

Moog Liberation Technical Informations

CIRCUIT DESCRIPTION

The Liberation is a monophonic synthesizer with an additional polyphonic tone generator designed for portable operation. The unit consists of the instrument which houses the synthesizer and a power supply box with external synthesizer interface and audio output. The units connect by a multiconductor cable.

NOTE

Prefix reference designators on keyboard schematic are 1000. Prefix reference designators on control board schematic are 2000. Buffer numbers include pin numbers.

KEYBOARD CIRCUIT

The Liberation has a 44F to C high note priority keyboard with linear glide. U1014-A feeds a constant 0.83mA through the keyboard resistors to produce 1 volt per octave. Since the top of the keyboard is maintained at 3.3 volts, the keyboard voltage output is the highest note depressed. The "Kb'd Scale Trim" R1109 adjusts the voltage drop across the keyboard for 1 volt per octave.

When any key is depressed, the voltage corresponding to that note appears at R1111 and charges C1026. U1024B, Q1024, and U1424A form a linear glide and sample-and-hold circuit. When any note is depressed, a trigger from the trigger extractor turns on Q1024 closing the feedback loop around U1024A and U1024B so the output of U1024A will track the voltage across C1026. The GLIDE control R2033 affects the charging time of C1032 and C1033 putting a lag in the control loop. As the value of R2033 is increased, the output of U1024A will glide between notes. GLIDE switch SW1001 shorts GLIDE control R2033 to eliminate the glide function. CR1005 and CR1006 equalize the glide time from bottom to top and from top to bottom of the keyboard.

When all keys are released, the trigger to Q1024 disappears, turning Q1024 off. C1032 and C1033 hold the voltage of the last note released. The output of U1024A is fed to the FILTER "RACKING" switch SW2011 and the oscillator summer U1014B. U1014B sums the keyboard voltage, the pitch bend ribbon, the SYNTH TUNE control R2058, oscillator modulation and forte and applies the signal to control both oscillators. The output of U1014B also goes down the interface cable to the external synthesizer interface.

POLYPHONIC TONE GENERATOR

The polyphonic tone generator is based on typical organ divider technology. VCO U1016 forms the high frequency master oscillator. The output of U1016 goes to U1017 which synchronizes the upper octaves on the keyboard. Dividers U1018 through U1023 generate the lower octaves using simple frequency divider techniques. All outputs feed summing resistors R1134 through R1177. When any key is depressed, the feed resistors for that key is connected to the keyboard which feeds summer U1015 and that note appears at the output. POLY TUNE control R2001 adjusts the frequency of the master oscillator which transposes all the notes of the polyphonic section. Poly Frequency Trim" R1119 sets the master frequency of the master oscillator.

POWER SUPPLY AND GROUNDING

The Liberation is powered from regulated ± 15 volts supplied from the Interface/Power Supply box

through the instrument cable. U1031 and U1032 convert the ± 15 volts to ± 12 volts. The safety ground wire is used for a signal ground reference for the interface box to minimize noise and hum.

FORCE SENSOR

The force sensor consists of a photoelectric sensor in the keyboard and a voltage controlled amplifier. Attached to the keyboard is an aluminum bar with a small metal vane that sits between a LED-phototransistor interrupter pack. With no keys depressed, the vane shades the phototransistor resulting in no output on the emitter of the phototransistor. When any key is depressed and force applied, the vane opens and light reaches the phototransistor. The more force applied, the more light reaches the phototransistor and the higher the output voltage.

The output of the force sensor controls the gain of VCA U1027. The input of the VCA is selected by FORCE SELECT switch SW1005 to be either a DC control voltage (bend) or the modulator voltage from MOD AMT control R1229. Therefore, the force signal controls the output amplitude of the selected signal. The output of the VCA is buffered by U1028B, fed to the FORCE AMOUNT potentiometer R1228, and then to MOD OSC switches SW2008 and MOD FILTER SW2009.

Since the metal vane does not completely shade the phototransistor, "Force Sensor Threshold Trim" R1183 adjusts the base voltage on Q1027 to guarantee the VCA is off when no force is applied. FORCE OFFSET R1194 adjusts the output offset of the VCA to zero to eliminate pitch shifts when the modulation switch is put into the force position.

RING MODULATOR

The ring modulator consists of an exclusive "OR" gate fed by a square wave from Oscillator 1 and Oscillator 2. U1004B generates a square wave from Oscillator 1 for one input of the exclusive "OR" gate in U016. The square wave from Oscillator 2 comes from U1012B and is buffered by Q1023 for the second input. The ring modulator signal from pin 9 of U1016 is fed directly to RING MOD potentiometer R2003 and then to the VCF.

OSCILLATORS 1 AND 2

Each oscillator consists of a temperature regulated current source, a precision sawtooth oscillator, triangle converter, and a pulse generator. Since Oscillator 2 is almost identical to Oscillator 1, Oscillator 1 will be described fully and the minor differences in Oscillator 2 noted later.

The exponential voltage to current converter consists of Q1001, reference voltage source Q1002 and matched resistor network N1002A, and temperature regulator Q1003, U1003B, Q1006, and Q1004.

The formula for the current through the collector of Q1001 equals:

$$I_{CQ1} = (I_{REF}) \frac{V_{in}}{e \cdot VT}$$

Where:

I_{REF} = current through Q1002

$VT = kT/28mV$ at room temperature

$$V_{in} = V_{BEQ1001} - V_{BEQ1002}$$

The reference current is maintained by U1003A. U1003A senses the voltage drop across R1017 and R1018 and pulls current out of the emitter of Q1002 to maintain this voltage drop at 11 volts. From the formula, the current through Q1001 is directly proportional to the reference current. Resistor network N1001 arranges resistors R1017 and R1018 to provide exact octave changes in the reference current which causes octave changes in the current from Q1001.

For every 20mV increase in voltage on the base of Q1001 or for every 20mV decrease on the base of Q1002, the current through Q1001 doubles. R1004, R1005 and R1006 scale the input to the standard 1 millivolt octave keyboard voltage. "Osc 1 Freq Trim" R1014 sets the oscillator frequency by offsetting the current source. U1002 prevents the reference current loop from self oscillating.

Since temperature changes affect the scale factor (volts per octave) and therefore keyboard tuning, Q1001 and Q1002 are in a transistor array which is maintained at 55°C by a temperature regulating loop heated by Q1004. The more current pulled from Q1004 by Q1006, the higher the chip temperature. Q1003 is an electronic thermometer with a 2mV per degree centigrade temperature coefficient. U1003A compares the chip temperature with the desired temperature set on "Osc 1 Temp Trim" R1001. U1003B then adjusts the drive to Q1006 to maintain the correct temperature.

The oscillator consists of voltage source U1006A, timing capacitor C1011, buffer U1004, comparator U1007A, and electronic switch Q1010. As was stated before, the linear keyboard voltage produces a current through Q1001 that varies at 1 volt per octave. This current charges C1011 producing a downward linear ramp starting at 6 volts. U1006 follows the voltage on C1011. When the voltage on U1006 reaches zero volts, the output of U1007A lumps to 6 volts for approximately 1µsec. This turns Q1010 on for 1 µsec, discharging C1011 to 6 volts. Q1010 then turns off again, the process repeats, and a sawtooth waveform appears on U1005.

Q1008 and Q1009 convert the sawtooth to a triangle wave. When the sawtooth is below 3 volts, Q1009 acts as a simple inverter. Above 3 volts, Q1009 converts the sawtooth to a triangle wave. U1006A amplifies and offsets the output of Q1009 to produce a 6 volt triangle. Q1008 compensates for the V_{BE} drop of Q1009. The sawtooth is converted to a 6 volt, 90% duty cycle pulse by comparator U1007B. The pulse output is buffered by Q1007.

All three waveforms are routed to WAVEFORM SEL. 1 switch SW2003 and the selected waveform is routed to OSC 1 level control R2029.

There are a few adjustments for Oscillator 1. "Osc 1 Scale Trim" R1005 sets the volts per octave and "Osc 1 Freq Trim" R1014 sets the reference frequency (transposes the keyboard). Since the exponential current source goes flat at higher currents, "Osc 1 Hi Freq Trim" R1054 compensates the oscillator to correct the tuning error resulting from this effect.

As stated before, Oscillator 2 is almost identical to Oscillator 1 but differs in the following areas: INTERVAL potentiometer R2001 varies the frequency of Oscillator 2; a fifth from Oscillator 1, Oscillator 2 is tuned an octave higher than Oscillator 1, Oscillator 2 can be synchronized to Oscillator 1 and the pulse width is a 50% duty cycle square wave.

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The INTERVAL potentiometer R2001 is connected through dead band diodes CR1001 and CR1002 and Q1071 and Q1016. Therefore, R2001 transposes Oscillator 2, CR1001, CR1002 and R1074 provide increased resolution around 0 to ease tuning the oscillator for small beat rates.

Since Oscillator 2 has a timing capacitor C1022 which is half the value of Oscillator 1, Oscillator 2 is tuned to octaves higher.

The sync function is provided by U1004A, OSC SYNC switch SW2005, Q1017, and Q1018. The saw-tooth reset pulse is differentiated by U1005, R1027, and R1028 producing a positive pulse at U1004A-2. When the OSC SYNC switch SW2005 is OFF, U1004A-3 is at +6 volts, U1004A-1 is at 12V, Q1017 is off, Q1018 is off and Oscillator 2 runs normally.

When OSC SYNC switch SW2005 is ON, every time Oscillator 1 resets a +6 volt pulse appears at U1004A-1. This fires Q1017 which fires Q1018, discharging C1022. This locks Oscillator 2's fundamental frequency to Oscillator 1. OSC SYNC switch SW2005 also routes the output of the FORCE AMOUNT potentiometer R1228 to Oscillator 2 for sync bending effects.

Comparator U1012B generates a 50% duty square wave from the sawtooth on U1011.

MODULATION OSCILLATOR AND SAMPLE HOLD

The modulation oscillator is a standard operational amplifier triangle and square wave generator followed by a waveform selector switch, sample hold/ buffer, and modulation wheel.

U2003B produces both a 3 volt triangle and a 2.4V pp volt square wave with MOD RATE control R2040 controlling the modulation frequency. Both waveforms are routed to MOD SHAPE switch SW2007. SW2007 also feeds the square wave to a differentiator C2008 and R2049 to produce a 100 usec sampling pulse for the sample-hold.

When MOD SHAPE switch SW2007 is set to the sample-hold mode, the 100 usec sampling pulse fires Q2001 sampling the noise voltage on U2002A. This produces a random voltage across C2009 which varies at the modulation rate. U2003A buffers the switch and feeds the modulation signal to the MODULATION AMOUNT potentiometer R1229 and FORCE SELECT switch SW1002. R1229 feeds MOD OSC switch SW2008 and MOD FILTER switch SW2009 for selection of oscillator and/or filter modulation.

U2003B also drives the RATE LED L1 and TRIG switch SW2006 through Q2002.

NOISE GENERATOR

Noise is generated by pseudo random digital noise generator U2001. The white noise output is fed through a 3dB/octave filter to produce pink noise. The pink noise output is amplified by U2002B and routed to the NOISE LEVEL control R2050 for an audio feed. The noise voltage is also filtered by R2028 and C2036, buffered by U2002A and fed to the sample-hold switch Q2001 to produce a random modulation voltage. R2032, R2031, and CE2001 limit the negative excursions of C2006 to prevent accidental turns on of Q2001.

TRIGGER EXTRACTOR

The output of the polyphonic summer U1015 is fed to U2004A when any key is depressed. U2004A pulls C2001 to the negative rail causing U2004B to fire, generating a V-trigger at U2004B-7. The time constant of C2001 and R2012 is long enough to keep the voltage on U2004B below the trigger threshold as long as any note is depressed, resulting in a constant trigger as long as any note is held down.

ENVELOPE GENERATORS

The Liberation has two independent envelope generators, one for the VCA and one for the VCF. Each envelope generator has three controls: Attack time, Decay/Release time, and Sustain level. RELEASE switch SW2010 activates the release time. Since both envelope generators are identical the operation of the one for the VCA will be the only one discussed.

The envelope generator is activated by a V-trigger from the trigger extractor. This V-trigger is routed to trigger generator Q2003 and Q2008 producing an S-trigger, and a buffered V-trigger. C2013 and R1085 produce a 200 usec S-trigger pulse with every V-trigger. R2086 feeds a trigger current down the cable for the external synthesizer interface.

The S-trigger from Q2003 turns switch U2005C off which removes the discharge path of C3010. The V-triggers from Q2008 and the S-trigger pulse from Q2003 activates the Dual Timer U2008. This puts -12 volts at pin 5 of U2008 which is inserted by U2005A. This grounds pin 3 of U2008B which turns the P-channel FET on, charging C2010 through the ATTACK TIME potentiometer R2060 and resistor R2067. The value of R2065 sets the charging time of C2010 and therefore the attack time. The voltage on C2010 is buffered by U2007B. When the voltage at the output of U2007B reaches -7 volts, U2008 changes from attack to decay. Pin 5 of U2008 drops to ground, which turns the P-channel of U2005B off and the N-channel on. C2010 is discharged through R2067 and DECAY/RELEASE control R2066 to the sustain voltage on the emitter of Q2004. The voltage at this point varies between 0 and 7 volts depending on the setting of the VCA SUST control, R2071. As long as any key on the keyboard is depressed, C2010 will hold at the sustain voltage.

When all the keys on the keyboard are released, the trigger generator returns to normal and U2008 is reset back to zero. With the RELEASE switch SW2010 in the OFF position, C2010 is discharged very quickly to ground through R2064. In the ON position, C2010 is discharged through DECAY/RELEASE control R2066 and therefore the release time equals the decay time.

The output of the top envelope generator is routed to the VCA to control loudness. The bottom envelope generator is routed to the VCF to control cutoff frequency.

VCF

The Liberation uses the patented Moog 24dB per octave lowpass filter with exponential control of cutoff frequency. A positive feedback loop is provided which sets a variable height resonance peak at the cutoff frequency of the filter. The filter can also be used as a sine wave oscillator.

The output of all sound sources are summed, attenuated and applied to the base of Q1034. Q1034 and Q1035 convert the input signal into a differential

signal current in the ladder. The collectors, capacitors, and the next emitters form a 1 pole current controlled lowpass filter. The cutoff frequency of the filter is directly proportional to the standing current in each leg of the ladder. The four stages in the ladder add up to a 4 pole lowpass filter.

The differential signal voltage is buffered by an AC coupled differential Darlington stage consisting of Q1038, Q1039, Q1040 and Q1041. The signal is routed to the VCA, U1030, and to the emphasis amplifier U1026B. U1026A converts the differential voltage into a single ended output which is applied to the EMPH potentiometer R2034.

Since the total phase shift equals 180° at the cutoff frequency of the filter and the feedback signal is injected into the minus input of the filter, we get positive feedback. This puts a resonance peak at the cutoff frequency of the filter. The height of the peak depends on the setting of the EMPH potentiometer R2034. At full emphasis, the filter will oscillate producing a sine wave. "Emph Trim" R1224 sets the oscillation threshold.

As stated before, the cutoff frequency of the filter is controlled by the standing current in the filter. The standing current is generated by Q1043 and Q1044, a poor man's exponential voltage to current converter. For every 10mV increase in base voltage on Q1043 the current through Q1044 doubles, resulting in an exponential control response.

The control signals for cutoff frequency are generated in many circuits. CUTOFF frequency control R2060 allows manual setting of the cutoff frequency from the front panel. The FILTER TRACKING switch SW2001 allows the filter to track the keyboard in 1:2 scale (2 octaves of keyboard movement per octave of filter movement) or full scaling with scale set by "Filter Scale Trim" R1207. Modulation is routed through the contour. The VCF contour generator is muted to the AMOUNT control R2062 allowing the envelope waveform to sweep the filter. The neck FILTER CUTOFF R1230 also controls the cutoff frequency. Modulation is routed through MOD FILTER switch SW2009 for modulation of cutoff frequency.

VCA

The VCA uses an operational transconductance amplifier as a control element. U1030 takes the differential signal voltage from the VCF and amplifies it. The gain of U1030 is proportional to the current flowing into pin 5. This current is supplied by Q1042 which is controlled by the VCA envelope generator.

The amplified voltage appears across VOLUME control R1227 and buffered by U1025B. The output of U1025B is routed to the interface box for the main audio output. "VCA Bal Trim" R1211 compensates for the input offset on U1030 to reduce control signal bleed-through.

POWER SUPPLY/INTERFACE

The Power Supply/Interface consist of four parts: a ± 15 volt regulated power supply, an audio output, an S-trigger generator, and a keyboard control voltage output.

The ± 15 volt power supply consists of the following: a 115/230 volt transformer, a full wave bridge, and 2 three-terminal regulators. The AC line voltage is routed through POWER switch SW1, an appropriate line fuse F1 and then to transformer T1. T1's primary windings are wired in parallel for 115

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volt operation and wired in series for 220 volt operation. Transformer T1, diodes CR1 through CR4 and capacitors C1 and C2 convert the line voltage to ± 23 volts r.m.s. DC. The r.m.s. ± 23 volts is passed through a preset 15 volt regulator U1. Resistors R3 and R1 boot strap the output of U1 to a nominal 15.5 volts to compensate for line voltage drops in the interface cables. Diode CR5 provides reverse polarity protection. The U2 provides 15.5 volts. Both regulation supply power for the instrument and all the rest of the circuitry in the interface box.

Audio from the instrument is routed directly through resistor R18 and capacitor C10 to AUDIO OUT jack J1. R18 and C10 provide output protection and AC coupling respectively.

The trigger generator consists of a summing amplifier, inverter and S-trigger drive transistor. The voltage trigger generated in the instrument is converted to a current using a 50K ohm resistor and sent down the interface cable. A trigger current is used to minimize crosstalk into the audio output. With no trigger current, the output of U2A is approximately 6 volts. This turns Q1 on and Q2 off. When the 630 microsecond trigger current is applied to U2A, U2A flips to -6 volts, Q1 turns off and Q2 turns on generating an S-trigger.

The inverted control voltage (keyboard, pitch ribbon and modulation) from the instrument is routed through resistor R15 and SCALE control R20 and then inverted by U3B. SCALE control R20 adjusts the output to 1 volt/octave. RANGE control R21 adjusts the output offset.

ALIGNMENT PROCEDURE

INTRODUCTION

All trim adjustments can be made on the Keyboard Circuit Board by removing the base plate. Component reference designations on this board, as well as the instrument neck, are prefixed by "1000." Those on the Control Circuit Board are prefixed by "2000." The adjustments should be performed in the order presented below to minimize interactions.

CHIP TEMPERATURE ADJUSTMENT

NOTE

This adjustment should be made at an ambient temperature of 73°F (22°C) if possible. If not, use the appropriate correction factor described in Table 1.

a) Before applying power to the instrument apply a short across R1010 and apply a separate short across R1086. If power has already been connected, short out both resistors and allow a five minute warm-up period before making the next measurement.

b) Measure the voltage at pin 5 of U1003B with DVM on 1.000V scale. Note reading.

c) Remove short across R1010 and adjust "Osc 1 Temp Trim" R1001 until DVM reads 60mV below original reading. Wait 30 seconds and readjust if necessary. If ambient temperature is different from 73°F, use the following table:

TABLE 1 CORRECTION FACTOR

°F	°C	mV DROP
62	16	70
67	19	65
72	22	60
77	25	55
82	28	50

4) Repeat procedure for Osc 2 Temp Trim adjustment except:

1. Use pin 5 of U1010B for voltage measurement.
2. Remove short on R1056 and adjust for correct voltage drop using "Osc 2 Temp Trim" R1057.

KEYBOARD SCALE ADJUSTMENT

- a) Set GLIDE control R2033 at minimum.
- b) Monitor voltage at pin 1 of U1029A with DVM.
- c) Alternately depress low F and high C keys.
- d) Adjust "Kybd Scale Trim" R1109 for 3.583 VDC difference to achieve 1 volt/octave scale factor.

POLY TUNE ADJUSTMENT

- a) Set POLY TUNE control R2002 at electrical center.
- b) Monitor frequency of pin 12 of U1017 with Frequency Counter.
- c) Adjust "Poly Freq Trim" R1119 for 880Hz (High A).

OSCILLATOR 1 SCALE, FREQUENCY AND HI END ADJUSTMENTS

- a) Allow unit to warm up for 15 minutes before making these adjustments.

NOTE

One method of scaling the oscillators is to use the Polyphonic section as a tuning reference.

b) Set the following controls:

1. Master VOLUME R1227	maximum
2. SYNTH TUNE R2054	electrical 0
3. GLIDE R2033	minimum
4. MOD OSC SW2908	OFF
5. OSC SYNC SW3005	OFF
6. Osc OCTAVE 1 SW2001	-2
7. OSC 1 mix R2029	minimum
8. POLY mix R2006	maximum
9. CUTOFF control R2068	maximum
10. EMP1 R2034	minimum
11. VCA SUST R2071	maximum

c) Center the following potentioms:

1. "Osc 1 Freq" R1014
2. "Osc 1 Scale" R1005
3. "Osc 1 Hi Freq" R1052

d) Monitor audio output at pin 7 of U1025B.

e) Depress and hold high A. Set POLY TUNE control R2002 for 880Hz output frequency.

f) Set OSC 1 mix control R2029 to maximum.

g) Depress and hold high A. Zero beat against Poly Output such that Osc 1 frequency is 440Hz using "Osc 1 Freq Trim" R1014.

h) Depress and hold low A and zero beat such that Osc 1 frequency is 55Hz using "Osc 1 Scale Trim" R1005.

i) Repeat steps g) and h) until perfect three octave spread is obtained.

j) Change Osc OCTAVE 1 switch SW2001 to 0 range. Depress and hold low A and zero beat such that Osc 1 frequency is 220Hz using "Osc 1 Freq Trim" R1014.

k) Depress and hold high A and zero beat such that Osc 1 frequency is 1760Hz using "Osc 1 Hi Freq Trim" R1052.

l) Repeat steps j) and k) until perfect three octave spread is obtained.

m) Repeat steps e) through l) until tuning is satisfactory on all ranges.

n) Center SYNTH TUNE control R2054. Set OCTAVE 1 switch SW2001 to -1. Depress and hold high A and use "Osc 1 Freq Trim" R1014 to set frequency to 880Hz.

OSCILLATOR 2 SCALE, FREQUENCY AND HI END ADJUSTMENTS

a) Allow unit to warm up for 15 minutes before making these adjustments.

b) Set controls same as for Oscillator 1 with the following exceptions:

1. Osc OCTAVE 1 switch SW2002 -1
2. OSC 2 mix R2030 minimum
3. INTERVAL R2001 electrical 0

c) Center the following trim pots:

1. "Osc 2 Freq" R1075
2. "Osc 2 Scale" R1065
3. "Osc 2 Hi Freq" R1103

d) Monitor audio output at pin 7 of U1025B.

e) Depress and hold high A. Set POLY TUNE control R2002 for 880Hz output frequency.

f) Set OSC 2 mix control R2030 to maximum.

g) Depress and hold high A. Zero beat against Poly Output such that Osc 2 frequency is 880Hz using "Osc 2 Freq Trim" R1075.

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h) Depress and hold low A and zero beat such that Osc 2 frequency is 110Hz using "Osc 2 Scale Trim" R1085.

i) Repeat steps g) and h) until perfect three octave spread is obtained.

j) Change Osc OCTAVE 2 switch SW2002 to +1 range. Depress and hold low A and zero beat such that Osc 2 frequency is 440Hz using "Osc 2 Freq Trim" R1075.

k) Depress and hold high A and zero beat such that Osc 2 frequency is 3520 Hz using "Osc 2 Hl Freq Trim" R1103.

l) Repeat steps j) and k) until perfect three octave spread is obtained.

m) Repeat steps e) through i) until tuning is satisfactory or all ranges.

n) Center SYNTH TUNE control R2044 and INTERVAL control R2001. Set Osc OCTAVE 2 switch SW2002 to 0. Depress and hold high A using "Osc 2 Freq Trim" R1075 to set frequency to 1763Hz.

FILTER SCALE, EMPHASIS, AND CUTOFF FREQUENCY ADJUSTMENTS

NOTE

Filter drift is normal and not a problem due to the fact that the VCF is not temperature compensated.

a) Set the following controls:

- | | |
|---|--------------|
| 1. GLIDE R2033 | minimum |
| 2. MOD FILTER SW2009 | OFF |
| 3. All mixer controls (R2029, R2030, R2020, R2003, R2006) | minimum |
| 4. Filter CUTOFF R2060 | electrical 0 |
| 5. EMPH R2034 | maximum |
| 5. AMOUNT R2062 | minimum |
| 7. FILTER TRACKING SW2011 | OFF |
| 8. VCA SUST R2071 | maximum |

b) Center the following trim pots:

1. "Freq Trim" R1202
2. "Filter Scale" R1205
3. "Emph Trim" R1224

c) Depress and hold low F. Verify filter is oscillating at audio output. If not, adjust "Emph Trim" R1224 until oscillation occurs.

d) Adjust Filter "Freq Trim" R1202 until frequency of oscillation is 660Hz ± 5Hz, measured at pin 7 of U1025B.

e) Adjust "Emph Trim" R1224 until sine wave oscillation at pin 1 of U1026A is -23dBm ± 3dBm.

f) FILTER TRACKING switch SW2011 to full.

g) Depress and hold low A. Using filter CUTOFF control R2060 zero beat filter against external oscillator, set to 3520Hz, such that filter frequency is 440Hz.

h) Depress and hold high A. Zero beat such that filter frequency is 3520Hz using "Filter Scale Trim" R1207.

i) Repeat steps g) and h) until satisfactory three octave spread is obtained. Note: Due to variations of voltage offsets in the filter circuit, it may be necessary to first tune high A with the filter CUTOFF control R2060 then tune low A with the "Filter Scale Trim" R1207. Repeat these steps until acceptable scale is obtained.

j) Reset filter CUTOFF control R2060 to electrical zero and FILTER TRACKING switch SW2011 to OFF.

k) Using filter "Freq Trim" R1202 reset filter frequency to 660Hz ± 10Hz while depressing low F.

VCA BALANCE ADJUSTMENT

a) Set the following controls:

- | | |
|---|---------|
| 1. TRIG SW2006 | ON |
| 2. MOD RATE R2040 | maximum |
| 3. Mixer controls (R2029, R2030, R2020, R2003, R2006) | minimum |
| 4. CUTOFF control R2060 | maximum |
| 5. EMPH R2034 | minimum |
| 6. AMOUNT R2062 | minimum |
| 7. RELEASE SW2010 | OFF |
| 8. VCA ATTACK R2065 | minimum |
| 9. VCA DECAY/RELEASE R2066 | minimum |
| 10. VCA SUST R2071 | minimum |
| 11. VOLUME R1227 | maximum |

h) Monitor pin 7 of U1025B.

c) Adjust "VCA Bal Trim" R1214 for minimum output level.

FORCE SENSOR THRESHOLD ADJUSTMENT

NOTE

Before making this adjustment, ambient light must be shielded from the keyboard force sensor photo interrupter.

a) Connect DVM between junction R186/R187 and junction R190/R191.

b) Adjust "Force Sensor Threshold Trim" R1193 for 0.000 VDC ± .010 VDC (with no keys depressed).

FORCE SENSOR OFFSET ADJUSTMENT

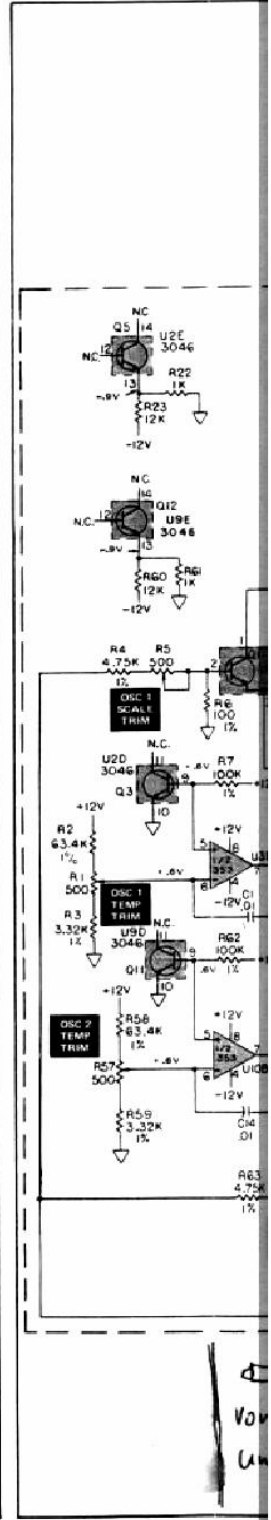
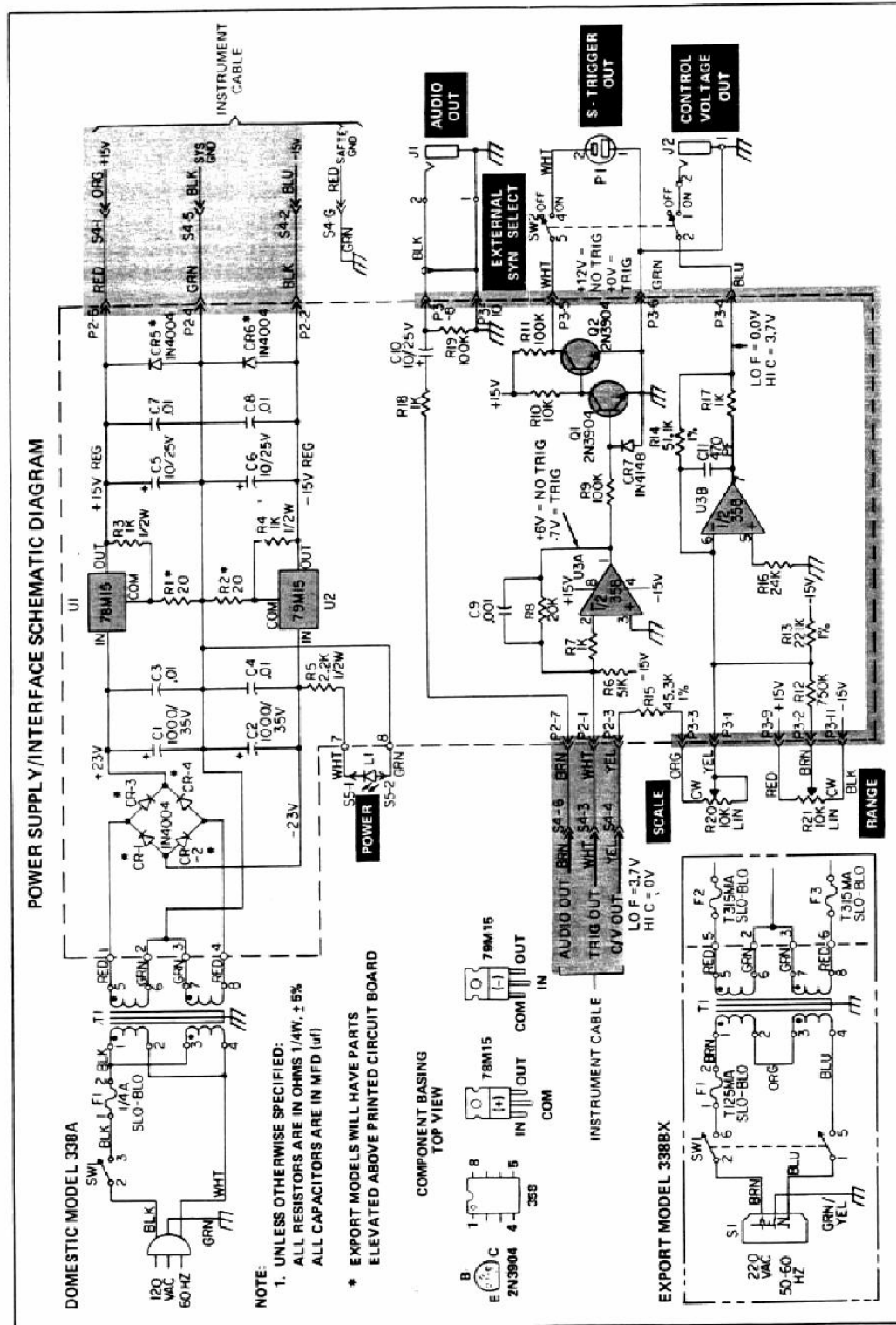
a) Measure voltage at pin 7 of U1026B with DVM.

b) Adjust "Force Offset Trim" R1184 for 0.000 VDC ± .001 VDC (with no keys depressed).

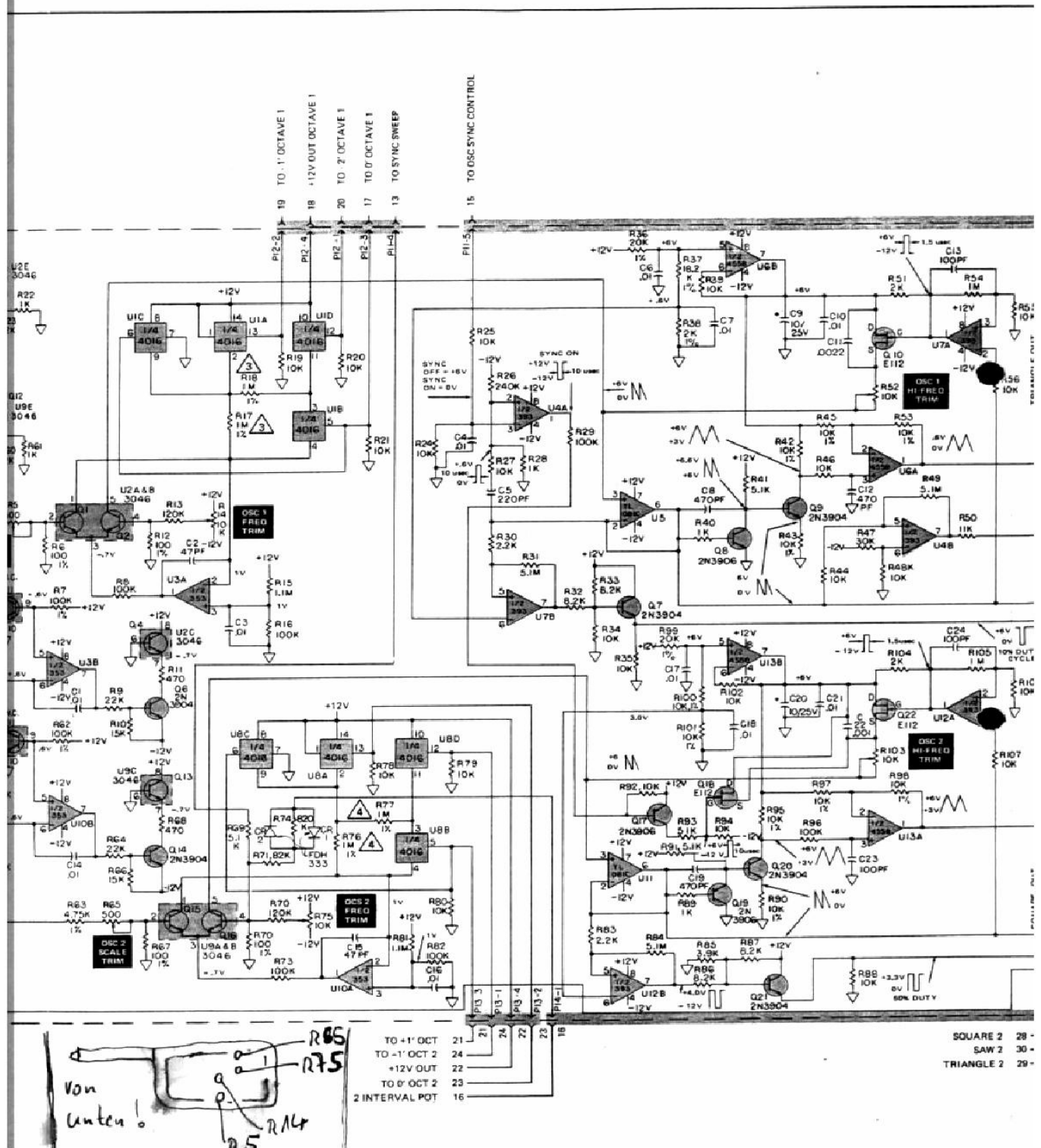
POWER SUPPLY INTERFACE PRINTED CIRCUIT BOARD ASSEMBLY SELECTED REPLACEMENT PARTS LIST

REF DESIG	PART NUMBER	DESCRIPTION	QTY
C1, C2	945-040209-0-1	Capacitor, Aluminum Electrolytic, 1000µf, 35V	2
C5, C6, C10	945-040209-0-01	Capacitor, Aluminum Electrolytic, 10µf, 25V	3
*F1, F2	030-044004-0-1	Fuse, T315MA, Slo-Blow 5X20MM	2
CR1 thru CR6	019-042019-0-01	Diode, Rectifier, 1N4004	6
CR7	019-041075-0-01	Diode, Signal, 1N4148	1
F3	010-040209-0-01	Connector, DIS, PC Header, 7 Pin, 1 Center	1
F9	010-040209-0-1	Connector, DIS, PC Header, 11 Pin, 1 Center	1
Q1, Q2	891-041051-0-01	Transistor, NPN, 2N2904	2
U1	991-041112-0-03	Integrated Circuit, Voltage Regulator, 3 Terminal, +15V, 700M15	1
U2	991-044378-0-02	Integrated Circuit, Voltage Regulator, 3 Terminal, -15V, 700M15	1
U3	991-041084-0-01	Integrated Circuit, Dual Operational Amplifier, 358	1
	*906-043605-0-01	Chip Fuse, PCB Mount, 5X20MM	4
	967-040935-0-01	Heat Sink	2

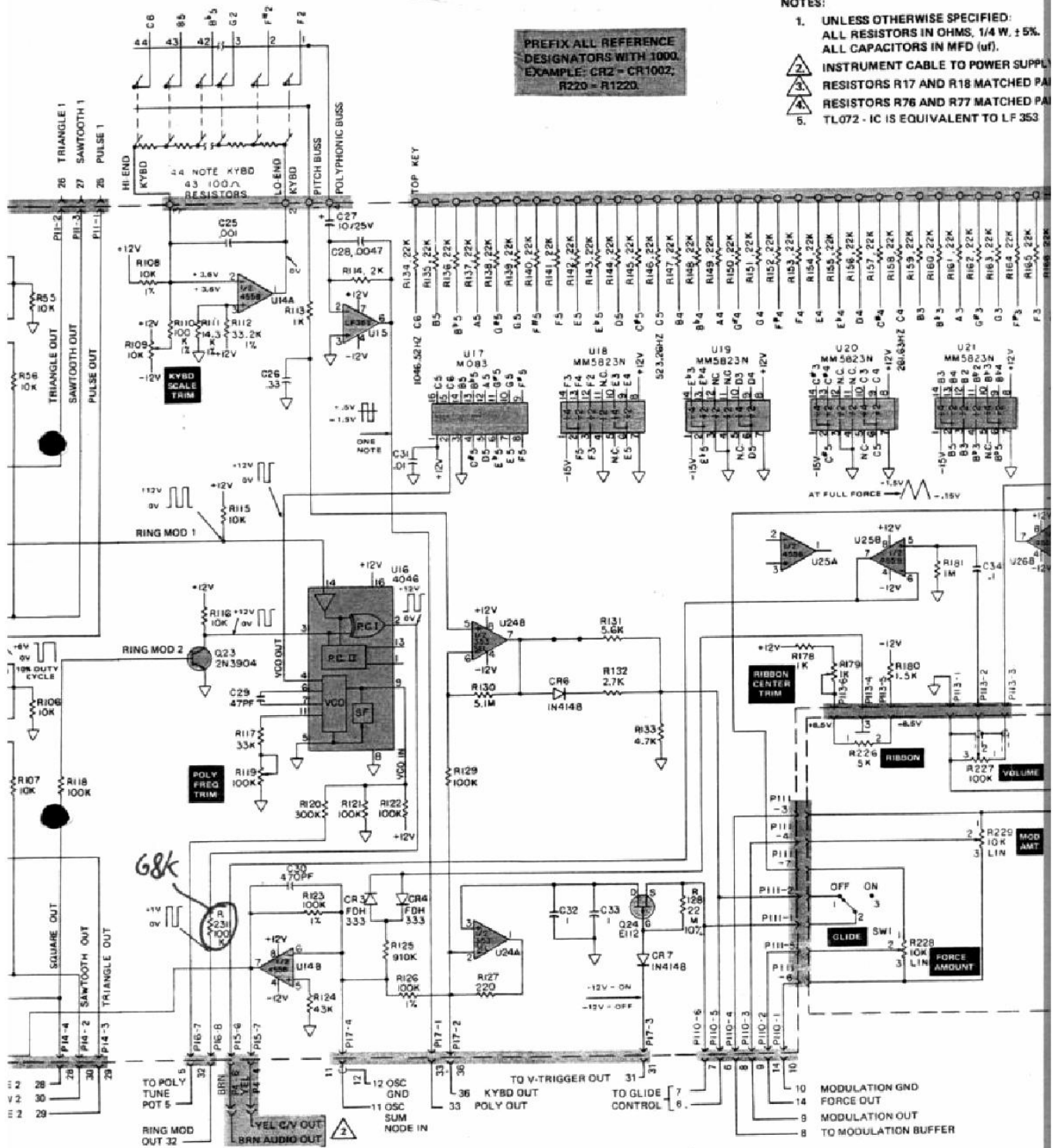
* Export Model Only



Moog Liberation Technical Informations



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PREFIX ALL REFERENCE DESIGNATORS WITH 1000. EXAMPLE: CR2 - CR1002. R220 - R1220.

- NOTES:
1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS IN OHMS, 1/4 W, ± 5%. ALL CAPACITORS IN MFD (uf).
 2. INSTRUMENT CABLE TO POWER SUPPLY
 3. RESISTORS R17 AND R18 MATCHED PAIR
 4. RESISTORS R76 AND R77 MATCHED PAIR
 5. TL072 - IC IS EQUIVALENT TO LF 353

