, can start above, below, or on the center of the pitch; or a glissando effect can start at any desired pitch. In addition, the repetition rate of any such pattern is voltage controllable; this application could, for example, produce a trill with a continuously varying speed.

When applied to processing modules such as a voltage controlled amplifier or a voltage controlled filter, these control signals are equally useful for amplitude and spectrum modulation of audio signals. A sawtooth waveform providing an amplitude envelope can produce a sharp, staccato articulation of the basic sound. In this

application, the highly accurate octave switching of the **RANGE** control provides tempo changes in a 2:1 ratio. The complementary auxiliary outputs provide the capability for amplitude modulation "panning" of a single audio signal between the two channels, or "fading" from one signal to another. Spectrum modulation effects such as "wah-wah" type resonances can be precisely initiated at any point in the resonance change pattern, varied in range, and in rate of repetition. The 921 Voltage Controlled Oscillator is also suitable as a reference for phase-lock synchronization with other oscillators to maintain precise intervals throughout the audio range. The extended low frequency range of the 921 Voltage Controlled Oscillator in control signal application for amplitude modulation permits crescendos and decrescendos of nearly two minutes duration.

In summary, the 921 Voltage Controlled Oscillator retains the basic operating features of previous Moog oscillators, and offers additional control features particularly suitable in control signal generation applications. The unprecedented versatility of this module, coupled with its wide frequency range and high stability, establishes a new standard in voltage controlled oscillators.





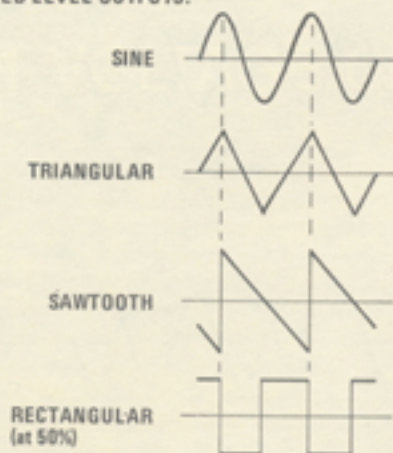
921 VOLTAGE CONTROLLED OSCILLATOR

The 921 Voltage Controlled Oscillator generates periodic waveforms within a total frequency range from .01 to 40,000 cycles per second. It produces sine, triangle, sawtooth, and rectangular waveforms simultaneously. The frequency of all waveforms and the width of the rectangular waveform are both voltage controllable. Complementary auxiliary outputs and provisions for triggered waveform clamping are included. 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 .01 to 40,000 hertz
- Fixed level sine, triangle, sawtooth, and variable width rectangular waveforms available simultaneously
- Complementary high level auxiliary output waveforms, switch-selectable, with continuously variable level
- Waveform clamping to a pre-set point by S and V trigger signals
- Voltage controllable rectangular waveform width
- Compatible with existing Moog modules



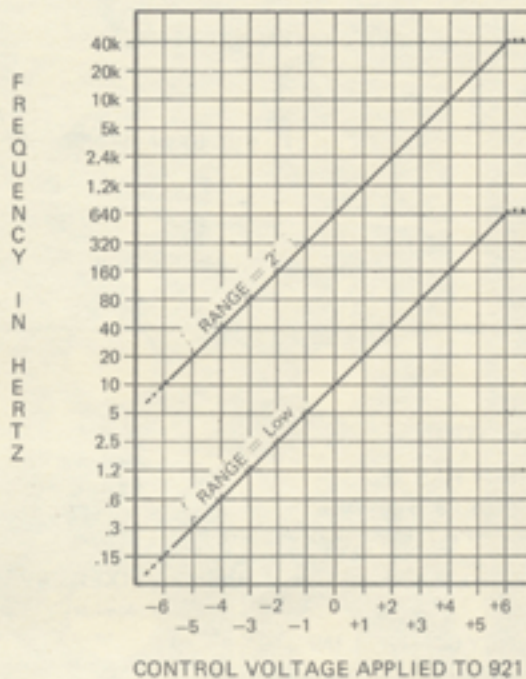
WAVEFORM SYNCHRONIZATION; FIXED LEVEL OUTPUTS:



CONTROL VOLTAGE VERSUS FREQUENCY

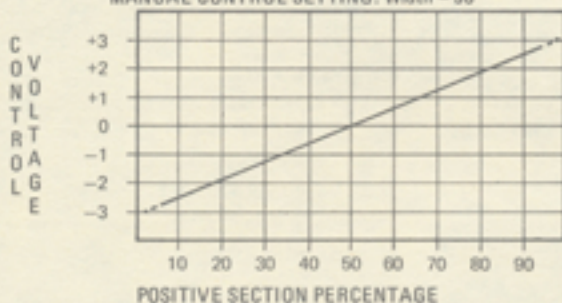
MANUAL CONTROL SETTINGS:

Scale = ± 12 semi.
Coarse Range = Audio
Frequency = -6

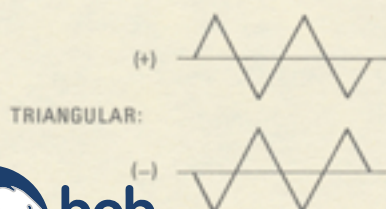
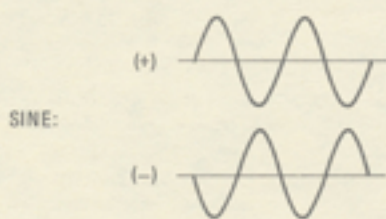


CONTROL VOLTAGE VERSUS RECTANGULAR WAVEFORM WIDTH:

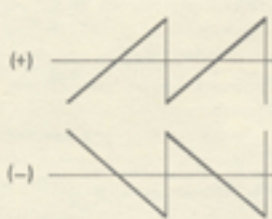
MANUAL CONTROL SETTING: Width = 50



VARIABLE LEVEL OUTPUT WAVEFORMS:



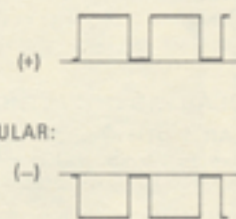
ASCENDING SAWTOOTH:



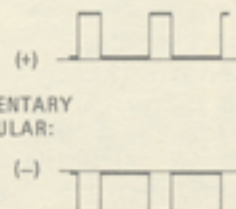
DESCENDING SAWTOOTH:



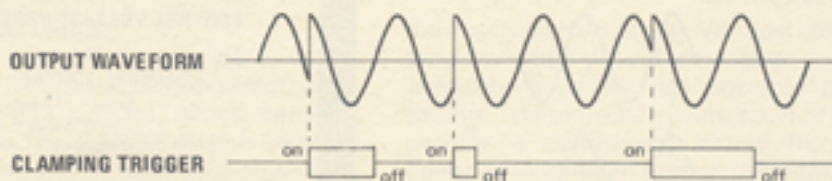
NORMAL RECTANGULAR:



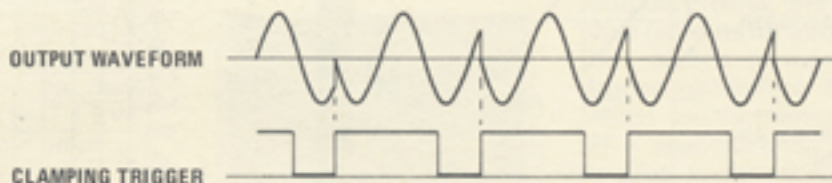
COMPLEMENTARY RECTANGULAR:



**WAVEFORM CLAMPING AT 25%,
WITH AN S-TRIGGER:**



**WAVEFORM CLAMPING AT 50%,
WITH A V-TRIGGER:**



SPECIFICATIONS

FREQUENCY RANGE

Guaranteed: .01 Hz to 40 kHz in two ranges (1 Hz to 40 kHz with COARSE RANGE switch in AUDIO position.) (0.01 Hz to 400 Hz with COARSE RANGE switch in SUB-AUDIO position.)

FREQUENCY CONTROL INPUTS

Number: 3 (summed)

Voltage/Frequency Scale Factor of Sum:

1 volt/octave

Scale Factor Linearity: 0.1% (30 Hz to 14 kHz)

Input Impedance: 100K ohms

MANUAL FREQUENCY CONTROLS

SCALE Switch: Sets span of FREQUENCY knob to either 2 or 12 octaves.

RANGE Switch: Changes oscillator frequency in steps of 2:1 (octave steps).

Accuracy of RANGE Switch Steps: 0.1%

COARSE RANGE Switch: SUB-AUDIO position drops frequency of oscillator to 1/100 of nominal value set by other controls and inputs.

RECTANGULAR WIDTH CONTROLS

RECTANGULAR WIDTH Knob: Duty cycle adjustable from 10% (counter-clockwise rotation) to 90% (clockwise rotation).

Rectangular Control Inputs: 2 (summed)

Effect of Rectangular Control Input: Changes duty cycle at the rate of 8% per volt.

Input Impedance: 100K ohms

CLAMPING CONTROLS

Clamping Point: Sets restart point of waveform from 0% to 100% of its cycle.

V-Trig Mode: Positive edge triggers clamping

Lowest V-Trig Step Size: From 0 to +2 volts

Slowest V-Trig Risettime: 0.1 millisecond

Minimum V-Trig On-time: 1 microsecond

Maximum Repetition Rate of V-Trig: 20 kHz

S-Trig On: Short to ground or signal capable of sinking 0.5 milliamps @ ≤ 0.5 volts (triggers clamp)

FIXED LEVEL OUTPUTS

Number: 4 (Sine, Triangular, Sawtooth and Rectangular waveforms)

Nominal Level: -4 dBm (approximately 1.3 volts peak to peak)

Nominal Output Impedance of Sine, Triangular and Sawtooth Waveforms: 800 ohms

Nominal Output Impedance of Rectangular Waveform: 50 ohms

Minimum Load Resistance on Rectangular Output: 2.5K ohms

Centering: All four waveforms are centered around zero volts.

AUXILIARY OUTPUTS

Number: 2 (one normal, one inverted)

Waveforms: Switch selectable sine, triangular, sawtooth, inverted sawtooth, rectangular and inverted rectangular.

Output Level of Sine, Triangular and Sawtooth Waveforms: Controllable from zero to seven volts peak to peak swinging symmetrically above and below zero volts.

Rectangular Output:

(+) jack 0.00 volts to +5.5V nominal

(-) jack 0.00 volts to -4.0V nominal

Inverted Rectangular Output:

(+) jack 0.00 volts to -4.0V nominal

(-) jack 0.00 volts to +4.0V nominal

Output Impedance:

(+) jack 0.01 ohm maximum

(-) jack 0.06 ohm maximum

MECHANICAL PACKAGE:

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

Depth Behind Panel: 6 1/2" excluding connector.

Rear Connector: Printed circuit card contact extension 3.359" wide. Mates with standard 22-pin connector (.156 centers).

Pin Assignments:

- (1) +12.00 Volts Input: 50 milliamps nominal, regulated to 0.01%
- (2) Ground Input
- (3) -6.00 Volts Input: 50 milliamps nominal, regulated to 0.01%
- (5) Frequency Control Input: $Z_{IN} = 5K$ ohms (one octave/500 millivolts)
- (6) Rectangular Width Control Voltage Output: Not Used
- (7) Ground: Reference for Pin 5
- (8) High Level Frequency Control Node: $Z_{IN} = 0.10$ ohm maximum (one octave/100 microamps)
- (9) Fixed Sine Output: 4 dBm at 800 ohms nominal impedance (paralleled to front jacks)
- (11) Fixed Triangular Output: -4 dBm at 800 ohms nominal impedance (paralleled to front jacks)
- (12) Fixed Rectangular Output: -4 dBm at 800 ohms nominal impedance (paralleled to front jacks)
- (16) Fixed Sawtooth Output: -4 dBm at 800 ohms, nominal impedance (paralleled to front jacks)
- (21) Low Level Frequency Control Node: $Z_{IN} = 5$ ohms maximum (one octave/10 microamps)
- (22) Ground: Shield for Pin 21

