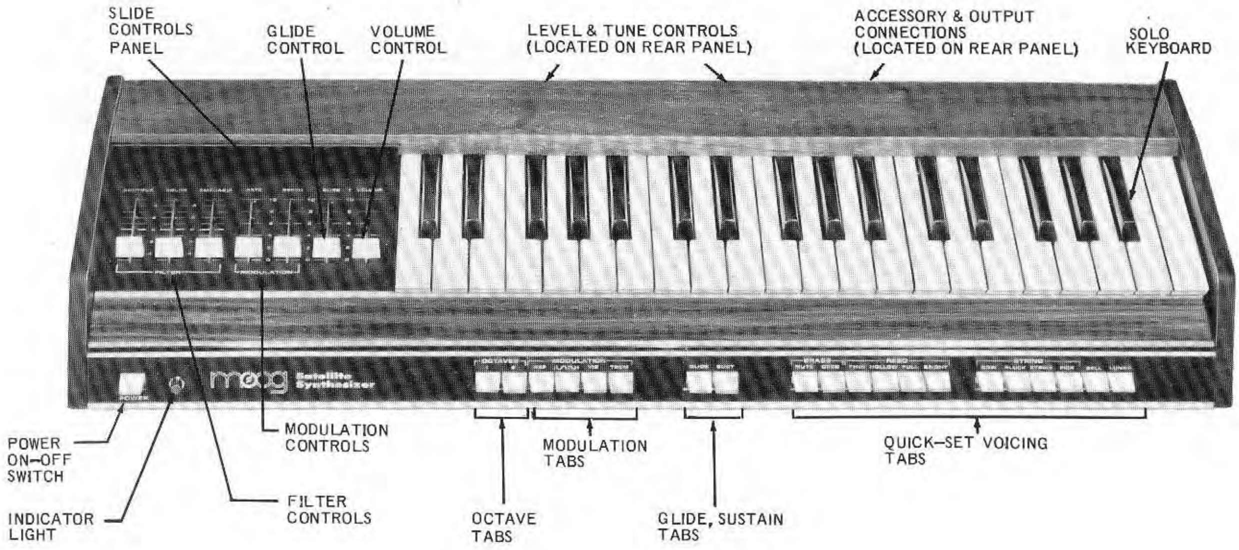
Controls



Before proceeding with Operation and Adjustment of your unit,refer to page 14 for Connection Instructions.

LEVEL ADJUST

This rotary control (located on the back of the unit)sets the overall output level, or volume, of the unit. Smaller changes in volume may be made with the VOLUME control on the Slide Control Panel.

TUNE

This rotary control (located on the back of the unit) provides a range of tuning which extends more than one-half octave. This flexibility can be used to tune your MOOG SATELLITE to other instruments, transpose to different keys, or even provide a glissando effect.

POWER AND INDICATOR LIGHT

An ON-OFF power switch is conveniently located on the front panel, with a red light which indicates when the power is ON.

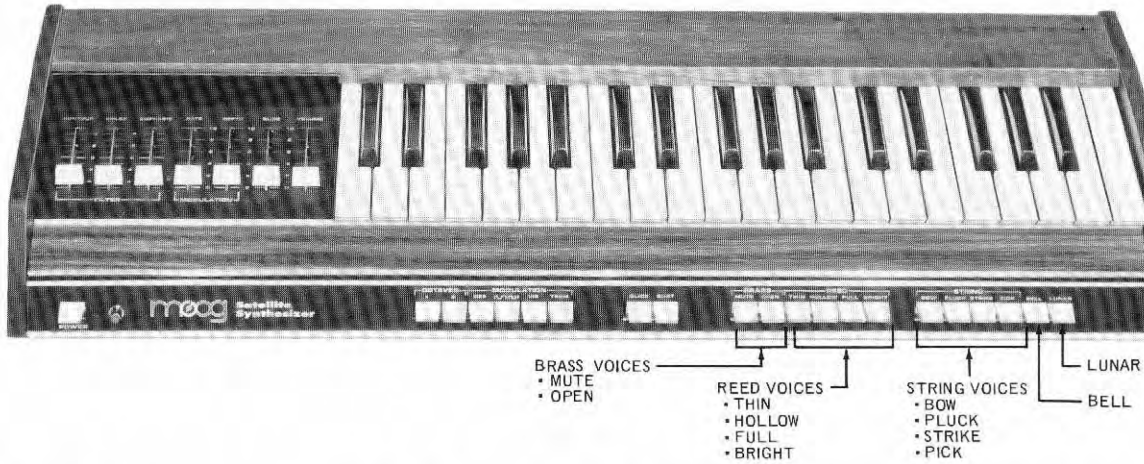
OCTAVES

With neither tab depressed, your MOOG SATELLITE will play in its highest pitch level. Depress tab "1", and whatever you play on the keyboard will be one octave lower. Raise tab "1" and depress tab "2", and the keyboard pitch level is lowered another octave. Depress both tabs and the pitch level is lowered still a third octave. Because of the electronic tailoring of the sounds to the requirements of each pitch level, you will find that the effectiveness of every sound seems to change magically as you change from octave to octave. Try all sound effects in all four pitch levels.

SUSTAIN

This "Quick-Set" tab allows the sound of a note to "linger" after the key is released. It provides interesting variations to the special voice settings described in this Manual.

Quick-Set Voice Tabs



With the unit connected and power ON, a sound can be heard when a note on the keyboard is struck, even though no voices are selected and all slide controls are set at "O" (except for the VOLUME control). The controls described herein will add and subtract from that sound in a multitude of combinations available for your exploration – shape it, change its attack and release, raise it, or lower it. We suggest that you play a phrase or two with each of the twelve "QUICK-SET" VOICE TABS conveniently located on the front of the unit. Try each with all the slide controls set at "O" (except for VOLUME).

Exact setting of slide controls for any particular effect will depend, not only on your musical taste, but also on your complete electronic reproduction system including amplifiers, speakers and other components.

NOTE: If more than one "QUICK-SET" Voice Tabs are depressed at the same time the sound will be that controlled by the Voice tab farthest to the left.

MUTE BRASS

This voice is a new version of the wah-wah effect. The sound approximates a double-acting wah-wah, or "ooo-wah-ooo." It starts with an emphasis on the "lows", moves to the "highs" and returns. Each time a key is depressed the "ooo-wah-ooo" sound is produced. Try it in each octave.

OPEN BRASS

The sounds of a trumpet, trombone, or tuba can be approximated by selecting this tab, and varying it with other controls. Characteristic of this voice (and some of the other "Quick-Set" voices) is a built-in timbre change which is faster in the upper octaves and is automatically slower in the lower octaves – much as the attack of a tuba differs from that of a trumpet. This attention to the authentic details of the attack in different octaves is a unique feature of the Satellite. Try it in each octave setting.

THIN REED

This voice provides a sound similar to that of a double reed. In the top octave the sound is oboe-like. In the lower octaves, the sound of a bassoon is approximated. You will note a slight timbre change in the onset of the tone and a slow attack.

HOLLOW REED

The hollow reed sound and the soft attack of the traditional clarinet and bass clarinet are characteristic of this voice – an excellent voice in all octave registers.

FULL REED

This full bodied reed sound is unique to the Satellite. It combines some of the qualities of a double reed wind instrument with those of a pipe organ with a little saxophone added. In the lowest registers, it is an excellent reproduction of the sound of the sarrusophone, a wind instrument popular in bands of the early 1900's.

BRIGHT REED

This voice approximates that of a saxophone. With adjustment of other controls you will be able to vary the sound through the characteristics of alto and tenor, baritone, and even bass saxophone.

BOW STRING

This gentle voice with its slow attack can be made to simulate violin, viola, cello, and even some of the sounds of the bass violin.

PLUCK STRING

This sound is quite percussive with a lingering decay. It is most useful for creating guitar-like or harpsichord-type effects, including that of a folk guitar.

STRIKE STRING

In the upper registers this voice is that of an electronic piano. In the lower registers it provides an interesting sound similar to that of an electric bass guitar.

PICK STRING

Banjo type sounds are provided with the hollow sound characteristic of this voice. In the lower registers it can simulate the plucked sound of the string bass, or bass violin.

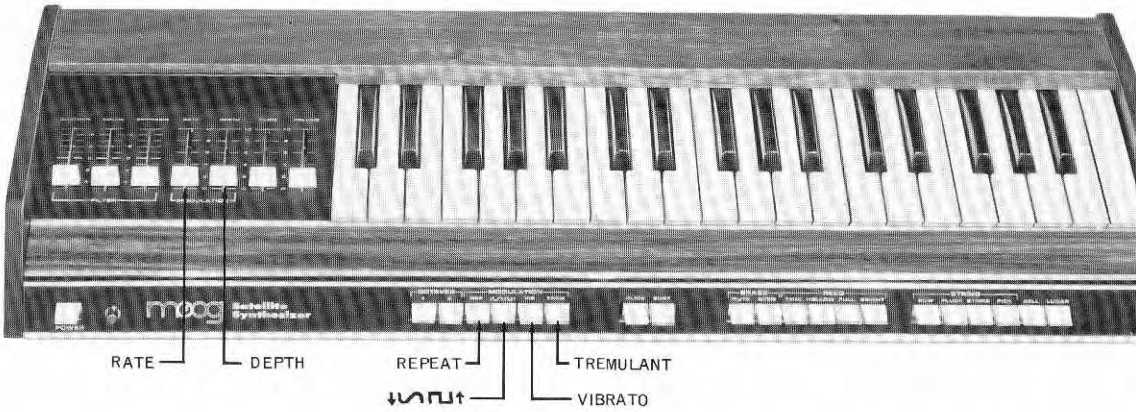
BELL

In the upper octaves a fine bell sound is provided by this voice. In the lower octaves, the huge sound of a large carillon can be reproduced.

LUNAR

This versatile voice perhaps is most characteristic of the Moog sounds. It provides, in its various adjustments, a wide variety of timbre changes with which you can produce many popular electronic "Moog" sound effects. It is most effective when used with SUSTAIN.

Modulation



The four function tabs labeled MODULATION on the front of the unit provide a selection of modulation types. The two MODULATION slide controls on the slide control panel adjust the RATE and DEPTH of modulation.

VIB (VIBRATO)

This tab provides a frequency-modulation vibrato similar to the type used in electronic organs. However, the wide range of effects offered by the two slide controls extends the capability of this effect far beyond vibrato and into the realm of the synthesizer.

When the VIB tab is depressed, the basic frequency of a note is varied (or "wiggled") to a degree determined by the DEPTH control and at a rate determined by the RATE control.

RATE

The rate of modulation may be varied from approximately one second at "O" to a rate so fast that at "10" the sound becomes a buzz. However, even at extreme settings, the basic character of the "QUICK-SET" voices is still apparent. For instance, MUTE BRASS, with VIB plus RATE at 10 becomes a BUZZ-WAH type of effect. With slower settings it is easy to obtain the effect of trills between notes, regardless of the voice selected.

DEPTH

This control adjusts the degree or intensity of modulation. For vibrato (VIB), increasing DEPTH corresponds to greater frequency variation. This frequency variation may be adjusted from less than one-half step (on the scale) to more than one octave. For tremulant (TREM), increasing DEPTH corresponds to greater timbre variation.

This flexibility, combined with the RATE control, makes possible synthesis of such effects as "out of tune" strings, huge bells whose clanging sounds interfere with each other, quarter tone scales, trumpet "shake" effects, and a myriad of others.

TREM (TREMULANT)

This tab provides modulation of the harmonic content of the tone. The harmonic content, or timbre, is varied at a rate determined by the RATE control and with an intensity determined by the DEPTH control.

NOTE: VIB and TREM can be used together.

REP (REPEAT)

The repeat tab affects only those "QUICK- SET" voices which have built-in timbre changes.
The timbre change associated with a specific voice will be repeated over and over again at a speed controlled by the RATE slide control. This is easily demonstrated by depressing MUTE BRASS, REP, OCTAVE 1 and 2, and setting RATE at 0. Play a sustained tone, then slowly move the slide control to 10 and return, while sustaining the tone.

NOTE: The DEPTH slide control has no effect on the REP function.

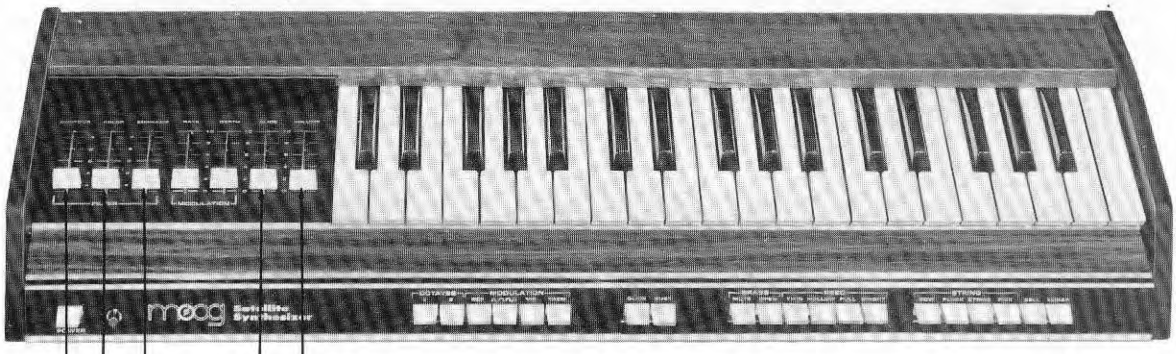
↓∿⊓⊔↑

This control provides a most versatile tool in achieving the distinctive sounds associated with the MOOG synthesizer. It affects the type of modulation obtained by two of the other MODULATION functions, VIBRATO and TREMULANT.

When this tab is in the up position, ↓∿⊓⊔↑ VIB and TREM are with a square-wave pattern. The variation of frequency (VIB), or variation of timbres (TREM), will be very abrupt and choppy, with discontinuities. With VIB, for instance, a definitive variation in frequency can be obtained, like a trill.

When ↓∿⊓⊔↑ is depressed, a sine wave type of modulation is obtained which provides a smooth variation of timbre or frequency — almost a glissando. The difference between the two effects is easily discernible in the following characteristically MOOG-type settings. Depress ↓∿⊓⊔↑ , MUTE BRASS, OCTAVE 2, VIB, set RATE at 3, and DEPTH at 6. Depress any key on the keyboard and listen to the smooth variation in frequency as you keep your finger on the key. Then raise the tab marked ↓∿⊓⊔↑ and observe the abrupt variation in frequency. Repeat the above steps with TREM instead of VIB, and then combine the two.

Slide Control Panel



FILTER CONTROLS

Once a "Quick-Set" tab voice selection is made, further refinement and adjustment of that voice may be made by using the three slide controls labeled FILTER.

CONTOUR

This controls the speed of the timbre change associated with the onset of the voice, and/or the timbre change associated with the release of that voice. The wide range of this control can provide both slow settings (useful for simulation of bass violin or tuba effects) and fast timbre change settings (which can provide wild chirping effects).

COLOR

This acts as a brightness control, but it has such a wide range that it can have major effect on the basic sound itself. Your choice may lie anywhere between adding in all of the high harmonics you wish, or eliminating them.

EMPHASIS

This control adds a resonance frequency area to the spectrum of the tone. At "O", spectrum of the "Quick-Set" sound is unchanged. As the control is pushed forward, the intensity of the sound within a pre-selected resonance area is increased. At maximum, there is a well defined narrow sharp peak in the spectrum of the tone.

FILTER CONTROLS SUMMARY

Remember, the "Quick-Set" tabs establish an overall range of sound and the three Filter slide controls give you a wide selection and control within the limitations of that range.

Try this:

1. Depress OPEN BRASS tab, and set the slide controls at "O".
2. Play a few notes on the keyboard.
3. Play again with various settings of the COLOR slide pot. The range of sound will be from that of a very dull trumpet to a very brassy one.
4. Now do the same with the EMPHASIS control. The sound will range through cornet, trumpet, and flugelhorn characteristics.
5. Repeat with various settings of the CONTOUR control. It will show the wide range of contoured timbres in the onset of the tones.

ADDITIONAL CONTROLS

MODULATION CONTROLS

See discussion under MODULATION on page 5.

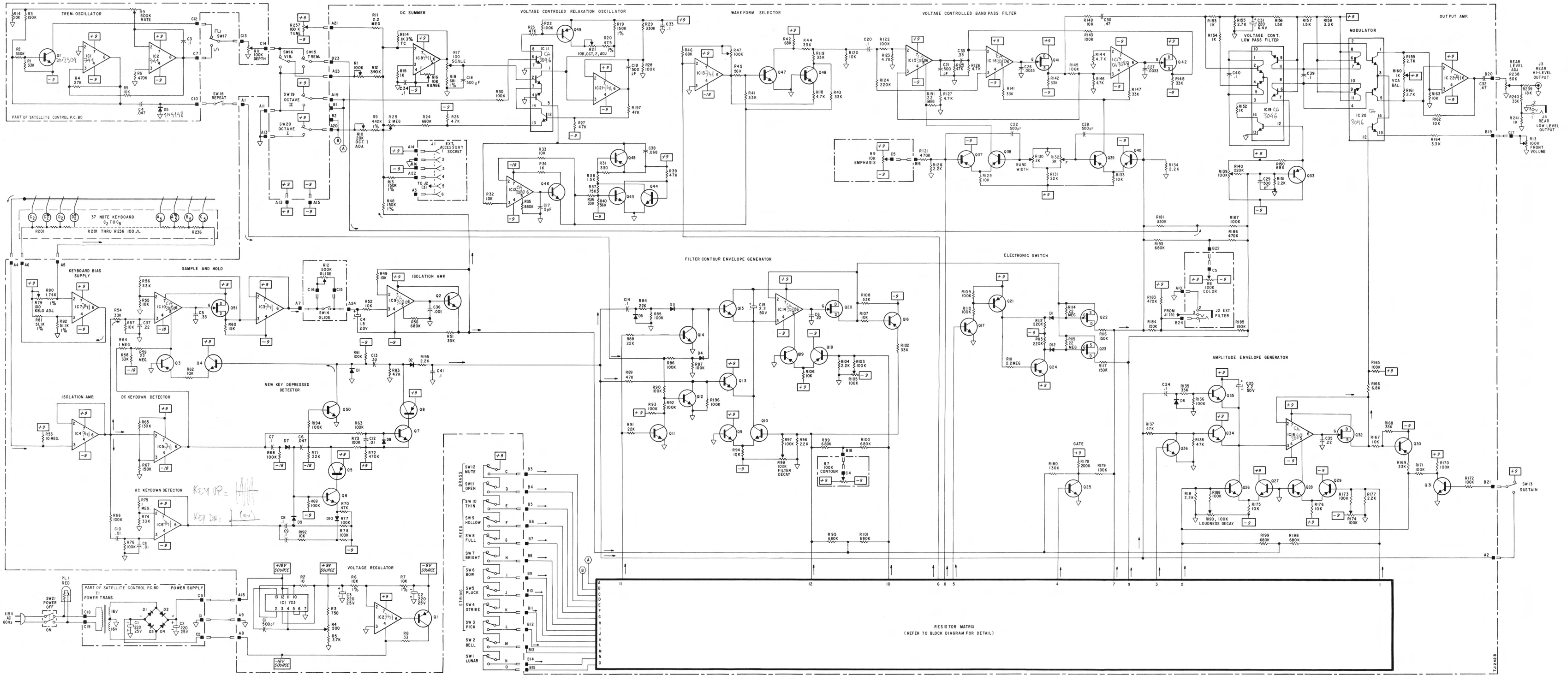
GLIDE

This is one of the most interesting of the Moog effects. Depress the GLIDE tab and set the GLIDE slide control at 6. Play any note on the keyboard. Release this note and quickly play a second note some distance away. The sound automatically glissandos from the first note to the second. The setting of the slide control determines the speed of the glissando, (10 is slow – 1 is fast). Try a melody of detached notes and notice the succession of glide attacks.

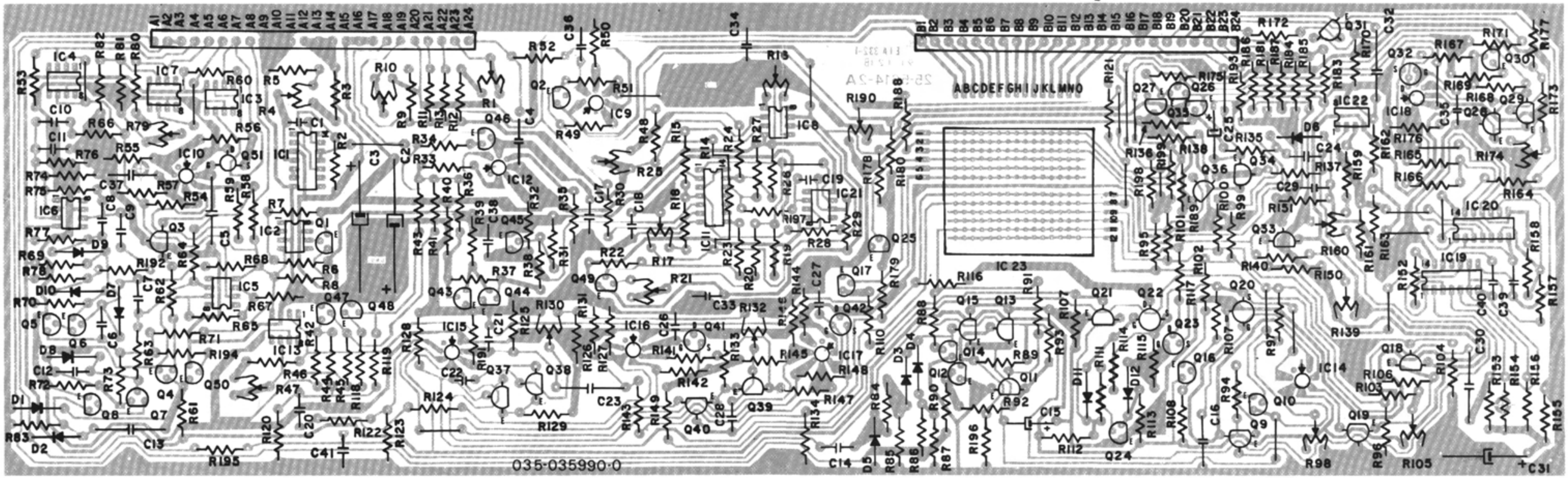
VOLUME

The VOLUME slide control provides finger-tip adjustment of fine gradations of the Satellite output. Major changes in sound level are obtained by means of the rotary knob on the back of the unit.

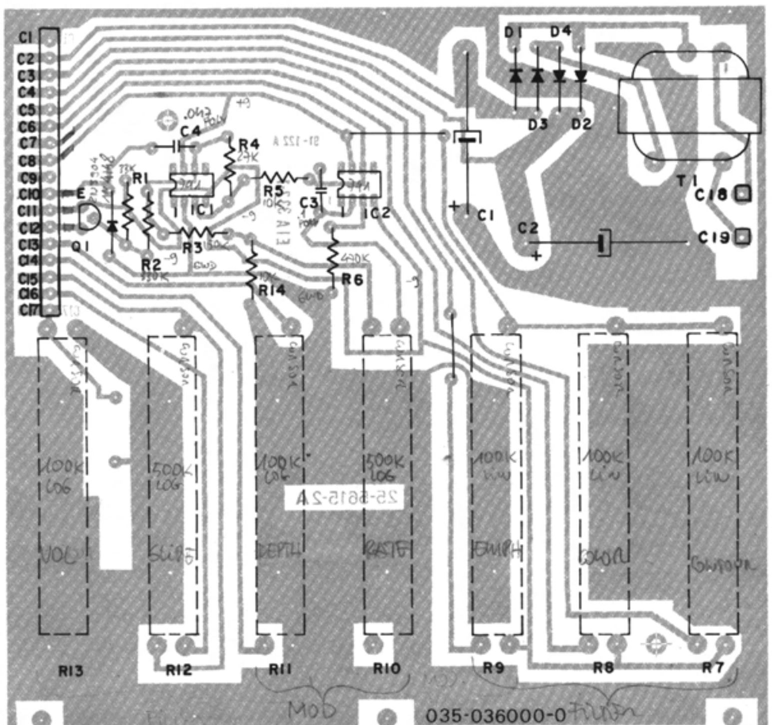
Moog Satellite Schematic Diagram



Wiring Diagrams



SATELLITE P.C. BD. ASSEMBLY



SATELLITE CONTROL P.C. BD. ASSEMBLY

TC1219B

How to Order Service Parts

Service parts are stocked only at our Customer Service Department in Sepulveda, California. Please order all your requirements from:

THOMAS ORGAN COMPANY
CUSTOMER SERVICE DEPARTMENT
8345 HAYVENHURST AVENUE
SEPULVEDA, CALIFORNIA 91343

A. Use your own order form, letter, or postcard.
B. Place your order on our Customer Service Department Electronic Secretary in the evening (dial Area Code 213, telephone number 893-4416) or – –
C. In case of extreme rush, call the Customer Service Department during the day at Area Code 213, telephone number 894-7161 and ask for extension 356 or 357.

Parts List

SATELLITE P.C. BOARD ASSEMBLY

SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
C2,C3	18-5217-3	220uF, 25V (Electro)
C4	18-5214-3	1.5uF, 20V (Tantalum)
C15,C25	18-5215-3	2.2uF, 50V (Electro)
C31	18-5216-3	220uF, 6.4V (Electro)
D1 thru D12	86-5044-3	Diode, Silicon (Signal IN4148)
R1,R47,R98, R103,R139,R174, R190	24-5340-3	100K Ohm, Trim Pot
R4	24-5335-3	500 Ohm, Trim Pot
R10	24-5338-3	20K Ohm, Trim Pot
R16,R21	24-5337-3	10K Ohm, Trim Pot
R17,R79	24-5342-3	100 Ohm, Trim Pot
R25	24-5341-3	2 Meg. Ohm, Trim Pot
R130,R132	24-5339-3	2K Ohm, Trim Pot
R160	24-5336-3	1K Ohm, Trim Pot
R6,R7	61-100201-2	10K Ohm, 1/4W, 1% Film
R9	61-442301-2	442K Ohm, 1/4W, 1% Film
R13,R19,R48	61-150301-2	150K Ohm, 1/4W, 1% Film
R18	61-681001-2	681 Ohm, 1/4W, 1% Film
R20	61-475201-2	47.5K Ohm, 1/4W, 1% Film
R80	61-174101-2	1.74K Ohm, 1/4W, 1% Film
R81,R82	61-511201-2	51.1K Ohm, 1/4W, 1% Film
R114	61-5000-1	1K Ohm, 3% Temp. Comp.
IC1	13-5020-6	Intergrated Circuit, (Voltage Reg. 723)
IC2,IC3,IC4, IC5,IC6,IC7, IC8,IC13,IC21, IC22	13-5018-6	Intergrated Circuit, (OP-Amp. 741)
IC9,IC10,IC12, IC14,IC15,IC16, IC17,IC18	13-5019-6	Intergrated Circuit, (OP-Amp. CA-3080)
IC11,IC19,IC20	13-5015-6	Intergrated Circuit, (Transistor Array SG-3821)
IC23	13-5074-3	Resistor Matrix
Q1	86-5150-2	Transistor, (PNP TIS93)
Q2,Q4,Q6,Q7, Q9,Q10,Q11, Q12,Q13,Q14, Q15,Q17,Q25, Q26,Q27,Q31, Q34,Q35,Q36, Q43,Q44,Q46, Q47,Q48,Q50	86-5149-2	Transistor, (PNP 2N3906)
Q3,Q5,Q8,Q16, Q18,Q19,Q21, Q24,Q28,Q29, Q30,Q33,Q37, Q38,Q39,Q40, Q49	86-5148-2	Transistor, (NPN 2N3904)
Q20,Q32,Q41, Q42,Q51	86-5147-2	Transistor, (FET, N-CHAN. E203)
Q22,Q23	86-5146-2	Transistor, (FET, N-CHAN. E112)
	45-5049-0	Connector, 12-Pin Male Polar
	45-5043-5	Terminal, IC, 4-Pin Socket
	45-5044-5	Terminal, IC, 7-Pin Socket
	45-5022-2	Socket, IC, 8-Pin Circular
	77-5129-0	Spacer, IC, Socket, 7-Line
	35-35990-0	Satellite, P.C. Bd. Assy.

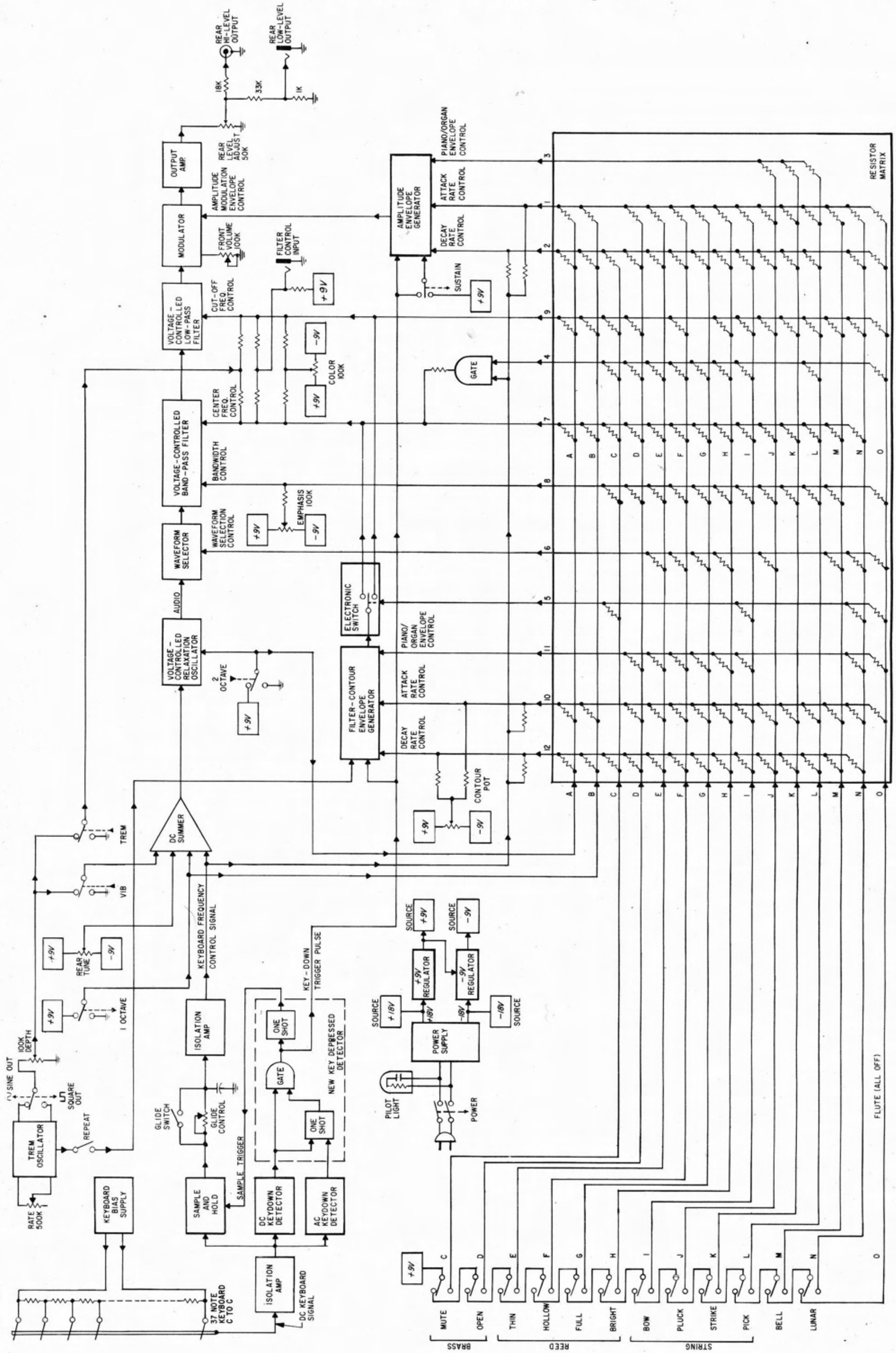
SATELLITE CONTROL P.C. BOARD ASSEMBLY

SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
C1,C2	18-5217-3	220uF, 25V, (Electro)
D1,D2,D3,D4	86-5045-3	Diode, Silicon (Power IN4004)
D5	86-5044-3	Diode, Silicon (Signal IN4148)
R7,R8,R9	24-5350-0	100K, Pot Slide, (Linear)
R10,R12	24-5352-0	500K, Pot Slide, (Log)
R11,R13	24-5351-0	100K, Pot Slide, (Log)
T1	80-5008-0	Transformer, Power
IC1,IC2	13-5018-6	Intergrated Circuit, (OP-Amp. 741)
Q1	86-5148-2	Transistor, NPN (2N3904)
	35-36000-0	Satellite Control, P.C. Bd. Assy.

MISCELLANEOUS CABINET PARTS LIST

	11-5837-0	Panel, Rear Controls
	40-5133-0	Overlay, Slider Panel
	40-5134-0	Overlay, Front Controls
SW1 thru SW21	69-5367-0	Switch, with Quick-Tab
	89-5083-0	Lamp, Pilot with Clip
	21-5355-1	Housing, 24-Pin Female
J1	45-5022-1	Socket, 6-Pin (Accessory)
J2	45-5023-1	Jack, Phone
J3	45-5076-3	Jack, RCA-Phono
J4	45-5024-1	Jack, Phone (Shorting Type)
R238	24-5353-0	50K Ohm, Pot Rotary (Level)
R237	24-5354-0	100K Ohm, Pot Rotary (Tune)
	52-5220-0	Knob, Rotary (Push-on)
	52-5221-0	Knob, Slide Pot
	77-5130-0	Standoff, P.C. Bd. Mounting
	49-5330-0	Foot, Rubber
	49-5331-0	Foot, Adjustable
	23-5017-0	Cord, A.C. Power
	22-5023-0	Strain Relief
	23-5051-1	Cable, Output Accessory
	23-5053-1	Adapter, "Y"
	62-8268-1	"A" Key Natural (Ivory)
	62-8269-1	"B" Key Natural (Ivory)
	62-8270-1	"C" Key Natural (Ivory)
	62-8271-1	"D" Key Natural (Ivory)
	62-8272-1	"E" Key Natural (Ivory)
	62-8273-1	"F" Key Natural (Ivory)
	62-8274-1	"G" Key Natural (Ivory)
	62-8275-1	"C" End Key Natural (Ivory)
	62-8276-1	"A" Key Natural (Black)
	62-8277-1	"B" Key Natural (Black)
	62-8278-1	"C" Key Natural (Black)
	62-8279-1	"D" Key Natural (Black)
	62-8280-1	"E" Key Natural (Black)
	62-8281-1	"F" Key Natural (Black)
	62-8282-1	"G" Key Natural (Black)
	62-8283-1	Sharp Black
	11-5847-0	Channel, Natural
	11-5848-0	Channel, Sharp
	26-5004-0	Bushing, Guide
	70-5201-0	Spring, Key Return
	97-5351-0	Screw, Key
	70-5202-0	Spring, Contact

Moog Satellite Block Diagram



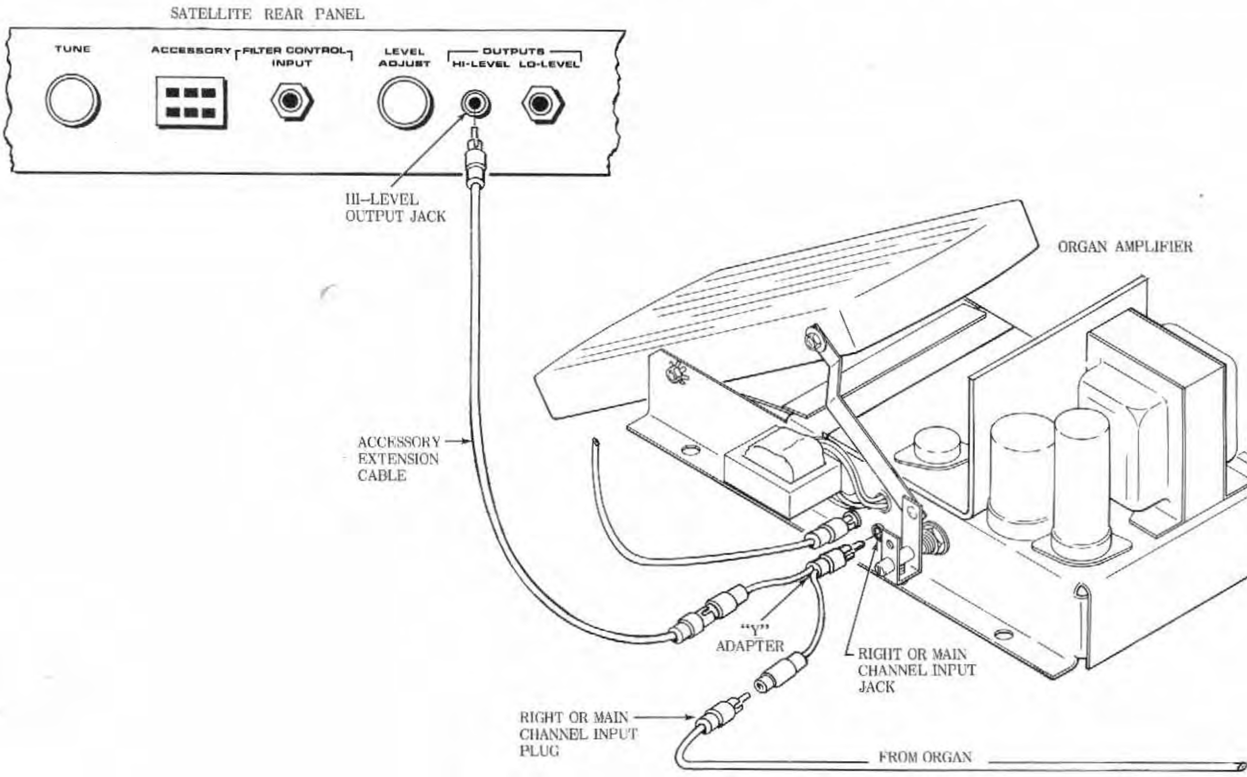
Accessory and Connections

For operation the Satellite Synthesizer unit should be placed on a horizontal surface in a location which will not interfere with its operation.

NOTE: Avoid placement in close proximity to electronic circuitry, as on the top of some electronic organs, because excessive hum may result.

LO-LEVEL OUTPUT (30 millivolts RMS), Phone Jack designed for use with Guitar Amplifier, P.A. Systems, etc.

HI-LEVEL OUTPUT (1 volt RMS), RCA Phono Jack designed for use with Electronic Organs. ("Y" Adapter and Accessory extension cable are included with your unit).



Connection Instructions

SINGLE CHANNEL ORGANS (MONAURAL)

Disconnect the RCA Phono plug from Amplifier Input Jack and insert the "Y" Adapter plug into the Amplifier Input Jack. Connect Accessory extension cable plug into "Y" Adapter socket and insert the plug on the other end of the extension cable into the HI-LEVEL OUTPUT jack on your Satellite unit. Connect the organ plug (previously removed) into the other "Y" Adapter socket.

DUAL CHANNEL ORGANS (STEREO)

Disconnect the RCA Phono plug from the Right or Main Channel Amplifier Input Jack and insert "Y" Adapter plug into Right or Main Channel Input Jack. Connect the Accessory extension cable plug into the "Y" Adapter socket and insert the plug on the other end of the extension cable into HI-LEVEL OUTPUT jack on your Satellite unit. Connect the Right or Main Channel plug (previously removed) into the other "Y" Adapter socket.

NOTE: Do not connect the Satellite Synthesizer into Leslie or Left Channel Input.

FILTER CONTROL INPUT

This jack is provided for the control of the Timbre with a Moog Pedal controller.

ACCESSORY SOCKET

Permits the attachment of a Foot Pedal to control several Synthesizer features. (Consult your dealer for availability of Moog Accessories).

Care of Your Moog Satellite

Your new MOOG SATELLITE Synthesizer is carefully designed to give you maximum pleasure and satisfaction with a minimum of care. Following these tips on the care of your Synthesizer will help keep it "showroom new".

- **LOCATION**

  As with any electronic instrument, avoid placement in direct or prolonged sunlight. Normal variation of temperature will not affect the tuning or electronic circuitry of the synthesizer. Storage location should be chosen to avoid placement in front of hot air registers, or beside an outside doorway in winter, as these elements may affect the finish of the cabinet.

- **CABINET**

  Quality hardwoods are used in your MOOG SATELLITE. Therefore, a minimum amount of care will insure you of having a piece of furniture that will retain its beauty. An occasional dusting with a soft, dry cloth should remove both fingerprints and dulling film. To clean the keys a soft cloth dampened in a mild soap solution should remove even the most persistent stains. Under no circumstances should solvents or cleaning fluids be used to clean keys or cabinet.

- **POWER REQUIREMENTS**

  This instrument must be operated from a standard 120 V.A.C. 60 Hz power outlet. Normal line voltage variation will not affect its operation. Power requirements of this unit are very low. All Solid State circuits are operated at a very low voltage and component life is therefore extended.

- **SAFETY**

  Your MOOG SATELLITE Synthesizer has been designed for maximum safety in its operation and trouble free performance. However, repair or service of electronic products should be done by qualified personnel familiar with the hazards relating to electricity and electronic circuitry. The risk of repair or service must not be assumed by the customer. Your dealer will provide a competent, experienced service technician for that purpose. Please contact your dealer, if your unit needs repair or service.

- **CONCLUSION**

  And now as you play . . . . Let us offer you our best wishes for a happy and rewarding experience with your new MOOG SATELLITE Synthesizer. We know it will bring you great pleasure and creative satisfaction.

Warranty

ALL COMPONENTS – ONE YEAR FROM DATE OF ORIGINAL SALE.

CABINETRY – 90 DAYS FROM DATE OF ORIGINAL SALE.

We warrant your Moog Satellite Synthesizer to be free of defects in material or workmanship. We agree to remedy any such defect by repairing or replacing at our option with a new or equal part in exchange through an authorized dealer or service technician. This does not apply to any instrument subjected to misuse, neglect, accident or acts of God or improper servicing performed by other than an authorized dealer or service technician which in any way affects the reliability of or detracts from the performance of this product. This warranty does not cover labor or transportation costs for the instrument or any part thereof.

For your protection and future reference, please keep this warranty along with your bill of sale.

THOMAS ORGAN CO. CHICAGO, ILL. 60648

MUSIC INC.
Academy Street (P.O. Box 131)
Williamsville, N.Y. 14221 • phone (716) 633-2280

September 20, 1972

SATELLITE SYNTHESIZER CIRCUIT DESCRIPTION & GENERAL TEST PROCEDURE

CIRCUIT FEATURES

The sound producing chain of the Satellite Synthesizer consists of an oscillator that produces both sawtooth and rectangular waveforms, a band pass filter, a low pass filter, and a variable gain amplifier. All four of these circuits in the sound producing chain are voltage controlled. The remainder of the circuitry is devoted to producing appropriate control voltages. The keyboard circuit produces one pitch control voltage whose magnitude depends on which key is depressed, and a trigger voltage which is on whenever any of the keys is depressed. The modulating oscillator produces triangular and square waveforms for modulating the oscillator and the filters. Two contour generators produce voltages that rise and then fall each time a key is depressed. One of these sweeps one of the filters, while the other sweeps the amplifier. A resistor matrix determines the average values of the voltage-controlled parameters. The power supply delivers ± 18 volts unregulated, and ± 9 volts regulated.

The resistor matrix has fifteen input columns and twelve output rows. A column is on when + 9 volts is applied to it, and it is grounded when it is off. The two left-most columns are connected to the "two octave" and "one octave" switches respectively. They shorten the contour times and raise the filter frequencies when they are on. The remaining columns are the quickset voices. Only one of these is on at a time. The rows are fed to low impedance points in the circuitry. Of the twelve matrix output rows, eight supply control currents for continuously variable parameters, while the remaining four supply switching current to determine circuit states.

DESCRIPTION OF CIRCUITRY ON LARGE BOARD

The large circuit board which mounts underneath the keyboard contains most of the Satellite circuitry. All connections to this board are made through two Molex connectors. Looking at the board from the component side with the connectors along the top edge, the left hand connector is designated "A" and the right hand connector is designated "B". The pins are numbered from 1 to 24 starting with the left hand pin on each connector. Drawing 08-005 is a schematic diagram of this board. The designations used in the discussion of the circuitry are those shown on drawing 08-005.

The positive power supply regulator consists of IC1 and the associated components. This circuitry is completely conventional. It will deliver 55 or 60 milliamperes before the voltage developed across current sense resistor R2 limits the current.

The negative regulated supply circuit consists of IC2, Q1, and associated components. This circuit simply adjusts its output to be the negative of the regulated +9. No current limiting, other than that supplied by R8, is provided.

The keyboard circuit consists of IC3, IC4, IC5, IC6, IC7, IC9, IC10, and related circuitry. The keyboard itself contains a string of thirty-six 100 ohm resistors. The string is connected between A5 and A6. The current through the resistor string is regulated by IC7 so that the drop across R79 and R80 is exactly 4.5 volts. R79 is set so that the voltage at A6 is exactly -4.5 volts.

The voltage at the keyboard buss is fed to voltage follower IC4. Because of resistor R53, the keyboard buss voltage rises to 7 volts or so when no key is depressed. The output of voltage follower IC4 is then fed to comparator IC5. The output of IC5 swings from +7 to -16 volts whenever the input goes above +4.8 volts. Q5 and Q6 comprise a monostable multivibrator that produces a pulse of approximately 20 milliseconds duration (Fig. 1). When the output of IC5 swings positive, a positive spike is fed through C7 and CR7 to the base of Q6, initiating a 20 millisecond pulse. R63, R73, and R72 are proportioned so that Q7 conducts only when the output of IC5 is positive and the output of the monostable (the collector of Q5) is negative. That is, Q7 begins to conduct approximately 20 milliseconds after a key is depressed, and stops conducting as soon as all keys are released. When Q7 conducts, Q8 is turned on, and the voltage at its collector goes from 0 to +9. When this happens, C13 discharges through R61, producing a ramp voltage at the base of Q4 that decreases from +9 to -0.6 in approximately 20 milliseconds (Fig. 2). Q4 is an emitter follower that supplies a current through R62 and Q3 to turn on IC10. IC10 and Q51 and associated circuitry comprise a sample-hold circuit. When the current ramp is fed to pin 5 of IC10, the voltage at the source of Q51 rapidly approaches that at the output of IC4. As soon as the base of Q4 drops below 0.8 volts, the bias current being fed to IC10 through Q3 drops to zero, and the voltage at the source of Q51 remains constant. As long as the output of IC5 remains positive (that is, as long as any key is depressed,) a very small trickle bias current of approximately 50 nanoamperes flows through R59 so that IC10 is capable of supplying a small current to C5 to keep its voltage constant. As soon as all keys are released, the output of IC5 goes negative and IC10 is virtually completely shut off. Thus, when only one key at a time is depressed, the voltage at the source of Q51 begins to approach the new key voltage approximately 20 milliseconds after the key is depressed, and is brought to be equal to the new key voltage well before the ramp current turning IC10 goes to zero. As long as a key is depressed, the correct voltage at the source of Q51 is maintained by the small trickle current going through R59. When the key is released, the trigger output at the collector of Q8 drops to zero, and the sample-hold circuit no longer samples the keyboard voltage. The 20 millisecond delay supplied by Q5 and Q6 is necessary to bypass the effect of contact bounce during key depression.

IC6 becomes important when two keys are depressed. Any abrupt change in voltage at the output of IC4 is fed through R56 66 and C10 to the input of IC6. C11 filters out spikes shorter than 1 millisecond or so that are associated with contact bounce or spurious interference. The resulting rounded pulse is amplified by IC6 (fig. 3). When the output of IC6 goes positive, CR9 conducts and also fires Q6. Therefore, a 20 millisecond positive going pulse is produced at the collector of Q5 whenever the keyboard buss voltage changes. While this 20 millisecond pulse is on, the trigger voltage at the collector of Q8 goes to zero. This recharges C13 and also resets the contour generators which will be described later. Thus, when a key is held down and a higher key is depressed, the sample-hold circuit again samples and the trigger is rest. The same happens when that higher key is released. However, if the higher key is held and the lower key is released, nothing will happen since the keyboard buss voltage remains constant. When all keys are released, CR9 conducts and a 20 millisecond pulse appears at the collector of Q5. However, the output of IC5 goes negative, so that when the collector of Q5 again goes negative, Q8 is not reset.

IC3 is a voltage follower. Its output is the voltage of the last key to be depressed. The variable resistor that controls the glide rate is connected between A7 and A24. The time constant of this resistor and C4 determines the glide rate. IC9 and Q2 are another voltage follower. The difference between this voltage follower and IC3 is only in the amount of input current required. IC9 is biased at a low current level so that input current does not result in a pitch error when the glide rate potentiometer is at its maximum resistance. The voltage at the emitter Q2 is the voltage which determines the pitch of the audio oscillator. It is also fed to the filters and contour generators so that as the keyboard voltage goes up the filter frequency also goes up and the contour time constants decrease.

IC8 is an operational adder. It adds the pitch, the one-octave transpose voltage, a tuning voltage from the fine tuning potentiometer on the rear panel, a modulating voltage, and the voltage from the external accessory socket. R14 is a temperature-compensating feed-back resistor. The summation constant increases with a temperature coefficient of approximately 3400 parts per million. The relationship between R14 and the input resistors is such that the output of IC8 decreases approximately 20 millivolts for each octave increase in frequency.

The audio sawtooth waveform is generated by charging C38 from one of the transistors in IC11, then rapidly discharging it through Q45. The current which charges C38 is determined by the voltage difference between pins 2 and 4 of IC11. The ratio of currents through these two transistors in IC11 is proportional to the voltage difference between their bases. The current from pin 1 of IC11 is kept constant via a feedback network. The voltage at pin 1 is compared with the voltage at the junction of R28 and R29. Any voltage difference generates an error signal which changes the total current to the transistor pair in IC11. When the "two octave" switch is up, R30 conducts and Q49 is saturated. This effectively places the series combination of R20 and R21 in parallel with R19. The voltage at pin 1 of IC11 is then determined by the current which flows through the parallel resistors R19 and R20-21. When the "two octave" switch is up, R30 does not conduct, Q49 is open, and R20-21 are out of the circuit. Thus the current from pin 1 of IC11 is one quarter as much when Q49 is open as it is when it is saturated and, for the same voltage difference between the bases, the current from pin 5 is also one quarter as much.

The lower end of C38 is applied to low-current voltage follower IC12-Q46. The voltage at the emitter of Q46 is fed to Schmitt trigger Q43-44. The Schmitt trigger has high hysteresis. When the voltage descends to the point where the Schmitt trigger fires, Q45 is turned on and C38 is rapidly discharged. The Schmitt trigger begins to shut off when the discharge is about 2/3 complete. Because of the storage time of Q44 and Q45, C38 is fully discharged before Q45 is completely off.

The sawtooth wave developed at the emitter of Q46 (Fig. 4) is applied through R41 to the base of Q47 and through R43 to the collector of Q48. Q47 is a high gain amplifier. The width of the rectangular wave that appears at its collector depends on the bias current supplied through R45 from the output of IC13. The control current which is fed to the input of IC13 from the resistor matrix determines the output voltage of IC13. When the control current is zero, Q47 remains saturated throughout the entire sawtooth cycle. Q48 also remains shut off, and the voltage across R120 is the undistorted sawtooth. As the control current increases, the voltage at the output of IC13 goes negative. When it is about -1 volt, the current through R113 is enough to completely saturate Q48 and effectively short out the sawtooth waves. When it is about -3 volts, Q47 begins to conduct on part of the sawtooth cycle and a narrow rectangular waveform appears at its collector. When the voltage at the output of IC13 is about -9 volts, the clipping of Q47 is symmetrical and a square wave appears at its collector. Thus, the waveform at the junction of R119 and R120 is first a sawtooth when the control current into IC13 is zero, then changes to a narrow rectangular, then to a broad rectangular, and finally to a square wave as the control current is increased. This waveform is fed to the bandpass filter.

The bandpass filter consists of IC15, IC16, and IC17, and their associated components. The input signal is fed to IC15 and IC16. IC16 and IC17 are identical integrators which are effectively connected in series. If it were not for IC15, the dual integrator network would produce two poles which would be very near to the imaginary axis. The presence of IC15 moves these poles to the left. Thus, the gains of IC16 and IC17 determine the center frequency of the filter, and the gain of

IC15 determines the bandwidth (Q). These gains are set by the bias currents which are fed from transistor pairs Q39-40 and Q37-38 respectively. These transistor pairs amy be compared directly to the transistor pair in IC11 which determines the frequency of oscillation. The main difference is that relatively constant currents are fed to these transistor pairs through R133 and R129. A precise, wide range relationship between output current and base-to-base voltage is not required of these transistor pairs. Only reasonable repeatability and the rough approximation of exponential characteristics are needed.

The bandwidth is determined by the voltage difference between the bases of Q37 and Q38. The voltage at the base of Q37 is the result of the bandwidth control currents flowing through R128. An increase of 18.5 mv doubles the bandwidth. There are two sources of Bandwidth control current: Row #8 of the resistor matrix, and the EMPHASIS potentiometer voltage applied to R121. The Center Frequency is determined by the voltage difference between the bases of Q39 and Q40. The voltage at the base of Q40 is the result of the center frequency control currents flowing through R134. An increase of 18.5 mv doubles the center frequency. These currents come from Row #7 of the resistor matrix, the COLOR potentiometer voltage applied to R193, the EXTERNAL jack voltage applied to R184, the modulation voltage applied to R181, the filter contour voltage applied to R116, and the keyboard pitch voltage applied through R179 and R180. The current from row #4 of the resistor matrix determines whether or not Q25 conducts. When Q25 conducts, it is saturated and shorts out the keyboard voltage which is routed to control the center frequency.

R130 and R132 are offset adjustments for setting correct values of bandwidth and center frequency respectively. They compensate for transistor offset voltages, resistor variations, and gain variations of IC15, IC16, and IC17.

The output of the bandpass filter is taken from the source of Q41 and applied across the bases of the bottom transistor pair of IC19. This transistor pair and the two immediately above it consitute a low pass filter whose cutoff frequency is proportional to the standing current. This current is in turn determined by the voltage difference between pin 13 of IC19 and the base of Q33. The voltage at the base of Q33 is the result of cutoff frequency currents flowing through R151. These currents come from row #9 of the resistor matrix, the COLOR potentiometer voltage applied to R186, the EXTERNAL jack voltage applied to R185, the modulation voltage applied to R187, and the filter contour voltage applied through R117. The setting of R139 determines the calibration current through R140. An increase of approximately 18.5 millivolts at the base of Q33 results in a one octave increase in the cutoff frequency of the low pass filter.

The transistor pair to the right of the low pass filter controls the amplitude of the audio waveform by variable transconductance. The current which determines this transconductance is in turn determined by the voltage of pin 12 of IC20, and the resistance between pin 13 and ground. The voltage applied to pin 12 is the amplitude contour voltage, and the resistor from B19 to ground is the 100k volume control potentiometer. IC22 is a differential amplifier, the output of which is the final audio waveform.

Of the two contour generators, the amplitude contour generator is the simplest, so it will be described first. This contour generator consists of Q35, Q36, IC18, transistor pairs Q26-27 and Q28-29, Q30, Q31, and the associated circuitry. When the trigger voltage goes on, Q35 partially discharges C25 so that the emitter of Q35 remains at 5 volts or so. If Q36 is saturated, Q34 does not go on at all. Row #3 in the resistor matrix determines whether or not Q36 is turned on. If Q34 is not turned on, the C25 is free to charge again through Q26. The charging current from Q26 is determined by the voltage control which the current from the resistor matrix develop across R189. Thus, the voltage at the emitter of Q35 is a decaying curve if Q36 is on, and a step followed by a decaying curve if Q36 is off. The rise time of the voltage at the emitter of Q35 is determined only by the ability of Q35 to discharge C25. Typically, this rise time is less then 1 millisecond. The decay time of the amplitude contour is determined by the voltage difference between the bases of Q26 and Q27. The voltage across R189 results from the amplitude contour decay time control currents coming from row #2 of the resistor matrix, the keyboard voltage applied to R199, and the shaping current from R169 and R171 (described below). R190 corrects for transistor offsets and other normal component variations. A voltage increase of 18.5 mv at the base of Q26 cuts the decay time in half.

IC18 and Q32 comprise a voltage follower whose slew rate is proporational to the bias current of IC18. The bias current comes from the collector of Q28 and is determined by the voltage difference between the bases of Q28 and Q29. Thus, since the decay time of an envelope is generally longer than the attack time, the voltage appearing at the source of Q32 has an attack time inversely proportional to the collector current of Q26. The contributions to attack time control are similar to those of decay time control. The quick-set current comes from row #1 of the resistor matrix.

Since Q26 is a nearly ideal current source, the decay slope at the source of Q32 would be a straight line, were it not for the action of Q30. At the beginning of the decay slope, the voltage at the base of Q30 is more positive than the emitter, and Q30 does not conduct. When the base of Q30 goes below -0.6 volts, Q30 acts as an emitter follower. The current through R169 slows down the decay slope. The more negative the base of Q30 goes, the higher is its control current, and the more the decay slope goes down. This gives the decay slope an extended tail and therefore sounds like a more natural exponential decay.

When the voltage at B21 is +9, Q31 is saturated and there is very little current flowing through R171. When the voltage at B21 is zero, R31 is open and current flows through R170-171 to greatly speed up the decay slope. The "sustain" switch connects B21 to +9 when it is down, and connects it to the trigger line when it is up. As a result, the tone is rapidly squelched when the "sustain" tab is up and the keys are released.

As noted above, the keyboard pitch voltage controls both attack and decay times through R199 and R198 respectively. These times change by a factor of approximately 2.5 over the complete keyboard range.

The filter contour generator contains most of the features of the amplitude contour generator. Q15 of the filter contour generator corresponds to Q35 of the amplitude contour generator, Q13 to Q34, and Q12 to Q36. An additional feature of the contour-initiating circuitry is the coupling in of trigger pulses from the modulating oscillator through R86 and R90 to produce repeated filter contours (Fig. 5). The "filter contour choice" control current that comes from the matrix row #11 through R88 and R91 determines whether the filter contour will rise and then immediately fall, or fall only upon release of all keys. Q9-10 of the filter contour generator corresponds to Q26-27 of the amplitude contour generator. The current from Q10 determines the decay time of the contour. Similarly, IC14 corresponds to IC18, Q18-19 corresponds to Q28-29, and Q16 correxponds to Q30. R95 and R101 couple the keyboard voltage to the attack and decay control circuits. Finally, the voltage applied to B18 from the contour potentiometer simultaneously varies the attack and decay times of the filter contour. Q22 and Q23 are routing switches; only one is on at a time. The "filter contour routing" control current from matrix row #5 determines whether Q17 is open or saturated. If Q17 is open, then Q21 is also open, and Q24 is saturated. Thus, Q22 is biased on and Q23 is biased off, and the contour is routed to the low pass filter. On the other hand, if Q17 is saturated, Q23 is biased on and the contour is routed to the center frequency control input of the bandpass filter.

DESCRIPTION OF CIRCUITRY ON SMALL BOARD

The raw power supply and modulating oscillator are mounted on the smaller circuit board, along with the seven slide potentiometers. Refer to drawing 08-004 for the schematic of this board. The raw supply is completely conventional. The nominal total load drawn from each of the raw voltages is 45 milliamperes. The modulating oscillator consists of IC1, IC2, and associated components. IC2 is an integrater and IC1 is a Schmitt trigger. The waverform at the output of IC2 is triangular and the waveform at the output of IC1 is square. The output of IC1 is used to drive Q1 in and out of saturation. Thus, the voltage at the square wave output (pin 12) is a square wave with a peak amplitude of precisely -9 volts. The trigger output (pin 10) is a positive pulse which occurs when the square wave switches from negative to positive. The current which supplies the integrater, and therefore the oscillator frequency, is varied by means of R10. The frequency range is 1-50 Hz.

Unless otherwise noted, controls and switches on the outside of the Satellite should be set in the following "normal" positions for testing:

CONTOUR	0
COLOR	0
EMPHASIS	0
RATE	0
DEPTH	10
GLIDE	0
VOLUME	10
FINE TUNE	Mid-Position
EFFECTS TABS	All up
QUICKSET TABS	All up

1. Adjust R4 until the +9 volt line is exactly 9.000 volts $\pm$10 mv. Verify that the -9 volts line is -9.000 volts $\pm$200 mv. ✓

2. Depress highest note on keyboard. Observe the voltage between A6 (common lead) and A5 (positive lead). Adjust R79 until voltage reads +9.000 volts $\pm$10 mv. This sets the keyboard current. ✓

3. Verify that the trigger voltage at the collector of Q8 is as shown in Fig. 6 when a single key is depressed. Hold that key down and depress the next highest key and verify that a trigger occurs. ✓

4. Verify that the keyboard pitch voltage at the emitter of Q2 goes from -4.50 volts to +4.50 volts $\pm$50 mv as the tester runs his hand up the keyboard. Also verify that this voltage holds while and after the key is released and does not drift more than 25 mv per minute. ✓

5. Depress "one octave" tab and the A above middle G on the keyboard. Observe a sawtooth wave as shown in Fig. 7 at the emitter of Q46. Adjust tune control to approximately the middle range. Adjust R16 for approximately 440 Hz.

6. Depress the C above middle G and adjust its frequency by means of the fine tuning control to some convenient value, say 500 Hz. Now play the lowest C on the keyboard and adjust R17 for precisely 125 Hz. Repeat until a precise two octave step results between these two C's. This sets the overall interval spacing.

7. Depress the lowest C. Observe that the frequency is precisely 125 Hz. Raise the "one octave" tab, and adjust R10 for precisely 250 Hz. This sets the one octave step.

8. Depress the "two octave" tab. Play middle "F" on the keyboard. Now flip the "two octave" tab up and adjust R21 for an oscillator frequency change of precisely two octaves. This sets the two octave step. 175 - 700

9. With all tabs up, depress the highest C and adjust the fine tune control for 2000 Hz. Play the lowest C. Adjust R25 for 250 Hz. Continue to go back and forth from the lowest C to the highest C until a perfect three octaves is obtained. This sets the high frequency compensation.

10. Repeat steps 6-9 until unit is in tune.

VIBR

11. Put the modulation waveform selector tab on square and the vibrato tab down. Put the MODULATION DEPTH ~~WIDTH~~ slider in its maximum position. Adjust R1 for a perfect octave jump.

WAVEF

12. Observe the waveform at the junction of R119 and R120. Depress the "hollow" tab. Adjust R47 for a symmetrical square wave. This sets the waveform calibration.

(VCF) ATT DEC

13. Depress the "one octave" tab and depress the second C from the bottom. Depress the "mute" tab. Observe the filter contour at the source of Q20 when the key is depressed. Adjust R98 and R105 until the filter contour matches the pattern shown in Fig. 9. This sets the filter contour attack and decay.

(VCA) ATTACK

14. Observe the voltage at the junction of R166 and R165. With the "mute" tab still down, depress the second C from the bottom, adjust R174 so that the attack time matches that shown in Fig. 10. This sets the amplitude contour attack.

(VCA) DECAY

15. Lift the "mute" tab and depress the "strike" tab. Depress the second C from the bottom. Adjust 190 for the decay time shown in Fig. 11. This sets the amplitude contour decay time.

(VCF) CUTOFF

16. Lift the "strike" tab and depress the "hollow" tab. Observe the waveform at the source of Q41. Depress the "one octave" tab and depress the second C from the bottom of the keyboard. Adjust R130 and R132 to obtain the waveform shown in Fig. 8. This sets the bandwidth and center frequency calibration.

OUT VOL

17. Raise all tabs. Depress the highest key on the keyboard. Set the VOLUME slider all the way up. Adjust R139 until the waveform at the output of IC22 is two volts peak-to-peak.

VCA ~~COMPEN~~ OFFSET

18. Short the junction of R149 and C30 to ground. Set the volume slider at maximum, hit and release a key and adjust R160 until minimum click or thump is heard.

19. Depress "bell" and "rep" tabs. Depress key and verify that the bell sound repeats.

20. Lift "rep" tab and depress "sust" tab. Hit and release a key and verify that bell decays slowly after the key is released.

21. Lift "rep" and "bell" tabs and depress "glide" tab. Verify that keyboard voltage glides between any two notes and verify that GLIDE slider varies glide rate.

22. Observe the voltage at A21. Using "tune" control set this voltage to 0 volts ± 100 mv. Depress "one octave" tab and A above middle G on the keyboard. Observe a sawtooth wave at emitter of Q46. Adjust R16 for precisely 440 Hz.

23. Cinch-Jones Six Pin Connector Test.

    a. Verify that the voltage between Pin 1 & 2 is +9.000 ±20 mv.

    b. Verify that the voltage between Pin 3 & 2 is -9.000 ±200 mv.

    c. Depress the "one octave" tab, depress low C on the keyboard, and adjust "tune" control for 125 Hz. Apply +900 volts to Pin 4 and verify that the oscillator frequency is now 500 Hz ±50 Hz.

    d. Raise all tabs and depress the lowest key on keyboard. Observe output of IC22. Apply -3 volts to Pin 5. Waveform should read .8 volts pp. approximately. This tests the external control of lowpass filter.

    e. Depress "bright" tab and second C from the bottom of keyboard. Observe waveform at source of Q41. Apply -3 volts to Pin 5. Waveform should compare to waveform in Fig. 12. This tests the external control of the bandpass filter.

    f. Raise all tabs. Momentarily apply +9.00 volts to Pin 6. Verify that a trigger occurs when the voltage is applied.

24. Depress "bright" tab and any key on keyboard. Apply -3 volts to Filter Control Jack. Verify that the harmonic content of output waveform decreases. This determines whether Filter Control Jack wiring is correct.

25. Turn "volume" and "level" pots to maximum. Depress highest key on keyboard. High and low outputs should read -10 and -20 dB ± 2 respectively. Check "level" control for correct operation.

26. Double check all "tabs", controls, and keyboard for correct operation.

CHKD. BY______DATE________ ______________________________ JOB NO.____________________

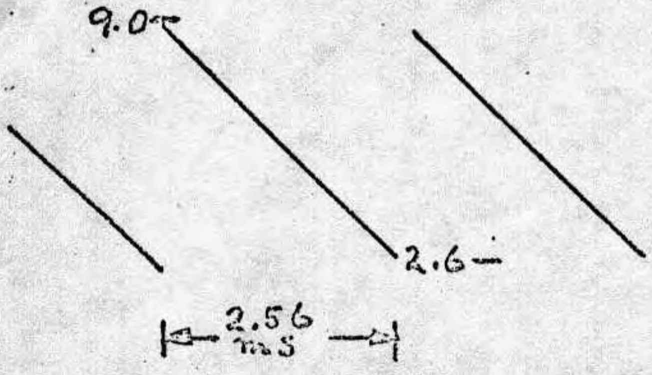


FIG. 7. EMITTER OF Q46 WITH MIDDLE G DEPRESSED.

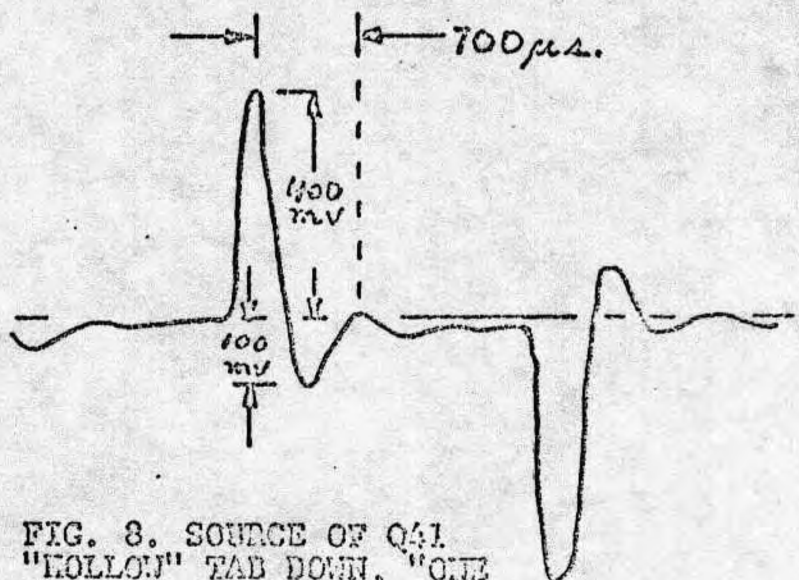


FIG. 8. SOURCE OF Q41 "HOLLOW" TAB DOWN, "ONE OCTAVE" TAB DOWN, FREQUENCY OF 262 Hz.

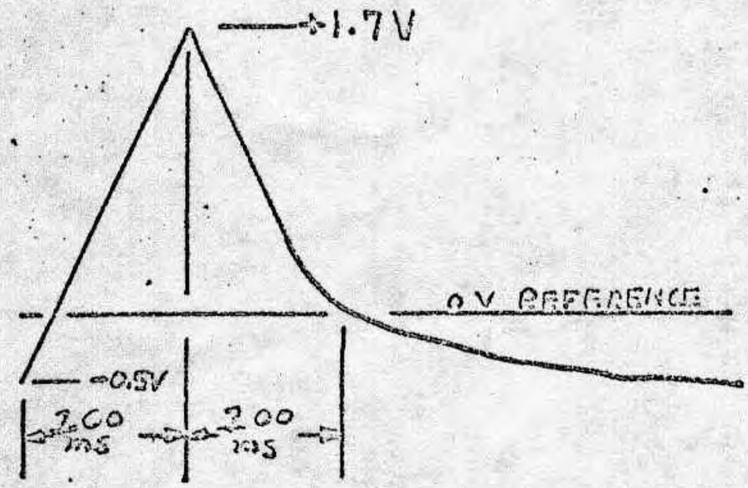


FIG. 9. SOURCE OF Q20 WITH "MUTE" AND "ONE OCTAVE" TABS DEPRESSED, FREQUENCY OF 262 Hz.

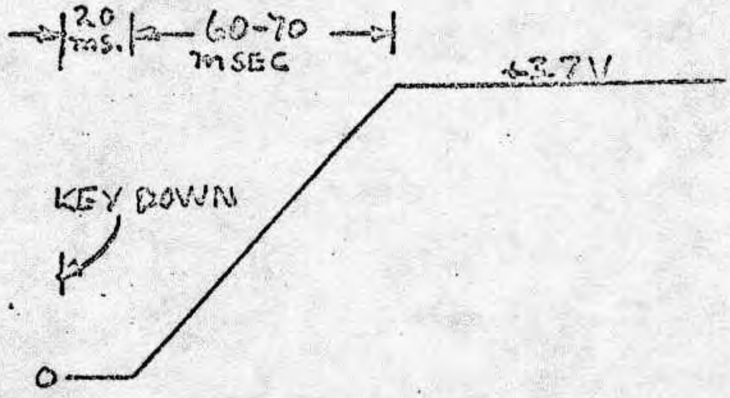


FIG. 10. JUNCTION OF R165 and R166 WITH "MUTE" AND "ONE OCTAVE" TABS DEPRESSED, FREQUENCY OF 262 Hz.

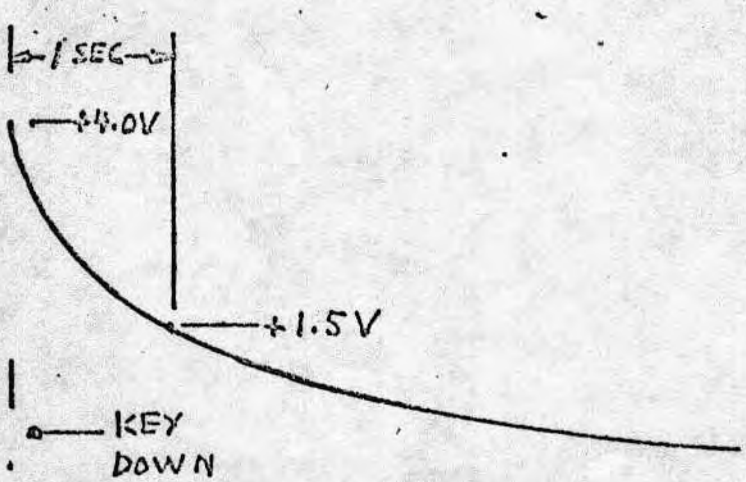


FIG. 11. JUNCTION OF R165 and R166 WITH "STRIKE" and "ONE OCTAVE" TABS DEPRESSED, FREQUENCY OF 262 Hz.

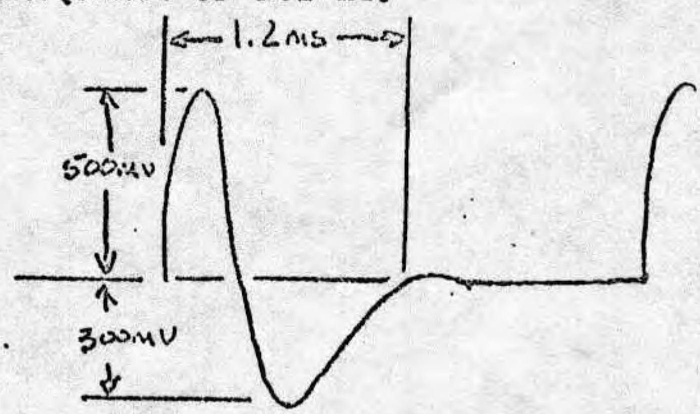


FIG. 12. SOURCE OF Q41 WITH "BRIGHT" TAB DEPRESSED, -3 VOLTS ON EXT. FIL., FREQ. OF 524HZ.

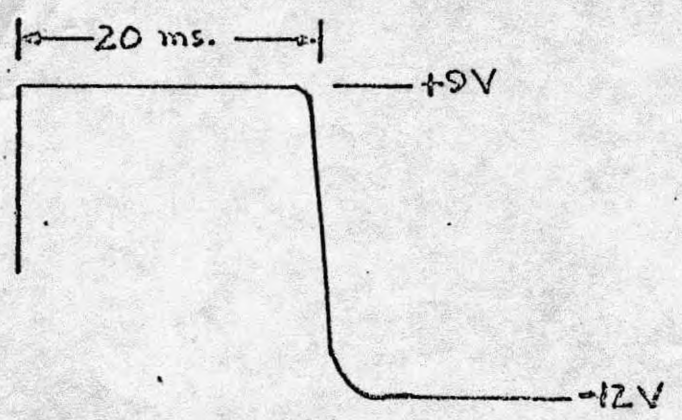


FIG. 1. COLLECTOR OF Q5

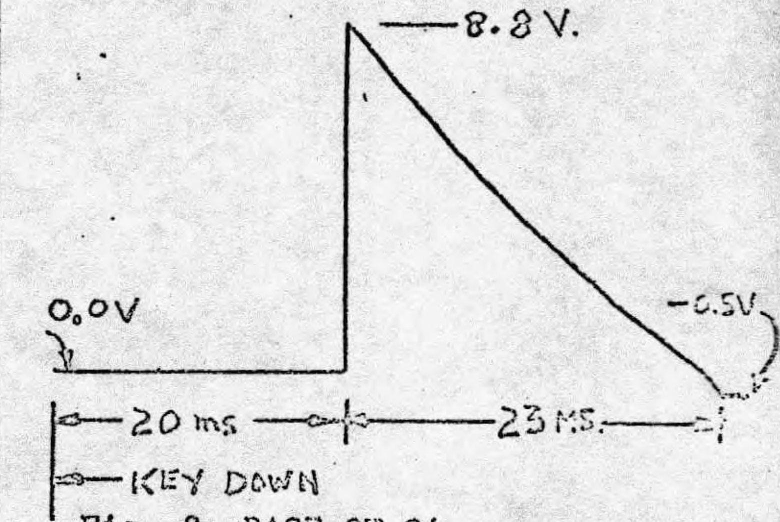


Fig. 2. BASE OF Q4

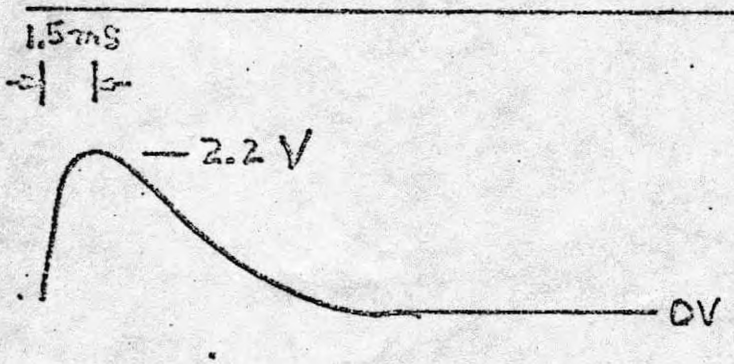


FIG. 3. PIN #6 OF IC6

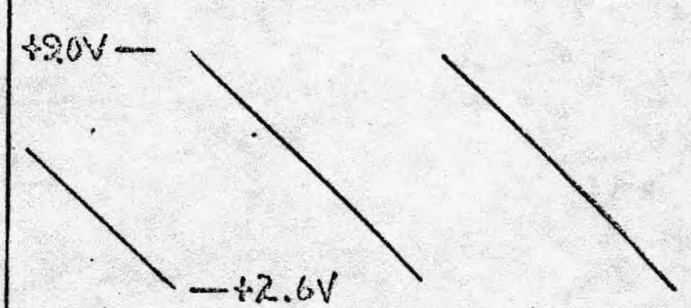


FIG. 4. EMITTER OF Q46

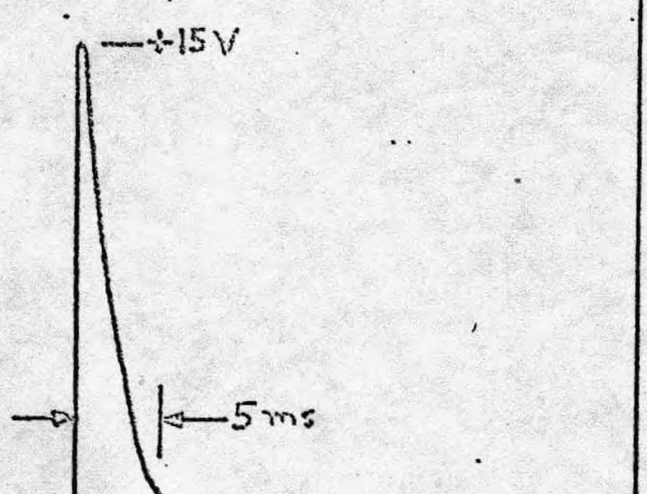


FIG. 5. JUNCTION OF R86 AND R90

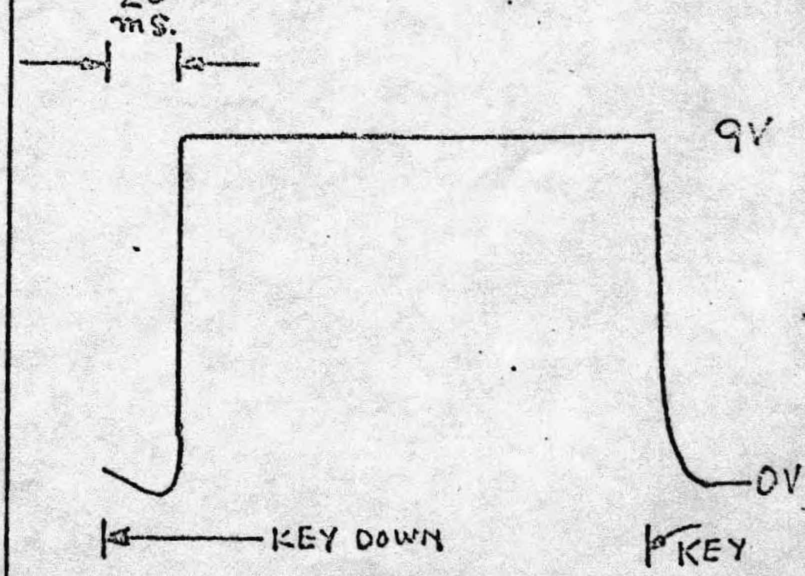


FIG. 6. collector of Q8

SATELLITE

SYMPTOMS	PROBABLE CAUSE	CORRECTION
1. No regulated +9 volts	No raw DC	1. Plug and line cord 2. Power Switch 3. Transformer T1 open 4. Diodes D1 - D4 open 5. Filter Caps shortened
	Load exceeds 50 ma	1. Measure resistance of +9 volts to ground nominal value 900 ohms 2. Check R2 & C3
	Bad regulator	1. Replace IC1
2. Regulated +9 volts not adjustable.	Bad regulator	1. Replace IC1 2. Check R3, R4, R5
	Load exceeds 50ma	1. Measure resistance of +9 volts to ground nominal value 900 ohms 2. Check R2 & C3
	Raw DC low	1. Transformer T1 2. Diodes D1 - D4 3. Filter Cap
3. Excessive ripple on +9 volts	Excessive ripple on raw DC	1. Filter Caps 2. Diodes D1 - D4 3. Transformer T1
	Bad regulator	1. Replace IC1 2. Check C3
4. No regulated -9 volts	No reference	1. Check +9 volts
	No raw DC	1. Transformer T1 2. Diodes D1 - D4 3. Filter caps
	Load exceeds 50ma	1. Measure resistance of -9 volts to ground nominal value 1000 ohms 2. Check C2

SYMPTOMS	PROBABLE CAUSE	CORRECTION
	Bad regulator	1. Replace IC2 2. Replace Q1 3. Check R8, R6, R7
5. Regulated -9 volts out of tolerance	Bad regulator	1. Replace IC2 2. Replace Q1 3. Check R8, R6, R7
	Load exceeds 50ma	1. Measure resistance of -9 volts to ground nominal value 1000 ohm. 2. Check C2.
	Raw DC low	1. Transformer T1 2. Diodes D1 - D4 3. Filter caps
6. Excessive Ripple on -9 volts	Excessive ripple on raw DC	1. Filter caps 2. Diodes 3. Transformer
	Bad Regulator	1. Replace IC2 2. Replace Q2 3. Check C2
7. No keyboard voltage	Keyboard shorted	1. Remove short
8. Keyboard voltage not adjustable	Ground on keyboard string	1. Remove short to ground
	Keyboard resistor string open	1. Replace bad resistor 2. Fix open
	Bad current source	1. Replace IC7 2. Check R80, R79, R81, R82
9. No trig signal	No keyboard voltage	1. Check keyboard current source 2. Check keyboard buss connection 3. Replace IC4 4. Check R53

SYMPTOMS	PROBABLE CAUSE	CORRECTION
	Key down comparator not switching (IC5)	1. Check input of IC5 for change 2. Check R65, R67 3. Replace IC5
	One shot not firing	1. Replace Q6, Q7 2. Check C7, C6, CR7, CR9, CR10 3. Check R68, R69, R70, R71
	DC gate not working	1. Replace Q7, Q8 2. Check CR8, C12, R73, R72 R83, R71
10. No 10 milli-second delay	One shot time not right	1. Replace C6 2. Replace Q5 Q6 3. Check R71, R69, R70
11. No higher note trigger	AC keydown detector	1. Replace IC6 2. Check CR9, CR10 3. Check R66, C10, C11, R76 R74, R75, C8, C9, R192, R17, R78
	One shot or DC gate	1. See No Trig section
12. No pitch voltage change	Sample & hold circuit not sampling	1. Check at A7 2. Check CR1, R61, C13 3. Replace Q50, Q4 4. Check R62 5. Replace Q3 6. Check R64, R58, R59 7. Replace IC10, Q51 8. Check C5, R54, C37, R57, R55, R56, R60 9. Replace IC3
	Open glide circuit	1. Check Glide switch 2. Check Glide pot
	Defective isolation amplifier	1. Replace IC9, Q2 2. Check C4, R52, R49, R50 C36, R51
13. Pitch Voltage goes backwards	Keyboard	1. Check for ground on keyboards 2. Check keyboard current source

	SYMPTOMS	PROBABLE CAUSE	CORRECTION
14.	Pitch Voltage drifts	Sample & Hold	1. Replace Q51, IC10, C5 2. Replace Q3 3. Check trig circuits
15.	OSC not running	Current source	1. Replace IC11, IC21 2. Check R19, R28 3. Replace IC8 4/ Check R17, R18, R16, R14 5. Check R13, R12, R11, R9, R20, R48, R24, R25 6. Check pin 6 IC8 för OV DC ±100 mv
		Relaxation OSC	1. Replace C38, Q45, IC12, Q46, Q43, Q44 2. Check R31, R38, R39, R37, R40, R36, R33, R34, R35, C17
16.	Sawtooth not to spec.	Isolation amp or Schmitt trig	1. Replace IC12, IQ46, Q43, Q44 2. Check R37, R36, R40, R35, R34 3. Check R39, R31, Q45, R41, R43
17,	High frequency OSC on sawtooth	Isolation Amp	1. Replace C17, IC12, Q46, R35 2. Check R36, R41, R43
18.	OSC running very high frequency	Current source	1. Replace IC11, R14 2. See osc not running section
19.	Osc. running out of frequency adjustment range	Summing amp	1. Check R16, R14, R17, R18, R12, R48, R11, R9, R10, C 38 2. Check tune control 3. See osc. not running section
20.	Osc. has severe f freq. drift problems		1. Check power supply 2. Check keyboard voltage 3. Check other control inputs 4. See osc. not running section
21.	Scale will not adjust	Summing amp	1. Check R17, R18, R14, R48 2. See 19
22.	One octave tab will not set up	Wiring	1. Check one octave switch
		Summing amp	1. Check R9, R10 2. Check keyboard voltage 3. See 21

	SYMPTOMS	PROBABLE CAUSE	CORRECTION
23.	Two octave tab will not set up	Wiring	1. Check two octave switch
		Exponential current source	1. Replace IC11, Q49 2. Check R20, R21, R22, R23 3. See 15
24.	High Freq. Comp. will not set up	Summing amp	1. Check R25, R24 2. Replace IC11 3. See 19
25.	Modulation depth will not set up	Summing amp	1. Check R12, R1 2. See 19
		Wiring	1. Check Vib tab 2. Check mod depth pot 3. Check sine-square tab 4. Check mod osc
26,	Wave form will not set up	Wave form selector	1. Replace IC13, Q47, Q48 2. Check R46, R47, R45, R118, R41, R42, R43, R44, R119, R120 3. Check matrix
27.	No filter contour signal	Filter contour	1. Check trig 2. Replace Q15, Q13, Q9, Q10, IC14, Q14, Q20, Q19, Q18 3. Check C15, C14, CR5, R84, R85, CR3 4. Check R94, R96, R97, R106, R104, R103, Q16, R102 5. Check matrix
28.	Filter decay does not set up	Filter contour decay current source	1. Replace Q9, Q10, Q15, Q16, Q13, Q12, Q11, Q14 2. Check keyboard voltage 3. Check R94, R96, R97, R102, R98, R95, R96, R99 4. Check one octave tab 5. Check mute tab 6. Check matrix 7. See 29
29.	Filter attack does not set up	Filter contour attack current source	1. Replace Q18, Q19, IC14, Q20, C16 2. Check R106, R104, R103, R105, R107, R108, R101, R100 3. Check contour pot 4. Check keyboard voltage 5. Check one octave tab 6. Check mute tab 7. Check matrix

SYMPTOMS	PROBABLE CAUSE	CORRECTION
30. No VCA contour	VCA contour	1. Check trig 2. Replace Q35, Q34, Q26, Q27, Q28, Q29, IC18, Q32, Q30, Q31, 3. Check C24, CR6, R135, R136 C25, R175, R189, R176, R177, C35, R165, R166, R167, R168 4. Check R188, R190, R173, R174, R199, R198 5. Replace IC20 6. Check one octave tab 7. Check keyboard voltage 8. Check mute tab 9. Check matrix
31. VCA attack does not set up	VCA contour decay current source	1. Replace Q28, Q29, IC18, Q32 2. Check R176, R177, R173, R174, R167, R168, R198, C35 3. Check keyboard voltage 4. Check one octave tab 5. Check mute tab 6. Check matrix 7. See 32
32. VCA decay does not set up	VCA contour decay current source	1. Replace Q26, Q27, Q31, Q35, Q34, IC18, Q36, Q30 2. Check R175, R189, R188, R190, R199, R172, R170, R171, R169, R168, R167, C25 3. Check keyboard voltage 4. Check one octave tab 5. Check strike tab 6. Check matrix
33. No signal out of Band pass filter	Band pass filter	1. Check center freq. adj. 2. Check band with adj. 3. Replace IC15, IC16, IC17, Q41, Q42 4. Check R122, R124, C20, C23, R142, R148, C26, C27, R141, R147
34. Bandpass filter will not set up	Bandwidth adjustment	1. Replace Q37, Q38, IC15 2. Check R128, R129, R130, R131 R121, R191 3. Check emphasis pot 4. Check R122, R123, R125, C23, C21, R126, R143 5. Check osc. freq.
	Center freq. adj.	1. Replace Q39, Q40, IC16, IC17, Q41, Q42 2. Check R134, R133, R132, R131, R141, R147 3. Check matrix

SYMPTOMS	PROBABLE CAUSE	CORRECTION
		4. Check contour input from R116 5. Check ext. fil & color pot 6. Check Trem. input 7. Check osc. freq.
35. No signal on output of VCA	Low pass filter	1. Replace IC19 IC20, O33 2. Check filter contour output 3. Check colot pot & ext. fil 4. Check R149, C30, R164, R150 R152, R151, R139, R140 5. Check matrix 6. Check R158 R157, R156, R155, R154,R153, C39, C40,C31 7. Check trem input 8. Check osc. freq.
	VCA	1. Replace IC20, IC22, 2. Check VCA contour output 3. Check vol pot 4. Check R164, C32, R160, R159 R161, R162, R163
36. Low pass filter will not set up	Lowpass filter	1. Replace IC19, IC20, O33 2. Check matrix 3. Check VCF contour output 4. See 35
	VCA	1. Replace IC20, IC22 2. Check vol pot 3. Check VCA contour output 4. See 35
37. VCA will not balance	VCA	1. Replace IC20, IC22, IC19 2. Check R160, R159, R161, R163 R162, R164 3. Check vol pot 4. See 35 & 36
38. Repeat will not function	Mod osc	1. Replace O12, O13 2. Check mod osc repeat trig out 3. Check rep tab 4. Check filt contour 5. See 33
39. Sustain will not function	VCA contour generator	1. Replace O31 2. Check R172, R170, R171 3/ Check Sustain tab 4. See 30

SYMPTOMS	PROBABLE CAUSE	CORRECTION
40. Glide does not function	Keyboard circuit	1. Check glide switch 2. Check flide pot 3. Replace C4 4. See 12
41. Tune pot does not function	Summing amp	1. Replace tune pot 2. Check R11 3. Check one octave tab 4. Check keyboard voltage 5. See 19
42. Accessory jack does not work	Wiring	1. Check connector wiring 2. Check board connections 3. See areas pertaining to function failing
43. One voice does not sound right	Matrix	1. Check adjustments 2. Check tab 3. Replace matrix
44. More than one voice does not sound right	Adjustments	1. Check adjustments
	Matrix	1. Find voices with errors and look for common cause example VCF contour routing control 2. Check control point 3. Check tabs 4. Replace matrix 5. Check modifier controls
45. Some voices have low volume	Low pass filter	1. See 35 2. Check matrix 3. See 44
	VCA	1. See 35 2. Check matrix 3. See 44
	Band pass filter	1. See 33 2. Check matrix 3. See 44
	Filter contour	1. Check VCF contour routing circuit Q22, Q23, CR11, CR12, Q21, Q24, Q17 2. Check matrix 3. See 44 4. See 27
	VCA contour	1. See 30 2. Check matrix 3. See 44
46. Double triggering	Keyboard	1. Adjust keyboard contacts