NO. 993-044595-001

TECHNICAL SERVICE INFORMATION for

moog LIBERATION

DOMESTIC MODEL 338A
EXPORT MODEL 338BX

MOOG MUSIC INC.
2500 Walden Avenue, Buffalo, New York 14225
NORLIN MUSIC INSTRUMENTS LIMITED
161 Alden Road, Markham, Ontario, Canada L3R 3W7
MOOG MUSIC B.V.
Waalhaven Zuidzijde 48, 3088 H.J., Rotterdam, The Netherlands

DISASSEMBLY PROCEDURES

> **CAUTION**
>
> Before proceding with disassembly, take special care to protect the finished wooden portions of the instrument from damage from sharp objects. The use of carpeting or styrofoam is recommended.

KEYBOARD CIRCUIT

1. To gain access to the keyboard circuit, remove the bottom cover by removing the eight screws and cup washers. This will provide the capability to troubleshoot the oscillator, the keyboard circuit, 12 volt regulator, VCA, VCF, force sensor and circuitry associated with the left-hand controller.

2. The board may be completely loosened by removing the four screws and lock washers along the center of the printed circuit board and connectors S19, S110, S111 and S113. This yields access to the keyboard contacts.

3. The force sensor may be removed by loosening the printed circuit board and removing the two mounting screws of the opto-interrupter at the center of the keyboard.

CONTROL BOARD

1. The control board assembly may be disassembled by removing the two 10-32 3/4" screws and washers at each end of the top assembly. To completely remove the printed circuit board, remove knobs from controls and sliders, the three screws on the back and the four screws securing the printed circuit board in place.

LEFT-HAND CONTROLLER

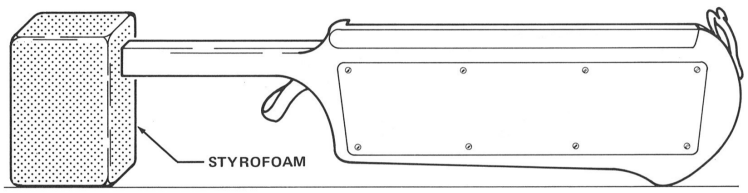
1. To gain access to the switches and controls, remove only the two screws at each end of the neck.

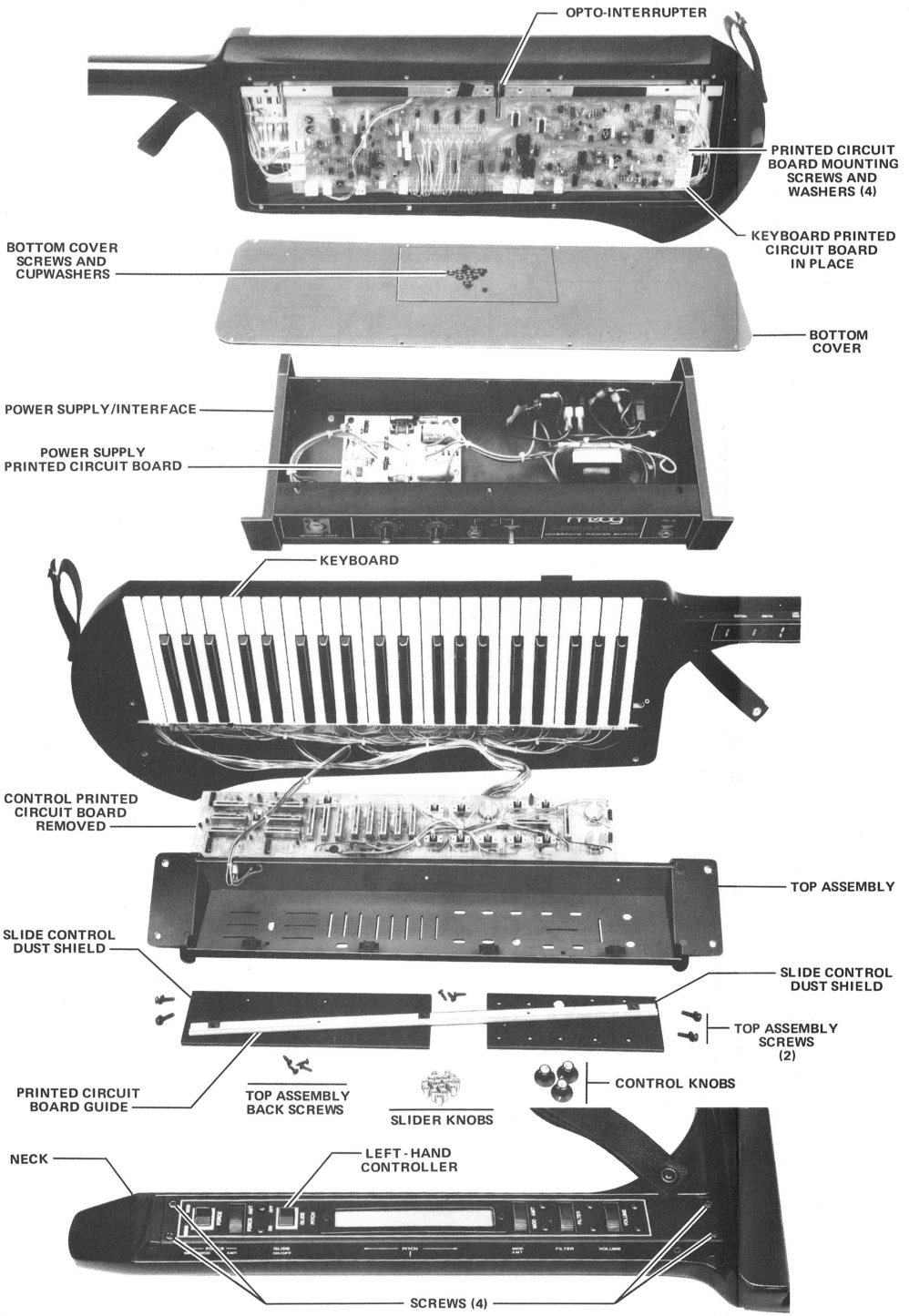
POWER SUPPLY/INTERFACE

1. To gain access to the power supply, remove the three screws on the rear lip of the back panel chassis, three screws on the top extrusion and the two top screws from each end cap. This allows the top cover to be removed.

OVERALL TROUBLESHOOTING

1. After the instrument is fully disassembled it is suggested that the instrument neck be strongly supported with a suitable material such as foam to facilitate troubleshooting. The foam can be used quite successfully by cutting an under-sized rectangular hole in the foam at a height that places the instrument in a horizontal plane with the keyboard facing up.





KEYBOARD CIRCUIT FINAL ASSEMBLY SELECTED REPLACEMENT PARTS LIST

REF DESIG	PART NUMBER	DESCRIPTION	QTY
P4	910-045019-001	Receptacle, No. DM7-XLR	1
R227	925-045014-002	Potentiometer, Rotary, VOLUME, 100K Ohm, 10% LOG	1
R228,R229	925-045014-003	Potentiometer, Rotary, FORCE AMOUNT and MODULATION AMOUNT, Linear, 10K Ohm	2
R230	925-045014-001	Potentiometer, Rotary, FILTER CUTOFF, Linear, 10K Ohm	1
S11,S18	906-040298-005	Connector, CIS, Housing, 5 Pin, .1 Center	2
S12 thru S14, S17,S19,S112	906-040298-004	Connector, CIS, Housing, 5 Pin, .1 Center	6
S15,S16	906-040298-008	Connector, CIS, Housing, 8 Pin, .1 Center	2
S110	906-040298-006	Connector, CIS, Housing, 6 Pin, .1 Center	1
S111	906-040298-007	Connector, CIS, Housing, 7 Pin, .1 Center	1
SW1,SW2	960-041311-005	Switch, SPDT, GLIDE and FORCE SELECT	2
	979-045177-001	Keyboard, 44 Note	1
	964-044471-001	White Key C3	1
	964-044471-002	White Key D3	1
	964-044471-003	White Key E3	1
	964-044471-004	White Key F3	1
	964-044471-005	White Key G3	1
	964-044471-006	White Key A3	1
	964-044471-007	White Key B3	1
	964-044471-008	White Key C4	1
	964-044472-001	Black Key	18
	975-044473-001	Spring No. 7	1
	960-044474-001	Switch Unit No. 6	1
	960-044474-002	Switch Unit No. 7	1
	914-044475-001	Damper 9B	1
	914-044475-002	Damper 8B	1
	906-040298-006	Connector, CIS, 6 Pin, .1 Center	1
	994-045069-001	Cable Assembly, Instrument	1
	910-045017-001	Connector, Cable Plug, Male, 6 Pin, Switchcraft XLR A6M	1
	910-045018-001	Connector, Cable Plug, Female, 6 Pin, Switchcraft XLR AF6	1
	986-041788-001	Cable, 8 Conductor, 2 No. 18AWG, 6 No. 22AWG, Belden 8448	40 Ft.
	910-040310-001	Keying Plug	2
	976-045081-001	Knob, Spring "D", .187 x .156	4
	975-045040-001	Spring, Torsion	1
	913-040345-007	Knob Insert, Blue	4
	913-040345-003	Knob Insert, Yellow	3
	913-040345-002	Knob Insert, Green	5
	913-040345-001	Knob Insert, Red	4
	915-044341-001	Dial, Potentiometer	4
	915-040272-001	Knob, 1/4 Inch Diameter, Slide Potentiometer	16
	915-040837-001	Knob, 1-1/8 Inch Diameter, Skirted	3
	975-045172-001	Spring, Force Sensor	1
	948-045171-001	Opto-interrupter, ON1102	1
	930-045062-001	Strap Button	1
	997-040585-004	Ribbon Assembly	1
	933-041678-001	Teflon Coated Fiberglass Tape (Ribbon)	1
	978-045031-001	Body, Instrument	1
	935-045063-001	Carrying Case	1
	932-045041-001	Shipping Carton	1
	993-044595-001	Service Manual	1

POWER SUPPLY/INTERFACE FINAL ASSEMBLY SELECTED REPLACEMENT PARTS LIST

A = DOMESTIC MODEL, X = EXPORT MODEL, BLANK = BOTH MODELS

REF DESIG	PART NUMBER	CODE	DESCRIPTION	QTY
F1	939-041620-002	A	Fuse, Slo-Blo, 1/4 A, 3AG	1
F1	939-044094-010	X	Fuse, T125MA, 5MX 20M	1
J1,J2	910-041306-001		Jack, Phone, 1 Circuit, Switchcraft 111	2
L1	939-041850-001		LED, Red, Hi Intensity	1
P1	910-041697-002		Plug, Panel	1
R20,R21	925-045056-001		Potentiometer, Rotary Control, Linear, 10K Ohm	2
S1	910-042913-001	X	Connector, CEE-22 Housing	1
S2	906-040298-007		Connector, CIS, 7 Pin, 1 Center	1
S3	906-040298-011		Connector, CIS, 11 Pin, 1 Center	1
S4	910-045020-001		Connector, XLR, 6 Pin Socket	1
S5	906-040298-002		Connector, CIS, 2 Pin, 1 Center	1
SW1	960-042800-001	X	Switch, Rocker, DPST, 250V, 8A	1
SW1	960-042753-001	A	Switch, Power, SPST, 125V, 15A	1
SW2	960-041311-003		Switch, Rocker, DPDT	1
	906-042911-001	X	Fuse Holder, 5MX 20M	1
	906-041331-006	A	Fuse Holder, Single	1
	915-040837-001		Knob, Skirted	2

KEYBOARD CIRCUIT PRINTED CIRCUIT BOARD ASSEMBLY SELECTED REPLACEMENT PARTS LIST

(PREFIX ALL REFERENCE DESIGNATORS WITH 1000)

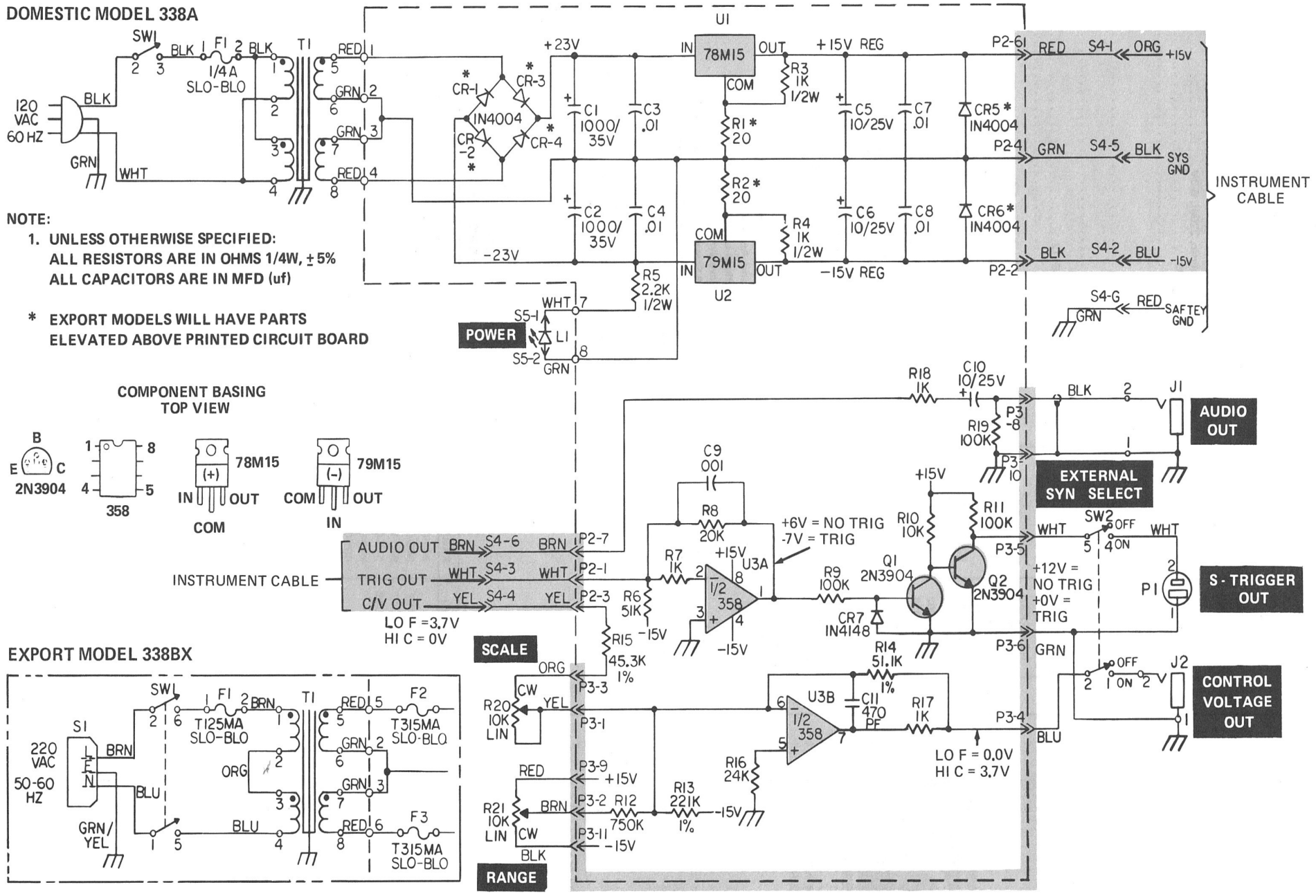
REF DESIG	PART NUMBER	DESCRIPTION	QTY
C9,C20,C27, C39,C44,C47, C48,C51,C52	945-040209-001	Capacitor, Aluminum Electrolytic, 10uf, 25V	9
C40	945-040209-003	Capacitor, Aluminum Electrolytic, 220uf, 6.3V	1
CR1 thru CR4	919-044466-001	Diode, Low Leakage, FDH333	4
CR6,CR7	919-041075-001	Diode, Signal, IN4148	2
Q6,Q7,Q9,Q14, Q20,Q21,Q23, Q24	991-041051-001	Transistor, NPN, 2N3904	8
Q8,Q17,Q19, Q25,Q42,Q43	991-041052-001	Transistor, PNP, 2N3906	6
Q10,Q18,Q22, Q24	991-041055-001	Transistor, FET, N-Channel, E112	4
Q28 thru Q33	991-042017-001	Transistor, NPN, 2N3392	6
R1,R5,R57, R65	925-042389-004	Resistor, Trim,Cermet, 500 Ohm	4
R14,R75,R109	925-042389-002	Resistor, Trim, Cermet, 10K Ohm	3
R52,R103, R184,R193	925-040275-004	Resistor, Trim, Carbon, 10K Ohm	4
R76,R77	949-044333-001	Resistor, Matched Pair, 1 Megohm, 1/4W, ±1%	2
R119,R202	925-042389-006	Resistor, Trim, Cermet, 100K Ohm	2
R179,R224	925-040275-002	Resistor, Trim, Carbon, 1K Ohm	2
R207	925-040275-011	Resistor, Trim, Carbon, 470 Ohm	1
R214	925-040275-001	Resistor, Trim, Carbon, 100K Ohm	1
U1,U8	991-041087-001	Integrated Circuit, CMOS, Quad Bilateral Switch, 4016	2
U2,U9, U28,U29	991-041104-002	Integrated Circuit, Trans Array, 3046	4
U3,U10	991-042908-001	Integrated Circuit, Dual Operational Amplifier, LF353	2
U4,U7,U12	991-042388-001	Integrated Circuit, Dual Voltage Comparator, 393	3
U5,U11	991-042386-001	Integrated Circuit, Operational Amplifier, TL081C	2
U6,U13,U14, U25,U26	991-041146-001	Integrated Circuit, Dual Operational Amplifier, 4558	5
U15	991-042793-001	Integrated Circuit, Operational Amplifier, LF351	1
U16	991-041091-001	Integrated Circuit, CMOS, Phase Locked Loop, 4046	1
U17	991-041105-002	Integrated Circuit, Top Octave Synthesizer, MO83	1
U18 thru U23	991-042015-001	Integrated Circuit, Digital, 6 Stage Frequency Divider, 5823	6
U24	991-042908-002	Integrated Circuit, Dual Operational Amplifier, Special, LF353	1
U27,U30	991-041089-003	Integrated Circuit, Operational Amplifier, 3080A	2
U31	991-041112-002	Integrated Circuit, +12 Volt Regulator, 78M12	1
U32	991-044316-001	Integrated Circuit, -12 Volt Regulator, 79M12	1
	967-040935-001	Heat Sink	2

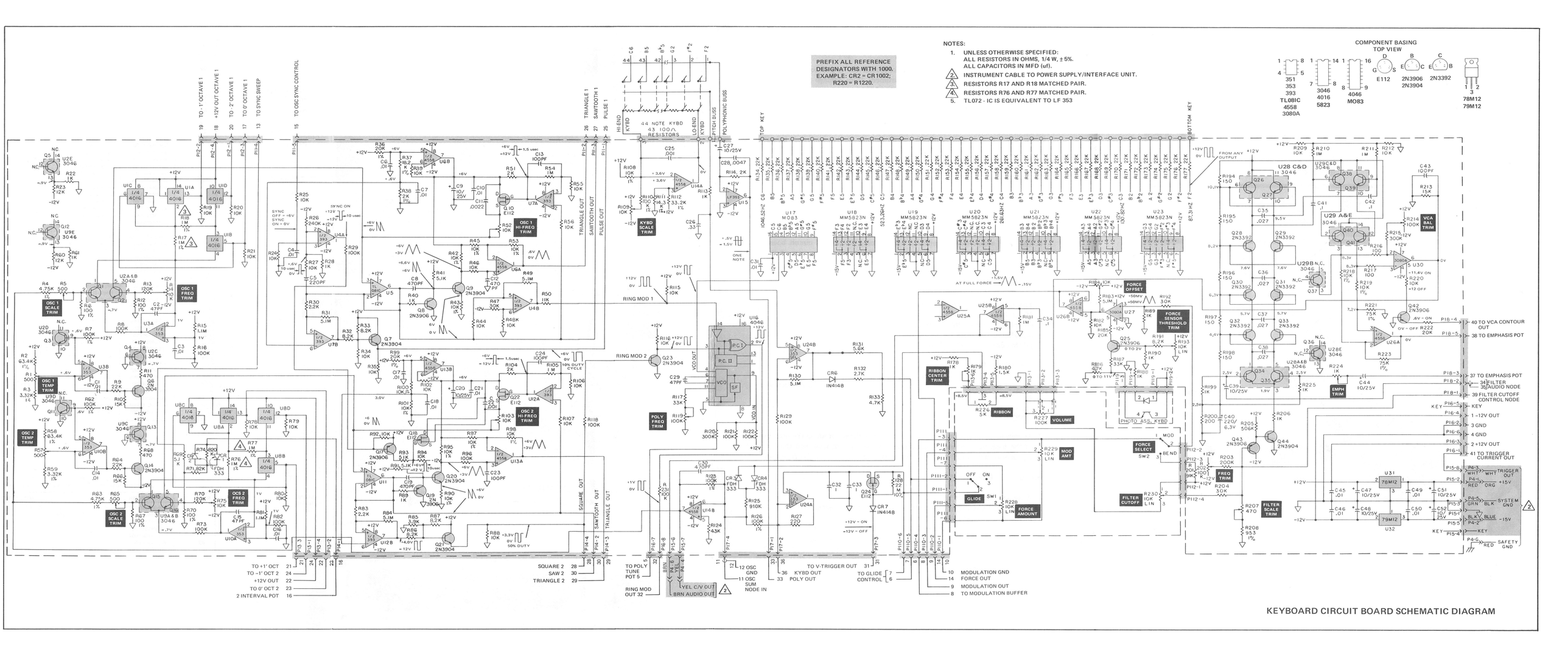
CONTROL BOARD PRINTED CIRCUIT BOARD ASSEMBLY SELECTED REPLACEMENT PARTS LIST

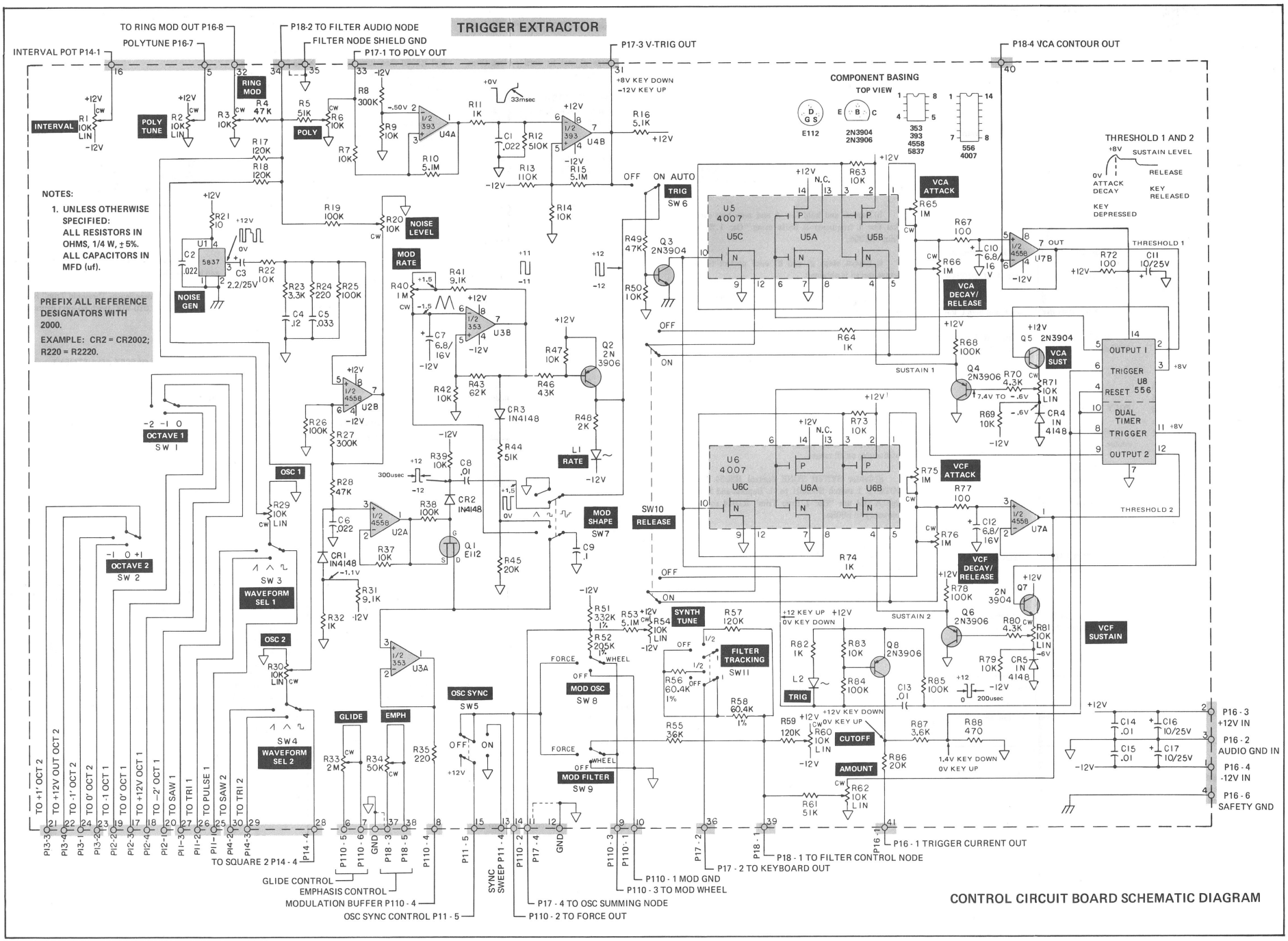
(PREFIX ALL REFERENCE DESIGNATORS WITH 2000)

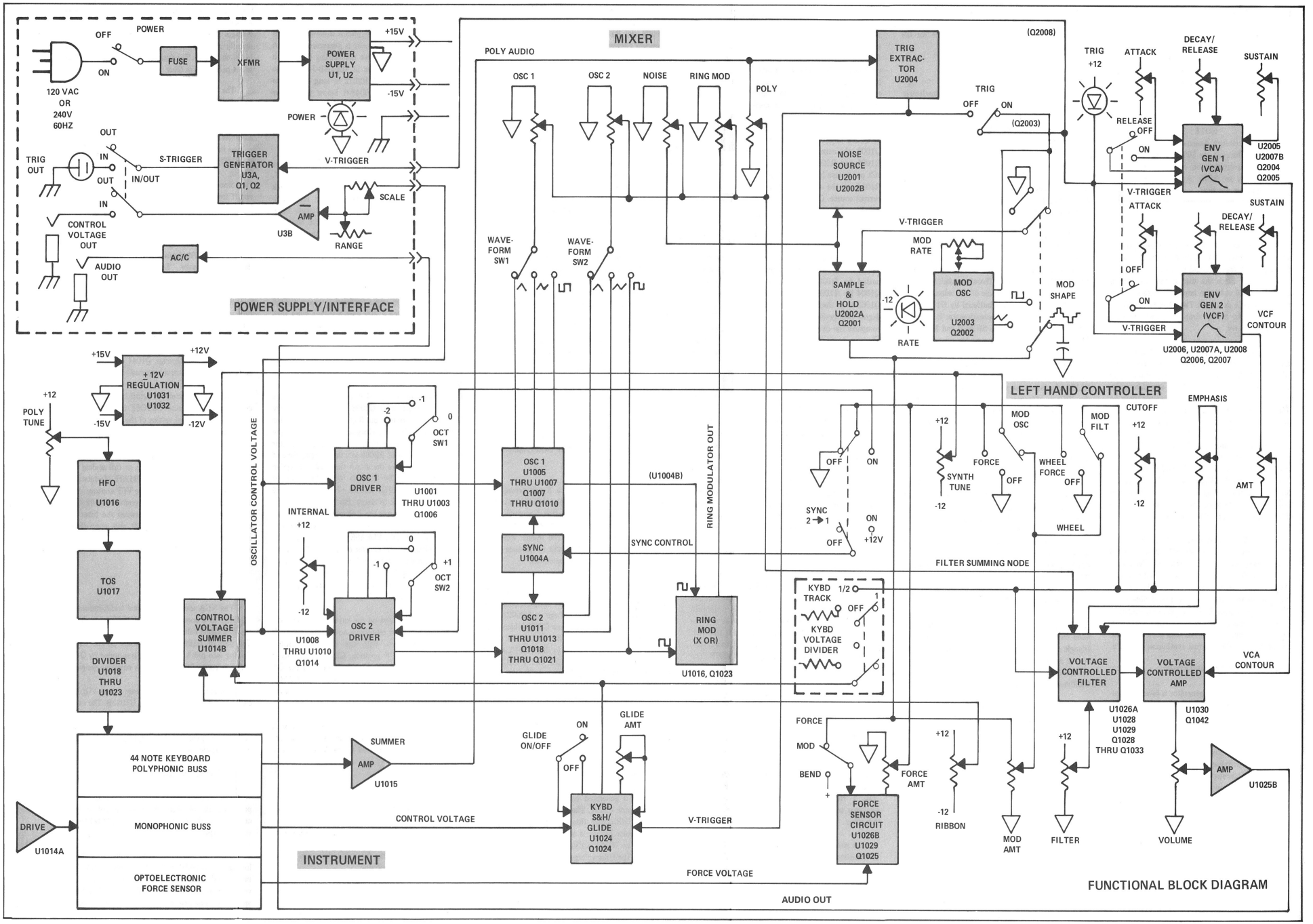
REF DESIG	PART NUMBER	DESCRIPTION	QTY
C3	945-040209-014	Capacitor, Aluminum Electrolytic, 2.2uf, 25V	1
C7,C10,C12	945-045049-001	Capacitor, Aluminum Electrolytic, 6.8uf, 16V	3
C11,C16,C17	945-040209-001	Capacitor, Aluminum Electrolytic, 10uf, 25V	3
CR1 thru CR5	919-041075-001	Diode, Signal, IN4148	5
L1,L2	939-041850-004	LED, Red, High Intensity	2
Q1	991-041055-001	Transistor, FET, N-Channel Junction, E112	1
Q2,Q4,Q6,Q8	991-041052-001	Transistor, PNP, 2N3906	4
Q3,Q5,Q7	991-041051-001	Transistor, NPN, 2N3904	3
R1,R2	925-045012-001	Resistor, Rotary, Linear, 10K Ohm	2
R3,R6,R20 R29,R30,R60,	925-045013-005	Resistor, Trim, Slide, 10K Ohm	3
R62,R71,R81	925-045013-001	Resistor, Trim, Slide, 10K Ohm	6
R33	925-045013-003	Resistor, Trim, Slide, 2 Megohm	1
R34	925-045013-004	Resistor, Trim, Slide, 50K Ohm	1
R40,R65,R66, R75,R76	925-045013-002	Resistor, Trim, Slide, 1 Megohm	5
R54	925-045012-001	Resistor, Rotary, Linear, 10K Ohm	1
SW1 thru SW4, SW7,SW8, SW9,SW11	960-045016-001	Switch, Lever, 2P3T	8
SW5,SW6, SW10	960-045015-001	Switch, Lever, 2P2T	3
U1	991-042016-001	Integrated Circuit, Noise Generator, 5837	1
U2,U7	991-041146-001	Integrated Circuit, Dual Operational Amplifier, 4558	2
U3	991-042908-001	Integrated Circuit, Dual Operational Amplifier, LF353	1
U4	991-042388-001	Integrated Circuit, Dual Voltage Comparator, LM393	1
U5,U6	991-041086-001	Integrated Circuit, CMOS, Dual Comparator Pair, Invert, 4007	2
U8	991-041109-001	Integrated Circuit, Dual Timer, 556	1

POWER SUPPLY/INTERFACE SCHEMATIC DIAGRAM




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/INTERFACE UNIT.
3. RESISTORS R17 AND R18 MATCHED PAIR.
4. RESISTORS R76 AND R77 MATCHED PAIR.
5. TL072 - IC IS EQUIVALENT TO LF 353
COMPONENT BASING TOP VIEW
351 353 393 TL081C 4558 3080A
3046 4016 5823
4046 M083
E112
2N3906 2N3904
2N3392
78M12 79M12
44 NOTE KYBD
43 100Ω RESISTORS
HI-END KYBD
LO-END KYBD
PITCH BUSS
POLYPHONIC BUSS
TOP KEY
BOTTOM KEY
TO '1' OCTAVE 1
+12V OUT OCTAVE 1
TO '2' OCTAVE 1
TO 0' OCTAVE 1
TO SYNC SWEEP
TO OSC SYNC CONTROL
TRIANGLE 1
SAWTOOTH 1
PULSE 1
TRIANGLE OUT
SAWTOOTH OUT
PULSE OUT
RING MOD 1
RING MOD 2
OSC 1 HI-FREQ TRIM
OSC 1 FREQ TRIM
OSC 1 SCALE TRIM
OSC 1 TEMP TRIM
OSC 2 HI-FREQ TRIM
OSC 2 FREQ TRIM
OSC 2 SCALE TRIM
OSC 2 TEMP TRIM
KYBD SCALE TRIM
POLY FREQ TRIM
RIBBON CENTER TRIM
FORCE OFFSET
FORCE SENSOR THRESHOLD TRIM
RIBBON
VOLUME
MOD AMT
FORCE SELECT
FORCE AMOUNT
GLIDE
FILTER CUTOFF
FREQ TRIM
FILTER SCALE TRIM
VCA BAL TRIM
EMPH TRIM
SYNC OFF = +6V SYNC ON = 0V
SYNC ON
10 usec
1.5 usec
10% DUTY CYCLE
50% DUTY
ONE NOTE
AT FULL FORCE
FROM ANY OUTPUT
PHOTO ASS. KYBD
TO +1' OCT
TO -1' OCT 2
+12V OUT
TO 0' OCT 2
2 INTERVAL POT
SQUARE 2
SAW 2
TRIANGLE 2
TO POLY TUNE POT 5
RING MOD OUT 32
BRN
YEL
YEL C/V OUT
BRN AUDIO OUT
12 OSC GND
11 OSC SUM NODE IN
TO V-TRIGGER OUT
KYBD OUT
POLY OUT
TO GLIDE CONTROL
MODULATION GND
FORCE OUT
MODULATION OUT
TO MODULATION BUFFER
40 TO VCA CONTOUR OUT
38 TO EMPHASIS POT
37 TO EMPHASIS POT
36 FILTER
35 AUDIO NODE
39 FILTER CUTOFF CONTROL NODE
KEY
1 -12V OUT
3 GND
4 GND
2 +12V OUT
41 TO TRIGGER CURRENT OUT
TRIGGER OUT
+15V
SYSTEM GND
-15V
KEY
SAFETY GND
KEYBOARD CIRCUIT BOARD SCHEMATIC DIAGRAM


TRIGGER EXTRACTOR
TO RING MOD OUT P16-8
POLYTUNE P16-7
INTERVAL POT P14-1
P18-2 TO FILTER AUDIO NODE
FILTER NODE SHIELD GND
P17-1 TO POLY OUT
P17-3 V-TRIG OUT
P18-4 VCA CONTOUR OUT
COMPONENT BASING
TOP VIEW
E112
2N3904
2N3906
353
393
4558
5837
556
4007
THRESHOLD 1 AND 2
SUSTAIN LEVEL
RELEASE
KEY RELEASED
KEY DEPRESSED
ATTACK DECAY
NOTES:
1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS IN OHMS, 1/4 W, ± 5%. ALL CAPACITORS IN MFD (uf).
PREFIX ALL REFERENCE DESIGNATORS WITH 2000.
EXAMPLE: CR2 = CR2002; R220 = R2220.
INTERVAL
POLY TUNE
RING MOD
POLY
NOISE LEVEL
NOISE GEN
MOD RATE
TRIG
SW 6
VCA ATTACK
VCA DECAY/ RELEASE
VCA SUST
SUSTAIN 1
OCTAVE 1
SW 1
OCTAVE 2
SW 2
WAVEFORM SEL 1
SW 3
WAVEFORM SEL 2
SW 4
OSC 1
OSC 2
RATE
MOD SHAPE
SW7
SW10
RELEASE
VCF ATTACK
VCF DECAY/ RELEASE
VCF SUSTAIN
SUSTAIN 2
SYNTH TUNE
FILTER TRACKING
SW11
MOD OSC
SW 8
MOD FILTER
SW 9
OSC SYNC
SW5
GLIDE
EMPH
CUTOFF
AMOUNT
TRIG
OUTPUT 1
TRIGGER
RESET
U8 556
DUAL TIMER TRIGGER
OUTPUT 2
THRESHOLD 1
THRESHOLD 2
+8V KEY DOWN
-12V KEY UP
+12 KEY UP
0V KEY DOWN
+12V KEY DOWN
0V KEY UP
1.4V KEY DOWN
0V KEY UP
7.4V TO -.6V
TO +1' OCT 2
TO +12V OUT OCT 2
TO -1' OCT 2
TO 0' OCT 2
TO -1 OCT 1
TO 0' OCT 1
TO +12V OCT 1
TO -2' OCT 1
TO SAW 1
TO TRI 1
TO PULSE 1
TO SAW 2
TO TRI 2
TO SQUARE 2 P14 - 4
GLIDE CONTROL
EMPHASIS CONTROL
MODULATION BUFFER P110 - 4
OSC SYNC CONTROL P11 - 5
SYNC SWEEP P11 - 4
P110 - 2 TO FORCE OUT
P17 - 4 TO OSC SUMMING NODE
P110 - 1 MOD GND
P110 - 3 TO MOD WHEEL
P17 - 2 TO KEYBOARD OUT
P18 - 1 TO FILTER CONTROL NODE
P16 - 1 TRIGGER CURRENT OUT
P16 - 3 +12V IN
P16 - 2 AUDIO GND IN
P16 - 4 -12V IN
P16 - 6 SAFETY GND
CONTROL CIRCUIT BOARD SCHEMATIC DIAGRAM


POWER SUPPLY/INTERFACE
POWER
OFF
ON
FUSE
XFMR
POWER SUPPLY U1, U2
+15V
-15V
120 VAC OR 240V 60HZ
POWER
V-TRIGGER
S-TRIGGER
IN/OUT
TRIGGER GENERATOR U3A, Q1, Q2
TRIG OUT
OUT
IN
CONTROL VOLTAGE OUT
AUDIO OUT
AC/C
AMP
U3B
SCALE
RANGE
MIXER
POLY AUDIO
OSC 1
OSC 2
NOISE
RING MOD
POLY
WAVE-FORM SW1
WAVE-FORM SW2
TRIG EXTRAC-TOR U2004
(Q2008)
TRIG
OFF
ON
(Q2003)
NOISE SOURCE U2001 U2002B
SAMPLE & HOLD U2002A Q2001
MOD RATE
MOD OSC U2003 Q2002
RATE
MOD SHAPE
V-TRIGGER
TRIG +12
ATTACK
DECAY/ RELEASE
SUSTAIN
RELEASE
OFF
ON
ENV GEN 1 (VCA)
U2005 U2007B Q2004 Q2005
ENV GEN 2 (VCF)
VCF CONTOUR
U2006, U2007A, U2008 Q2006, Q2007
LEFT HAND CONTROLLER
+15V
-15V
+12V
-12V
± 12V REGULATION U1031 U1032
+12
POLY TUNE
HFO U1016
TOS U1017
DIVIDER U1018 THRU U1023
OSCILLATOR CONTROL VOLTAGE
OSC 1 DRIVER
U1001 THRU U1003 Q1006
OCT SW1
INTERNAL
OSC 2 DRIVER
U1008 THRU U1010 Q1014
OCT SW2
CONTROL VOLTAGE SUMMER U1014B
OSC 1 U1005 THRU U1007 Q1007 THRU Q1010
SYNC U1004A
OSC 2 U1011 THRU U1013 Q1018 THRU Q1021
(U1004B)
SYNC CONTROL
RING MODULATOR OUT
RING MOD (X OR)
U1016, Q1023
SYNC 2 → 1
FILTER SUMMING NODE
SYNTH TUNE
FORCE
WHEEL FORCE
WHEEL
MOD FILT
CUTOFF
EMPHASIS
AMT
KYBD TRACK
KYBD VOLTAGE DIVIDER
VOLTAGE CONTROLLED FILTER
U1026A U1028 U1029 Q1028 THRU Q1033
VOLTAGE CONTROLLED AMP
U1030 Q1042
VCA CONTOUR
44 NOTE KEYBOARD POLYPHONIC BUSS
MONOPHONIC BUSS
OPTOELECTRONIC FORCE SENSOR
DRIVE
U1014A
SUMMER AMP
U1015
GLIDE ON/OFF
GLIDE AMT
KYBD S&H/ GLIDE U1024 Q1024
CONTROL VOLTAGE
V-TRIGGER
FORCE VOLTAGE
AUDIO OUT
INSTRUMENT
FORCE
MOD
BEND
FORCE AMT
FORCE SENSOR CIRCUIT U1026B U1029 Q1025
RIBBON
MOD AMT
FILTER
VOLUME
AMP
U1025B
FUNCTIONAL BLOCK DIAGRAM

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. Suffix numbers include pin numbers.

KEYBOARD CIRCUIT

The Liberation has a 44 F to C high note priority keyboard with linear glide. U1014A feeds a constant 0.83mA through the keyboard resistors to produce 1 volt per octave. Since the top of the keyboard is maintained at 3.6 volts, the keyboard voltage output is the highest note depressed. The "Kybd 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 R1113 and charges C1026. U1024B, Q1024, and U1024A form a linear glide and sample-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 G1026. 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 TRACKING switch SW2011 and the oscillator summer U1014B. U1014B sums the keyboard voltage, the pitch bend ribbon, the SYNTH TUNE control R2054, oscillator modulation and force 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 synthesizes the upper octave 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 resistor for that key is connected to the keyboard which feeds summer U1015 and that note appears at the output. POLY TUNE control R2002 adjusts the frequency of the master oscillator which transposes all the notes of the polyphonic section. "Poly Frequency Trim" R1119 sets the center 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 SW1002 to be either a DC control voltage (bend) or the modulation 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 U1026B, 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" R1193 adjusts the base voltage on Q1025 to guarantee the VCA is off when no force is applied. FORCE OFFSET R1184 adjusts the output offset of the VCA to zero to eliminate pitch shifts when the modulation switch is put into the force postion.

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 U1016. The square wave from Oscillator 2 comes from U1012B and is buffered by Q1023 for the second input. The ring modulator signal from pin 2 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:

$$ICQ1 = (IREF)\ e^{\frac{Vin}{VT}}$$

Where:

IREF = current through Q1002

$VT = \frac{KT}{q}$ 28mV at room temperature

$Vin = VBE_{Q1001} - VBE_{Q1002}$

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 volt per octave keyboard voltage. "Osc 1 Freq Trim" R1014 sets the oscillator frequency by offsetting the current source. C1002 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 U1005, 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. U1005 follows the voltage on C1011. When the voltage on U1005 reaches zero volts, the output of U1007A jumps to 6 volts for approximately 1 usec. This turns Q1010 on for 1 usec, 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 VBE 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" R1052 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.

The INTERVAL potentiometer R2001 is connected through dead band diodes CR1001 and CR1002 and R1071 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 an octave higher.

The sync function is provided by U1004A, OSC SYNC switch SW2005, Q1017, and Q1018. The sawtooth reset pulse is differentiated by C1005, 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 p.p 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 R2039 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 R2020 for an audio feed. The noise voltage is also filtered by R2028 and C2006, buffered by U2002A and fed to the sample-hold switch Q2001 to produce a random modulation voltage. R2032, R2031, and CR2001 limit the negative excursions of C2006 to prevent accidental turn 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-6 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 C2010. The V-trigger 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 inverted by U2005A. This grounds pin 3 of U2008B which turns the P-channel FET on, charging C2010 through the ATTACK TIME potentiometer R2065 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, the 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 puts 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 18mV 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 routed 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" R1214 compensates for the input offset on U1030 to reduce control signal bleed-through.

POWER SUPPLY/INTERFACE

The Power Supply/Interface consists 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 volt operation and wired in series for 230 volt operation. Transformer T1, diodes CR1 through CR4 and capacitors C1 and C2 convert the line voltage to ± 23 volts raw DC. The raw +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 regulators 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 20K ohm resistor and sent down the interface cable. A trigger current is used to minimize crossfeed into the audio output. With no trigger current, the output of U3A is approximately 6 volts. This turns Q1 on and Q2 off. When the 600 microamp trigger current is applied to U3A, U3A 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 designators 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 interaction.

CHIP TEMPERATURE ADJUSTMENT

> **NOTE**
>
> This adjustment should be made at an ambient temperature of 72°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 R1066. 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 72°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

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

1. Use pin 5 of U1010B for voltage measurement.

2. Remove short on R1066 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 U1024A 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 at 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 SW2008	OFF
5. OSC SYNC SW2005	OFF
6. Osc OCTAVE 1 SW2001	-2
7. OSC 1 mix R2029	minimum
8. POLY mix R2006	maximum
9. CUTOFF control R2060	maximum
10. EMPH R2034	minimum
11. VCA SUST R2071	maximum

c) Center the following trimpots:

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

c) Center the following trimpots:

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.

h) Depress and hold low A and zero beat such that Osc 2 frequency is 110Hz using "Osc 2 Scale Trim" R1065.

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 Hi Freq Trim" R1103.

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 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 1760Hz.

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
6. AMOUNT R2062	minimum
7. FILTER TRACKING SW2011	OFF
8. VCA SUST R2071	maximum

b) Center the following trimpots:

1. "Freq Trim" R1202
2. "Filter Scale" R1207
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 ± 50Hz, measured at pin 7 of U1025B.

e) Adjust "Emph Trim" R1224 until sinewave 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" R1203 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

b) 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	945-040209-011	Capacitor, Aluminum Electrolytic, 1000uf, 35V	2
C5,C6,C10	945-040209-001	Capacitor, Aluminum Electrolytic, 10uf, 25V	3
*F2,F3	939-044094-011	Fuse, T315MA, Slo-Blow, 5X20MM	2
CR1 thru CR6	919-042019-001	Diode, Rectifier, IN4004	6
CR7	919-041075-001	Diode, Signal, IN4148	1
P2	910-040299-007	Connector, CIS, PC Header, 7 Pin, .1 Center	1
P3	910-040299-011	Connector, CIS, PC Header, 11 Pin, .1 Center	1
Q1,Q2	991-041051-001	Transistor, NPN, 2N3904	2
U1	991-041112-003	Integrated Circuit, Voltage Regulator, 3 Terminal, +15V, 78M15	1
U2	991-044316-002	Integrated Circuit, Voltage Regulator, 3 Terminal, -15V, 79M15	1
U3	991-041084-001	Integrated Circuit, Dual Operational Amplifier, 358	1
	*906-043605-001	Clip, Fuse, PCB Mount, 5X20MM	4
	967-040935-001	Heat Sink	2

*** Export Model Only**

Norlin®
NORLIN MUSIC, INC.

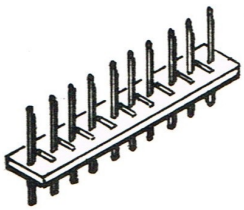
Factory Service Bulletin

2500 WALDEN AVE. • BUFFALO, NEW YORK 14225 • UNITED STATES
51 NANTUCKET BLVD. • SCARBOROUGH, ONT. M1P 2N6 • CANADA
WAALHAVEN • Z.Z. 48 ROTTERDAM • THE NETHERLANDS

SUBJECT: Connector Alert

NUMBER: 811

DATE: 3-19-81



Models:

Prodigy	S/N 7263 to	S/N 10830
OPUS 3	S/N 1001 to	S/N 1338
Liberation	S/N 1001 to	S/N 1278

The above models have C.I.S. connectors made by AMP which have potentially poor plating of the header pins. Repairs should be effected as required.

The pins within the header are made of steel which are first plated with nickel and then plated with tin. There is a deficiency in the nickel plating causing the pin and plating to separate.

Any headers suspected of causing poor or intermittent solder connections should be replaced or resoldered. The resoldering technique involves the use of an extra activated multicore solder such as .064 diameter ERSIN #7821745 solder and a 40 watt soldering iron.

Remove the old solder using a solder sucker and prepare the header by heating the pin and trace simultaneously.

CAUTION

> Be sure to avoid long exposure of the soldering iron to the printed circuit board traces and to clean the activated flux residue from the printed circuit board after soldering is completed.

Some excellent, recommended flux cleaners are Miller-Stephenson MS-190HD HEAVY DUTY FLUX REMOVER or a METHYL/ETHYL KEYTONE product. Use a stiff brush while applying the flux cleaner through an absorbent tissue to insure the least exposure of flux to other parts of the board. Allow to dry and if the board is tacky, repeat until clean.

If there is sufficient time to use a replacement header here are the AMP and Moog part numbers that may be ordered:

Header	Description	AMP #	Moog Part Number	Remarks
11 pin	.1" Spacing	1-640098-1	910-040299-011	Smaller pin versions may be obtained by cutting the 11 or 8 pin headers using wire cutters
11 pin	.15" "	1-640057-1	910-040301-011	
6 pin	.1" " Right Angle	1-640099-8	910-042392-008	

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2500 WALDEN AVE. • BUFFALO, NEW YORK 14225 • UNITED STATES
51 NANTUCKET BLVD. • SCARBOROUGH, ONT. MIP 2N6 • CANADA
WAALHAVEN • Z.Z. 48 ROTTERDAM • THE NETHERLANDS

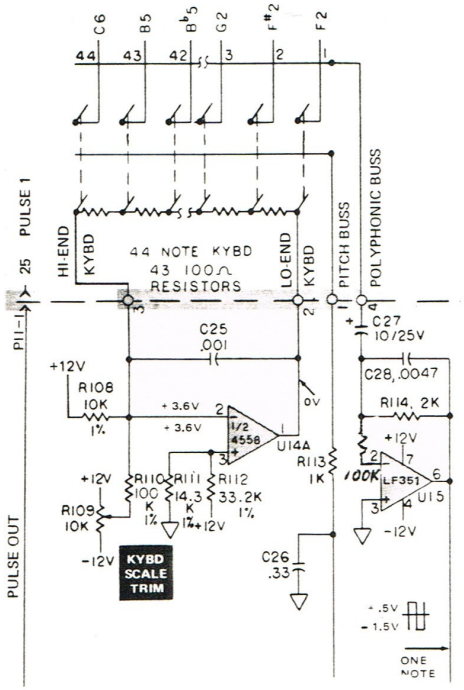
SUBJECT: Liberation S/N Below 1160 NUMBER: 1405B DATE: 3/10/83

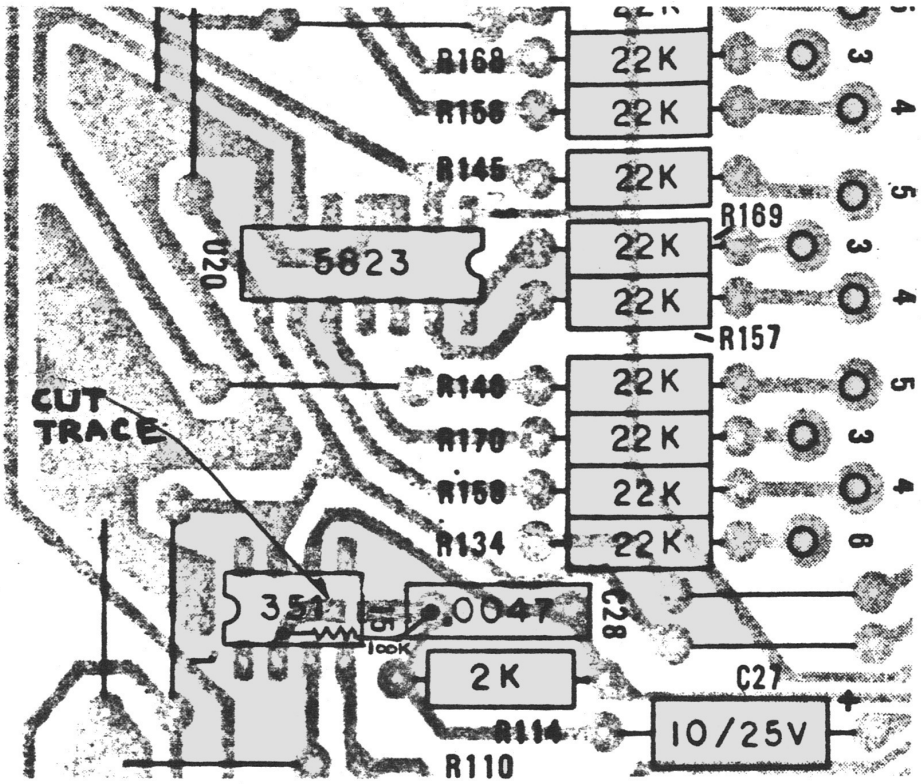
SYMPTOM: Unit will not trigger with one key depressed or sporadically triggers with more than one key depressed.

CAUSE: A static build-up on the polyphonic buss causes a failure of U15 (LF351) on the keyboard circuit (bottom) board. This can be verified by checking Pin 6 of U15 for D.C. offset and/or oscillation.

CURE: Remove the keyboard circuit board and replace U15. Cut the trace between Pin 2 of U15 and C28. Tack a 100K 5% ¼W resistor across the trace cut. This provides input protection for U15. See reverse for board location.

It is recommended that all units returned for service have this modification performed. Estimated time for this modification is ½ hour.




R168
22K
R166
22K
R145
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R169
5823
U20
22K
22K
R157
R140
22K
CUT
TRACE
R170
22K
R159
22K
R134
22K
351
.0047
C28
100K
2K
C27
10/25V
R114
R110