

The **DPO** is a dual VCO designed for generating complex waveforms and implementing FM synthesis in the analog domain. Expanding on the classic arrangement of primary and mod oscillators, the DPO has both of the VCOs operable as complex signal sources. It is, in essence, a Dual Primary Oscillator. Dynamic FM, Circular FM, Hard Sync and Additive Harmonic synthesis processes are all achieved with internal routing on the DPO. The DPO has two modulation buses (Mod & FM), each with multiple destinations, the depth of which is adjustable per destination. The DPO is a 100% analog, vintage voiced musical instrument.

OSCILLATOR A WAVEFORM OUTS: Triangle wave output. 10Vpp. Sawtooth wave output. 9Vpp. Sine wave output. 10Vpp.

BEAT FREQUENCY LED: Provides visual indication of the phase difference between VCOs A & B.

OSCILLATOR B WAVEFORM OUTS: Sine wave output. 10Vpp. Square wave output. 9Vpp. Final wave output is processed by the Shape, Angle & Fold circuits. 10Vpp.

FOLLOW CV IN & ATTENUATOR: The **Follow CV Input** is a unipolar control. Range: 0V to 5V. The **Follow Attenuator** determines how well VCO A follows VCO B. With nothing patched to Follow CV In, it acts as a standard control. When patched, it acts as an attenuator for that signal.

SHAPE ROTARY, SHAPE CV IN & ATTENUATOR: The **Shape Rotary** is a unipolar control that determines the shape of the waveform feeding the Fold circuit. Morphs from *Sine* to *Spike* to *Glitched Triangle*. The **Shape CV In** is a unipolar control signal input normalised into the Mod Bus. Range: 0V to +5V. The **Shape Attenuator** is a unipolar level control for the Shape CV Input.

VCO A COARSE TUNE ROTARY: Controls coarse tuning for oscillator A frequency. Range: 9.5 octaves; 12hz-6khz.

VCO A 1V/OCT SCALE TRIM: Used to calibrate VCO A.

VCO A FINE TUNE ROTARY: Controls fine tuning for oscillator A frequency. Range: 1.75 octaves.

VCO MODE BUTTON: Cycles between 4 modes (indicated by LED): **No LED:** Standard, **Lock** (Blue LED): VCO A is phase locked to VCO B. **Sync** (Pink LED): VCO A is Hard Synced to VCO B. **LFO** (Amber LED): VCO A acts as a low frequency oscillator.

VCO A EXPONENTIAL CV IN & ATTENUATOR: Bipolar exponential frequency CV input for VCO A. Normalled to FM Bus. Range: 10V. The associated **Exponential Attenuator** acts as a unipolar level control for the Exponential CV Input.

VCO A 1V/OCTAVE CV IN: Bipolar pitch control for VCO A. Optimal range: +/-5V.

VCO A LINEAR CV IN & ATTENUATOR: Unipolar linear frequency CV input for VCO A. AC coupled. Normalled to FM Bus. Range: 10V. The associated **Linear Attenuator** acts as a unipolar level control for the Linear CV Input.

FM BUS ROTARY, INDEX CV IN, ATTENUATOR & LED: The **FM Bus Rotary** is a unipolar control that sets the depth of the FM. The **FM Bus Index CV Input** is a bipolar CV input. Range: +/-4V. The **FM Bus Index Attenuator** acts as a bipolar level control for the FM Bus Index CV Input. The **FM Bus Index LED** provides visual indication of the currently programmed FM Index value.

VCO B LINEAR CV IN, LINEAR ATTENUATOR & EXTERNAL LOCK IN: Unipolar linear frequency CV input for VCO B. AC coupled. Normalled to FM Bus. Range: 10V. The associated **Linear Attenuator** acts as a unipolar level control for the Linear CV Input. **External Lock In** allows VCO B to be phase locked to a hard-edged signal (square, pulse or Sawtooth) from other VCOs.

VCO B 1V/OCTAVE CV IN: Bipolar pitch control for VCO B. Optimal range: +/-5V.

MOD BUS INDEX ROTARY, EXTERNAL SOURCE IN, INDEX IN, ATTENUATOR & LED: The **Mod Bus Index Rotary** is a unipolar control that sets the depth of the Mod Bus. The **Mod Bus External Source Input** interrupts internal routing of VCO A sine wave as a modulation source. Range: +/- 8V. The **Mod Bus Index CV Input** is a bipolar CV input signal. Range: +/- 4V. The associated **Mod Bus Index Attenuator** acts as a bipolar level control for the Mod Bus Index CV Input. The **Mod Bus Index LED** provides visual indication of the currently programmed Mod Index value.

VCO B EXPONENTIAL CV IN & ATTENUATOR: Bipolar exponential frequency CV input for VCO B. Normalled to FM Bus. Range: 10V. The **Exponential Attenuator** acts as a unipolar level control for the CV Input.

VCO B COARSE TUNE ROTARY & VCO B 1V/OCT SCALE TRIM: Controls coarse tuning for oscillator B frequency. Range: 9.5 octaves; 12hz-6khz. The **1V/Octave Scale Trim** control is used to calibrate VCO B.

ANGLE ROTARY, ANGLE CV IN & ATTENUATOR: The **Angle Rotary** tilts the added harmonics to either end of the wave-cycle. The **Angle CV In** is a bipolar control signal input normalised into the Mod Bus. Range: 8V. The **Angle Attenuator** is a unipolar level control for the Angle CV Input.

VCO B FINE TUNE ROTARY: Controls fine tuning for oscillator B frequency. Range: 1.75 octaves.

FOLD ROTARY, FOLD CV IN, FOLD ATTENUATOR & STRIKE GATE IN: The **Fold Rotary** is a unipolar control that continuously varies the low-order harmonics of the signal by folding the waveform into itself. **Fold CV In** is a unipolar control signal input normalised into the Mod Bus. **Fold Attenuator** is a unipolar level control for the Fold CV Input. The **Strike Gate In**, when patched, briefly opens the Fold circuit to 100%. Requires an 8V - 10V gate or clock to operate.

Follow: Follow is useful in maintaining FM or Sync ratios while controlling the DPO with a sequencer or keyboard. The lag that occurs when Follow is set to less than 100% will introduce moments of dissonance and noise, due to the temporary tracking errors. This is a wonderful way to introduce uncertainty to an otherwise stable sequence of notes.

FM Bus: The internal FM bus is hardwired for Sine wave in both directions. With nothing patched to the Linear and/or Expo FM inputs, the associated attenuator sets the final index of FM applied to each destination. As you increase the Index level, the amplitude of VCO A sine bused to VCO B Linear FM and Expo FM attenuators is increased. At the same time, the amplitude of VCO B sine bused to VCO A Linear FM and Expo FM attenuators is increased. Therefore, you could have different amounts of Linear and Expo FM in both directions, all at once. At greater than 90% Index, all four FM bus lines (Linear & Expo for both VCOs) go into overdrive when the associated attenuators are set to beyond about 80%. The FM overdrive, combined with the bi-directional dynamic FM, results in some extreme circular FM capabilities. These sounds will get out of hand quickly. The key to controlled FM within the DPO is attenuation, since setting the Index to 100% really does push the circuit to its limit.

Mod Bus: The internal Mod Bus Source is hardwired for VCO A Sine wave, with the power to use any external source by patching to the External Source CV In. With nothing patched to the Shape, Angle and Fold CV inputs the associated attenuator sets the final amount of modulation applied to the destination. As you increase the Index level, the amplitude of VCO A Sine bused to the Shape, Angle and Fold jacks is increased. Therefore, you could have different amounts of modulation at each of those three destinations (Shape, Angle, and Fold).

