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MICRO-TEL CORPORATION
BALTIMORE, MARYLAND
U.S.A.

OPERATING AND MAINTENANCE MANUAL FOR SG-811 SWEPT SIGNAL GENERATOR

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ADDENDUM

This supplement contains additions and changes to the standard manual, and applies only to the model and serial number listed below

Model: SG-811

Serial No: 286

Date: February, 1981

Mikrotel SG 811
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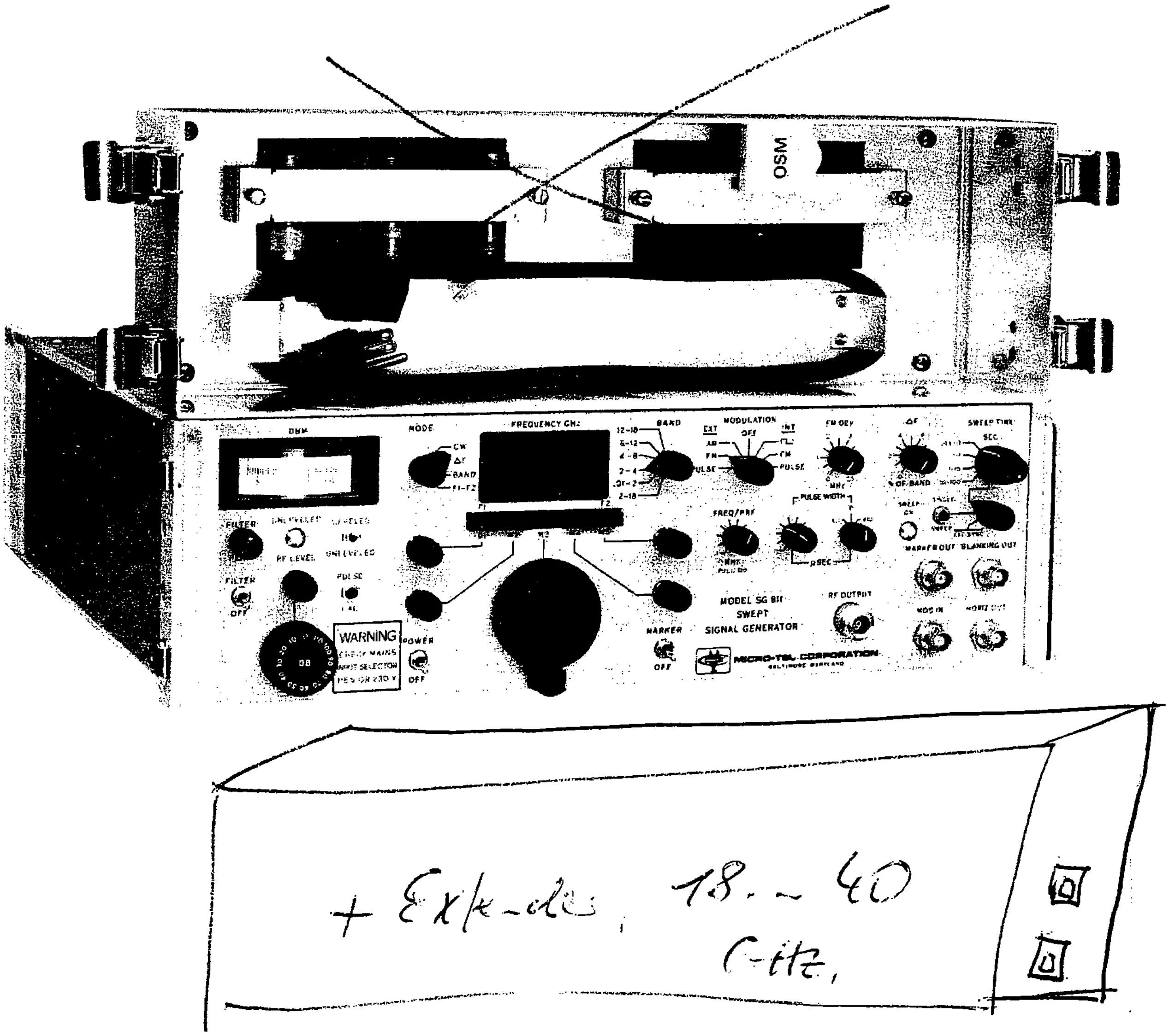


SG-811 Swept Signal Generator

Figure 1.1

1.0 GENERAL DESCRIPTION

This section provides an overview of the operation of the SG-811 Swept Signal Generator, a description of the options available, and the specifications to which it is built.

1.1 INTRODUCTION

The Micro-Tel SG-811 Swept Signal Generator is a small, compact signal source that covers the entire frequency range of 10 MHz to 18 GHz without plug-ins. It performs all the functions of a sweeper, and because of its effective shielding, modulation capability, and optional attenuator, it is a conventional signal generator.

A large number of options are available, including internal and external leveling with absolute power calibration, calibrated output attenuator, output filter, signal sample, high pulse on-off ratio, remote digital control, and limited frequency coverage.

A standard feature is the removeable RF Unit. All RF components are contained in a single, shielded module within the main frame. This module may be removed from the generator and operated remotely through a control/power cable.

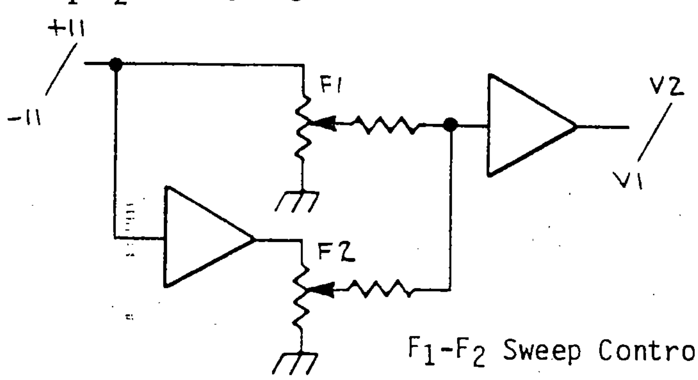
All standard units operate from 115/230 VAC, 50-400 Hz. Operation from 12 VDC is available as an option.

The SG-811A and SG-811B are the same except for power output. As an option, the SG-811C adds solid-state and TWT amplifiers in an external assembly to increase the power above the levels available directly from solid-state sources.

1.2 PRINCIPLES OF OPERATION

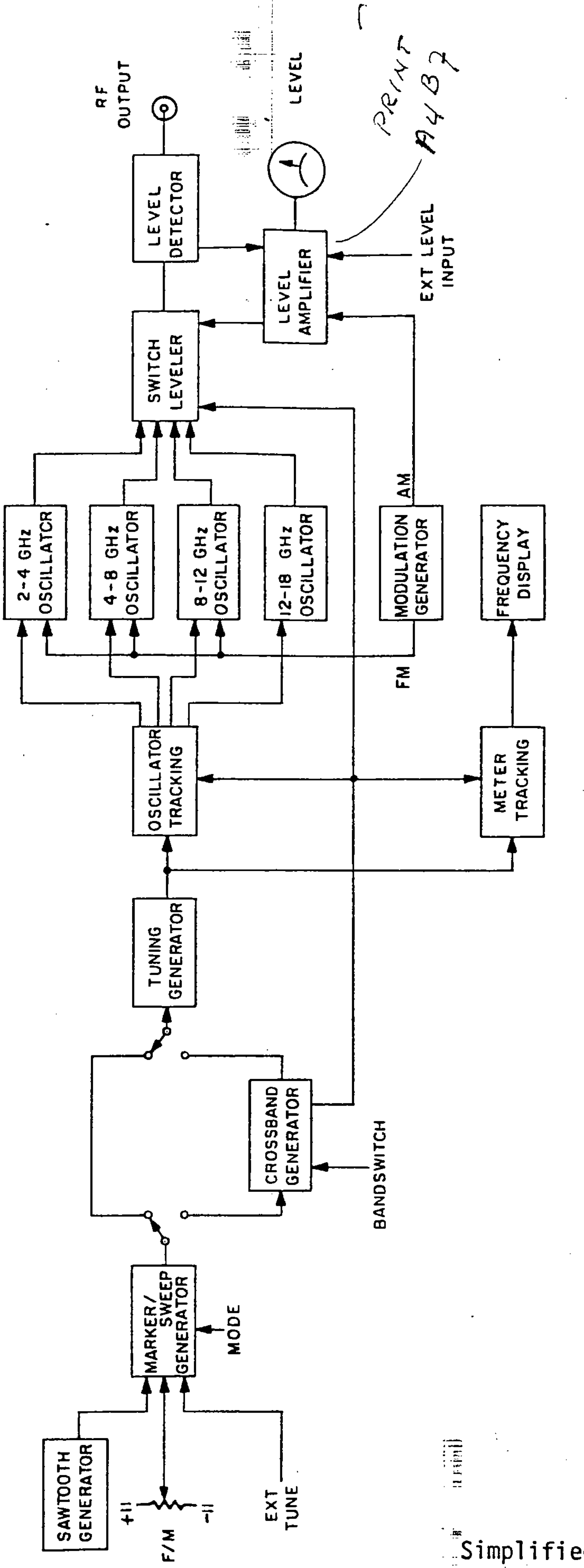
The simplified functional block diagram of the SG-811 is shown in Figure 1.2. The RF sources are YIG oscillators which are electronically tuned and have a very linear tuning function. The RF output of the four YIG oscillators are switched to the single output port and leveled by a PIN switch. The RF output is sampled by the level detector and compared in the level amplifier circuits to a preset value; the difference is amplified to drive the PIN in the direction to zero this error. The preset value to the level amplifier is varied to produce amplitude modulation and to attenuate the RF output over a 20 dB range.

The composite tuning signal is synthesized in the Marker/Sweep Generator from two components. One is the DC manual tuning voltage at the arm of the selected F/M tuning control; the other is the output of the sawtooth generator. Both components vary from -11 to +11 volts at the low and high limits of each band respectively. The external tuning input may be substituted for either component. In the CW mode, only the DC component is used. In the BAND mode, the full band is swept, and only the sawtooth component is used. In the △ F mode, the frequency is swept a small percentage about a center frequency, so the composite signal is the DC component summed to an attenuated, adjustable value of the sawtooth. In the F_1-F_2 mode, the generator may be swept between any two frequencies in the selected band, and the tuning signal is generated as shown in Figure 1.3. The F_1 control varies the amplitude of the sawtooth, and the F_2 control varies the amplitude of the inverted sawtooth. The output of both controls is summed to form the composite F_1-F_2 tuning signal.



F_1-F_2 Sweep Control

Figure 1.3



Simplified Functional Block Diagram

Figure 1.2

The marker controls connect between -11 and +11 volts. The marker pulses are generated by comparators which compare the sawtooth with the voltage at the arm of each marker control. The blanking signal is generated by the flyback portion of the sawtooth.

For single band operation the composite tuning signal drives the tuning generator directly, and bands are switched by the front panel control or an external signal. In the crossband mode, the -11 and +11 volt composite signal must tune from the low end of the lowest band to the high end of the highest band. Therefore the composite tuning signal is fed to the crossband generator where it is divided into segments, each segment proportional to one single band. The segments are selected by voltage comparators having their reference inputs set to voltages proportional to the band switchover points. The comparator outputs are converted to BCD bandswitch commands to select the corresponding YIG oscillator and tracking circuits. Each segment of the original tuning excursion is amplified and offset to extend from -11 to +11 volts and therefore tune the selected oscillator over its full frequency range.

In both single band and crossband operation, the input to the tuning generator extends from -11 to +11 volts. The tuning generator converts this to extend from 0 to +9 volts so that it can be electronically switched to the tracking networks. The tracking networks modify the output of the tuning generator to match the tuning characteristics of each oscillator. Similar tracking networks adjust the input of the digital frequency display to compensate for variations in the individual YIG oscillator tuning characteristics. There is one oscillator tracking network and one meter tracking network for each band.

In addition to its main tuning coil, each YIG oscillator has a small generator for FM.

If Option 1, coverage from .01 to 2.0 GHz, is included, the output of the 2-4 GHz YIG oscillator is extended to cover 2.31 to 4.3 GHz and is heterodyned by a stable 2.3 GHz source. The difference output of .01 to 2.0 GHz is filtered and amplified.

1.3 STANDARD EQUIPMENT AND OPTIONS

The basic SG-811A and SG-811B Swept Signal Generators contain four YIG oscillators multiplexed to a single output connector, and cover the frequency range of 1.9 to 18 GHz in a single band or four separate bands. Other standard features are:

*Internal and external leveling
*Calibrated power level variable over a 20 dB range.
*Internal FM and squarewave modulation.
*Remotable RF Unit.
*Digital control of mode, band and power.
*External analog frequency Control

dabei:

1.3.1 10 MHz TO 2.0 GHz - OPTION 1

This option adds internal components covering the .01 to 2.0 GHz range in one band. Output from .01-18 GHz is from a single connector with manual bandswitching at 2 GHz. Automatic switching at 2 GHz is available on special order with a 3 dB loss of output power.

1.3.2 CALIBRATED OUTPUT ATTENUATOR OPTIONS 2 and 2A

dabei

This option offers the choice of a 70 dB (Option 2) or 110 dB (Option 2A) output attenuator adjustable in 10 dB steps. The attenuators are digital devices and are controlled manua conjunction with the standard 20 dB continuous control, offers calibrated output to -80 or -120 dBm respectively. Attenuator accuracy is ±4% of setting at 18 GHz. Maximum output power is reduced by 2 dB or less, and the variation in leveled output is increased to ±1.5 dB.

1.3.3 FILTERED OUTPUT OPTIONS 3 and 3A

The harmonic output of the YIG oscillators used in the SG-811 is typically 20 dB down. The addition of this automatically-tracked YIG filter reduces the harmonic output to 60 dB. Since the filter has an insertion loss of 6 dB, it can be switched out from the front panel when not in use. The filter is primarily for manually-tuned applications. Option 3 covers 1.9-18 GHz: Option 3A covers 0.4-18 GHz.

1.3.4 RF SAMPLE - OPTION 4

This option provides a signal sample at a nominal level of 0 dBm for use with frequency counters, synthesizers, and stabilizers. Option 4 RF Sample output is 1.9-18 GHz. In Band 1 the RF Sample output is 2.3 GHz above the RF output on the Front Panel.

1.3.5 INTERNAL PULSE GENERATOR OPTION 5

Option 5 adds a fully self-contained pulse capability to the SG-811 with pulse width from 0.1 to 100 usec and PRF from 100 to 10,000 Hz. Rise and fall times are less than 20 nanoseconds. On-Off ratio is 70 dB when using a filtered device such as a receiver with preselector. Means are provided to calibrate the pulse output amplitude. A sync pulse is available, and external pulsing may be employed.

1.3.6 DIGITAL CONTROL AND IEEE 488 OPTIONS 6 and 6A

Frequency of the standard SG-811 can be controlled by an external analog voltage. The standard generator also includes external digital control of band selection, amplitude in 1 dB steps over a 10 dB range, and Mode (CW, F, etc). If BCD digital frequency control is required, Option 6 adds a D-A Converter in the form of a plug-in circuit board. Alternatively, Option 6A provides the same control in the IEEE 488 format. All digital input signals terminate in a rear panel connector.

1.3.7 EXTERNAL DC POWER OPTION 7

The standard SG-811 operates from 115/230 VAC, 50-400 Hz. This option adds the capability of operating from a negative-ground, DC input over the range of 11.0 to 14.0 volts.

1.4 SPECIFICATIONS

Band	1*	2	3	4	5	6
Frequency Range - GHz	.01-2	1.9-18	1.9-4	4-8	8-12	12-18
Frequency Display Accuracy	+20MHz	+1%	+.5%	+.5%	+.5%	+.5%
Harmonic Output	------------------20 dB------------------					
Harmonic Output w/Option 3A	------------------60 dB (1)-------------					
Non-Harmonic Output	20 dB--------------60 dB-----------------					
Peak Residual FM - kHz	10	50	10	15	20	30
Residual AM - 100 kHz BW	------------------50 dB------------------					
Output Power Control Range	--------20 dB Accuracy ±0.2 dB (2)--------					
Frequency Stability - MHz/°C	.4	2.5	.4	.5	1.0	1.5

Leveled Power Output - dBm (3)	SG-811A	SG-811B
.01-2 GHz	7 mW ±1 dB	15 mW ±1 dB
2-12 GHz	8 mW ±1 dB	15 mW ±1 dB
12-18 GHz	6 mW ±1 dB	12 mW ±1 dB

RFI — Less than -80 dBm

Modes:

- Band — Sweeps entire range selected by bandswitch. Five markers provided.
- F_1-F_2 — Sweeps between any two selected frequencies. R Three markers provided.
- ΔF — Sweeps 0-10% about any of five preselected frequencies.
- CW/Manual Sweep — Preset any five frequencies or manually tune entire band.

Sweep Rate: Continuously adjustable from .03 to 100 seconds per sweep, except 2-18 GHz is limited to 36 milliseconds minimum sweep time.

Sweep Modes:
Internal
External -- Sync
Single Sweep

Modulation: Internal/External

- AM	100-10,000 Hz squarewave
- FM	100-10,000 Hz, 0-5 MHz deviation
- Pulse (Option 5)	100-10,000 Hz, .1-100 usec 70 dB on-off ratio. 20 ns rise and fall

Size: 5-1/2 x 17 x 18 inches

Weight: 45 pounds

Power Required: 115/230 volts, 50-400 Hz
12 VDC with Option 7.

* Coverage from .01-2.0 GHz is optional

(1) Harmonic output below 400 MHz is 20 dB.

(2) Panel meter is calibrated linearly in dBm and reads output power, ahead of the attenuator if Option 2 or 2A is installed.

(3) These are minimum leveled power output and maximum leveling variation when operated in crossband mode without options. Expect improvement in leveling to $\pm$0.7 dB for operation in single bands. Expect losses in power output of $\overline{1}$ dB per option at 18 GHz when options are switched out. Some variation can be expected because of the various combinations of options. Filtered output (Option 3A) limits at 0 dBm below 2 GHz.

NOMINAL INSERTION LOSS (dB)		
Option	In	Out
1	1.0	1.0
2, 2A	2.0	---
3, 3A	5.0	1.0
4	1.0	---
5	3.0	1.0

2.0 INSTALLATION

This section contains important information concerning checks which should be accomplished prior to installation or applying power to the instrument.

2.1 UNPACKING AND INSPECTION

The SG-811 should be unpacked and visually inspected for any damage which may have occured during shipment. Remove the top and bottom covers. Inspect for loose components. Check that all printed circuit boards are firmly seated in their sockets.

The SG-811 may be mounted in any convenient position or attitude, and no consideration need be given to cooling unless it is operated at a high temperature or placed next to equipment which radiates excessive heat.

2.2 REMOTE UNIT

The complete generator is packaged within the single case when the RF Unit is not located at a remote location. If the RF Unit is to be located outside the mainframe.

1. Remove the top and bottom covers.

2. Remove the green cover plate on the right side panel and then remove the right side panel. Eight screws on this panel attach to the RF Unit.

3. Remove the coaxial cable from the ALC connectors on the RF Unit and inside rear panel. Remove P7 and P8 (Option 5) from the RF Unit. Disconnect the power/control cable from the RF Unit.

4. Remove the four thumbscrews which mount the RF Unit to the internal frame, and carefully lift the RF Unit from the mainframe.

5. The power/control cable connects to the bulkhead connector J9 on the rear panel. The coaxial cable marked P7 connects to the rear panel bulkhead connector J7. If the SG-811 has Option 5, Internal Pulse Generator, a second coax cable marked P8 must be connected to J8 on the rear panel. Secure or remove the coaxial cable which connects to the rear panel EXT ALC IN connector. If the SG-811 has Option 4, RF Sample, secure or remove the coaxial cable which connects to the rear panel RF SAMPLE OUT connector.

6. Replace the side panel, and the top and bottom covers.

7. Connect the power/control cable from J9 on the rear panel to the corresponding multipin connector on the RF Unit. The two connectors are Bendix PT06A-20-41P(SR) at the SG-811 and Bendix PT06A-20-41S(SR) at the RF Unit. The interconnecting cable can be up to 200 feet of 20 gage wire connecting corresponding pins of the above connectors. A prefabricated cable such as Alpha No. 5355 is recommended; unused wires are cut off. Type RG-223/U coaxial cable should connect P7 on the SG-811 to J7 on the RF Unit, with a UG-88C/U connector at the mainframe and Solitron 2900-6002 connector at the RF Unit. If the SG-811 has Option 5, a similar coaxial cable must connect J8 on the mainframe to J8 on the RF Unit.

The above procedure is reversed when replacing the RF Unit in the mainframe.

2.3 REMOTE CONTROL INPUT

The pin connections to the REMOTE CONTROL INPUT connector on the rear panel are listed in Figure 2.1. The 10 dB attenuator steps operate only if the SG-811 contains Option 2 or 2A. The digital frequency control operates only if the SG-811 contains Option 6 or 6A. The connector to the REMOTE CONTROL INPUT is Amphenol 57-40500.

The Digital Frequency Control word entered on pins 26 through 41 is a four digit BCD number from 0000 to 9999 representing the low end and high end of the selected band respectively. Since each band is definable to 10,000 resolution points, bit weight is the frequency coverage of each band divided by 10^4.

The BCD Remote Band input is as follows:

Band	Frequency	Pin Numbers 4	3	2	1
1	.01-2 GHz	0	0	0	1
2	2-4 GHz	0	0	1	0
3	4-8 GHz	0	0	1	1
4	8-12 GHz	0	1	0	0
5	12-18 GHz	0	1	0	1
8	2-18 GHz	1	0	0	0

2.4 POWER REQUIREMENTS

Before connecting the SG-811 to an AC power source, check the position of the 115/230 LINE VOLTAGE switch on the rear panel and the rating of the fuse.

CAUTION

The generator will be damaged if it is connected to a 230 volt source with the switch in the 115 volt position.

Set the slide switch to the correct line voltage. Connect the generator to a 3-wire, grounded 50/400 Hz power source. Current drain is below 2 amperes, so any conventional power cable or connectors are suitable. If the generator has not been exposed to a large ambient temperature change, it will be ready to operate at once

NOTE

When the SG-811 is connected to an AC line, control circuits in the power supply will be energized.

The SG-811 may be operated from a negative ground, 12 volt DC power source it if contains Option 7, External DC Power. The DC input connector is a Bendix PT06A-12-35(SR). Pin C is ground and pin A is the positive input. Connect 16 gage wire to this connector and keep the leads to the power source as short as possible. Heavier wire will be required if the voltage at the SG-811 input drops below 11.0 volts. For DC operation, set the rear panel AC-DC switch to its DC position.

PIN NO.		
1	A	BCD REMOTE BAND INPUT
2	B	
3	C	
4	D	
5	REMOTE BAND ENABLE (LO)	
6	NOT USED	
7	A	BCD REMOTE ATTEN INPUT 1 dB STEPS
8	B	
9	C	
10	D	
11	A	BCD REMOTE ATTEN INPUT 10 dB STEPS
12	B	
13	C	
14	D	
15	REMOTE ATTEN ENABLE (LO)	
16	Mode 1	EXT FREQ CONTROL (LO)
17	Mode 2	EXT ΔF (LO)
18	Mode 3	CW (LO)
19	Mode 4	EXT F_1-F_2
20	Mode 5	BAND (LO)
21	Mode 6	ΔF (LO)
22	Mode 7	F_1-F_2 (LO)
23	PHASE LOCK ENABLE (LO)	
24	GND	
25	GND	

PIN NO.		
26	1	DIGITAL FREQUENCY CONTROL INPUT
27	2	
28	4	
29	8	
30	10	
31	20	
32	40	
33	80	
34	100	
35	200	
36	400	
37	800	
38	1K	
39	2K	
40	4K	
41	8K	
42	EXT DIGITAL FREQ CONTROL ENABLE (LO)	
43	REMOTE MODE ENABLE (LO)	
44	NOT USED	
45	NOT USED	
46	NOT USED	
47	NOT USED	
48	GND	
49	GND	
50	GND	

NOTES:

1. (LO) Negative true TTL logic. All other inputs are positive true TTL logic.
2. Amphenol 57-40500 connector.

REMOTE CONTROL INPUT CONNECTOR

FIGURE 2.1

3.0 OPERATION

This section describes the operation of the SG-811 Swept Signal Generator.

3.1 INPUT AND OUTPUT CONNECTORS

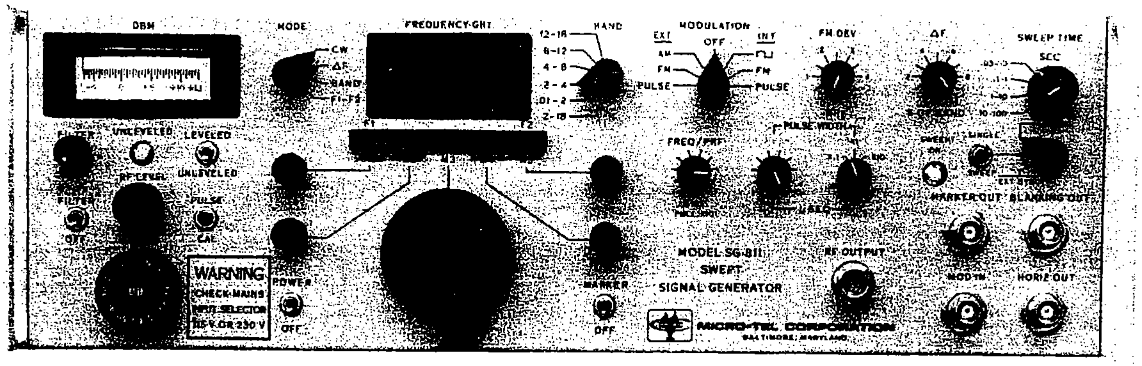
Listed below are the input and output connections of the SG-811.

3.1.1 FRONT PANEL

DESCRIPTION	TYPE	FUNCTION
RF OUTPUT	N	Generator RF output. This connector is attached to the RF Unit which may be located away from the mainframe.
MARKER OUTPUT	BNC	Provides a -15V pulse in the sweep modes at the instant that the RF output frequency equals the marker frequency read-out. This pulse may be summed with the vertical oscilloscope display. Refer to Figure 3.5.
BLANKING OUT	BNC	Provides a retrace blanking pulse in the sweep modes. Connect to the blanking input of an oscilloscope (Z axis) or the pen lift of a recorder. Output is +10 VDC during retrace.
MOD IN	BNC	Accepts external AM, FM or pulse modulation. See Section 3.7 for modulation sensitivity.
HORIZ OUT	BNC	Sweep output for the horizontal axis of an oscilloscope or recorder. Varies linearly from approximately -5 volts at the start of the sweep to +5 volts at the end of the sweep.

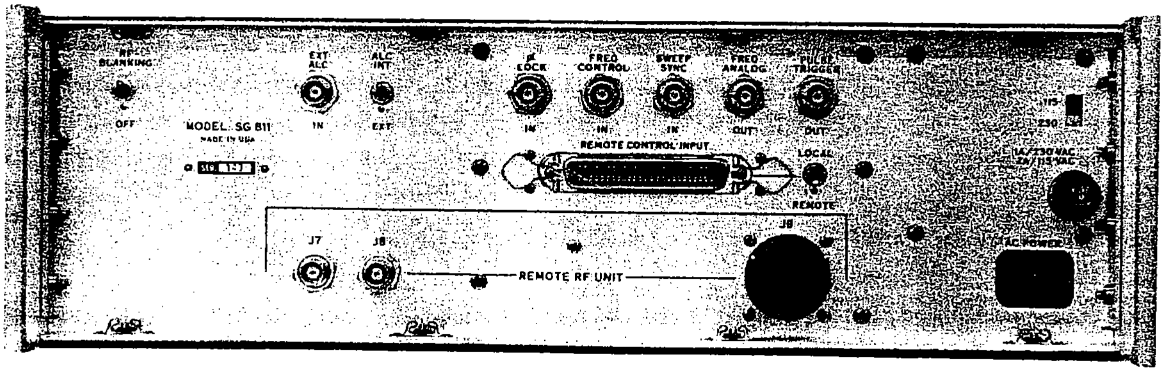
3.1.2 REAR PANEL

DESCRIPTION	TYPE	FUNCTION
EXT ALC IN	BNC	Input from external level detector with the RF Unit mounted in the mainframe. With the RF Unit in a remote location, the EXT ALC IN is on the RF Unit.



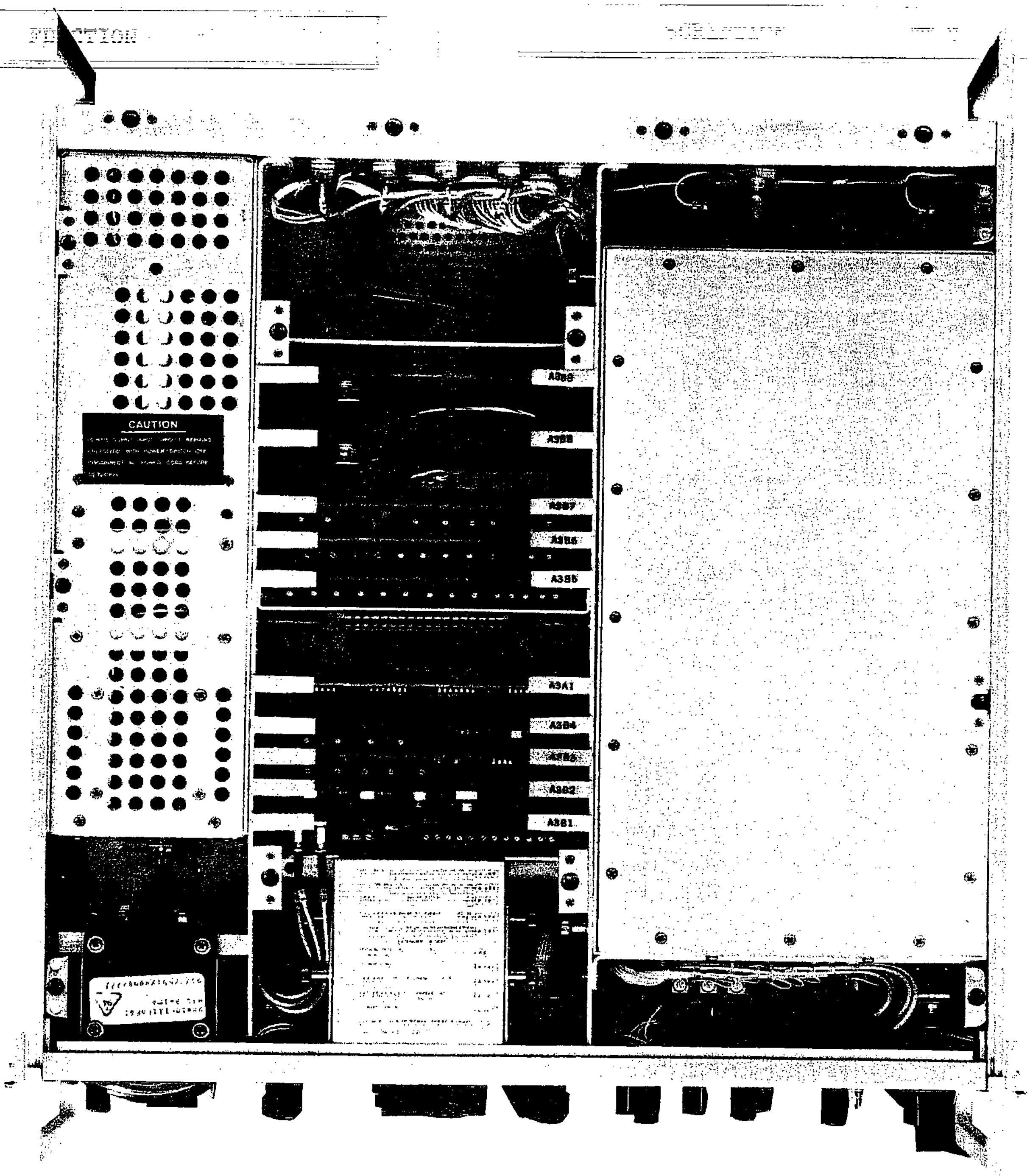
SG-811, Front View

Figure 3.1



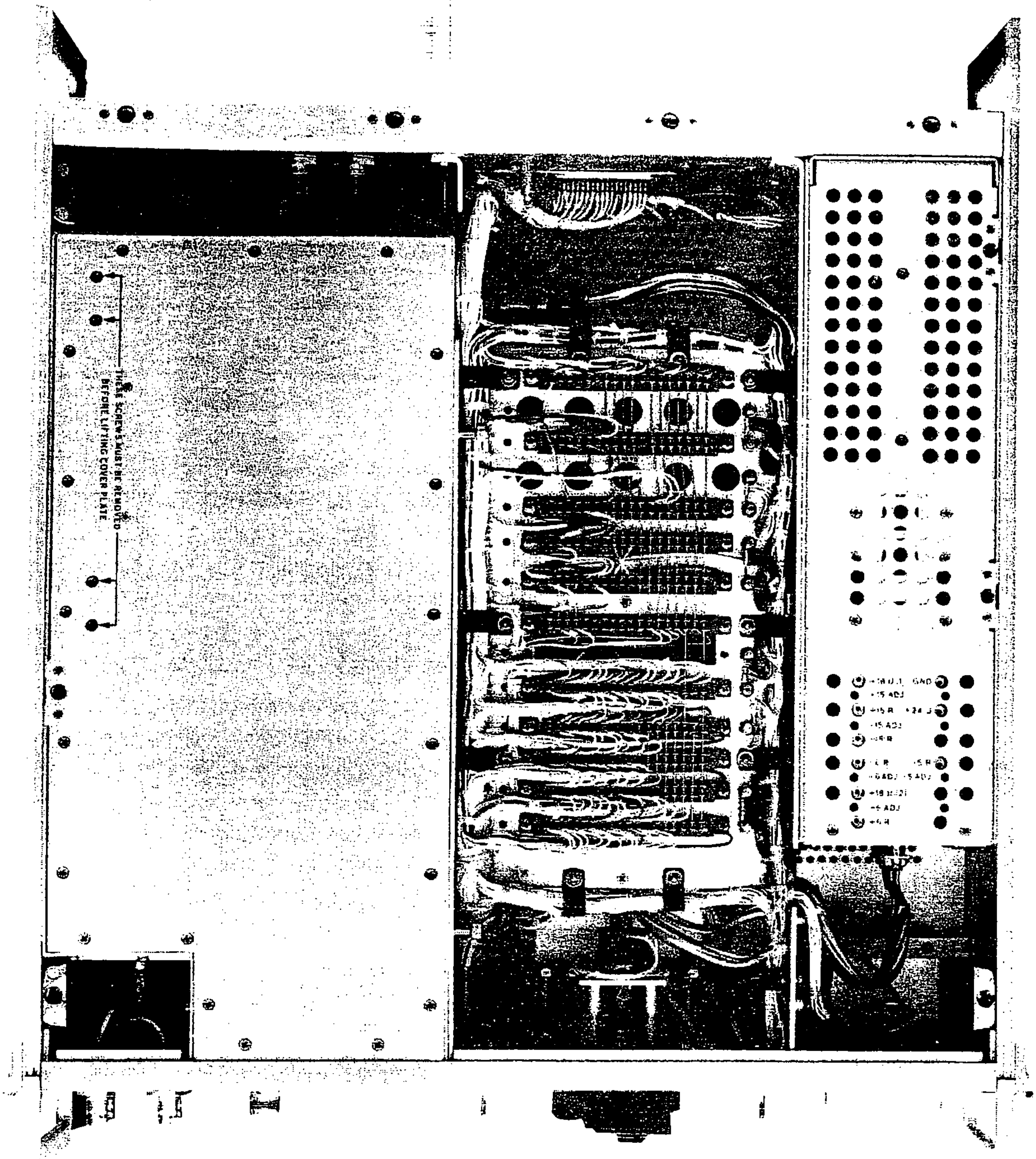
SG-811, Rear View

Figure 3.2



SG-811, Top View

Figure 3.3



SG-811, Bottom View

Figure 3.4

DESCRIPTION	TYPE	FUNCTION
ϕLOCK IN	BNC	Input from a stabilizer or synthesizer to phase lock the oscillators.
FREQ CONTROL IN Hur ik remote !	BNC	External analog control of frequency. Varies from 0 volts at the low end of each band to +10 volts at the high end of each band
SWEEP SYNC IN	BNC	Provides external synchronization of sweep during swept mode operation. Accepts ground or TTL low signal.
FREQ ANALOG OUT	BNC	Voltage output proportional to frequency. Varies from 0 to +10 volts for each band.
PULSE TRIGGER OUT	BNC	Sync output for Square Wave, FM or Pulse Modulation. Pulse precedes RF pulse by about 100 ns. Pulse width is approximately 0.5 us. Pulse amplitude is nominally +5 volts.
REMOTE CONTROL INPUT	50 Pin Amphenol 57-30500	Inputs for digital remote control of the SG-811. See Figure 2.1 for pin assignments.
RF SAMPLE OUT	SMA	RF Output sample used for frequency counting or stabilizing the RF sources. Option 4.
AC POWER	3-Wire	Power input for operation from 115/230 VAC, 50-400 Hz source.
EXT DC POWER	Bendix PT06A-12-3S(SR)	Power input for operation from a 12 VDC source. Option 7.
J7	BNC	Level control to the RF Unit when the RF Unit is operated external to the mainframe.
J8	BNC	Pulse drive to the RF Unit when the RF Unit is operated external to the mainframe and has Option 5.
J9	Amphenol PTB-20-41PS	Power and control of the RF Unit when the RF Unit is operated external to the mainframe.

3.2 CONTROLS AND INDICATORS

This section lists the operating controls and indicators which are located on the front and rear panels.

3.2.1 FRONT PANEL

DESCRIPTION	TYPE	FUNCTION
BAND	Rotary Switch	Selects RF band.
MODE	Rotary Switch	**CW:** Single frequency RF output as selected by the pushbutton selector F_1/M_1, M_2, M_3, M_4 or F_2/M_5, and set by the corresponding tuning controls. **ΔF:** RF output sweeps about the center frequency set by the selected tuning control F_1/M_1, M_2, M_3, M_4 or F_2/M_5. Deviation around this center frequency is set from 0 to 10% of the band by the Δ F % of BAND control. **BAND:** RF output sweeps over the entire selected band. **F_1-F_2:** RF output sweeps between the frequencies set by the F_1/M_1 and F_2/M_5 controls.
F_1/M_1, M_2, M_3, M_4 and F_2/M_5 and five associated tuning controls	Pushbutton Switches and Potentiometers	**CW:** Tunes RF output frequency. Five frequencies may be set up, one by each control, and selected by the corresponding pushbutton. The digital frequency meter reads the selected frequency. **ΔF:** Tunes the center frequency of the swept frequency range. Five center frequencies may be set up, one by each control, and selected by the corresponding pushbutton. The digital frequency meter reads the selected center frequency. **BAND:** Each control tunes a marker, and the corresponding frequency is read on the digitial frequency meter.

DESIGNATION	TYPE	FUNCTION
		F_1-F_2: F_1/M_1 and F_2/M_5 tunes the sweep limits. The digital frequency meter reads the frequency F_1, frequency F_2, or marker frequencies depending on the pushbutton depressed. Markers are provided at M_2, M_3, and M_4 frequencies.
MODULATION	Rotary Switch	Selects internal or external source of AM, FM or pulse modulation. In the center position there is no modulation. **INT. ⊓⊔ :** Provides squarewave of 100 Hz to 10 kHz as set by the FREQ/PRF control. **INT. FM:** Provides internal FM modulation with a deviation of 0 to +5 MHz as set by the FM DEV control. Frequency may be set 100 Hz to 10 kHz with the FREQ/PRF control. **INT. PULSE:** Provides internal pulse modulation with a pulse width of .1 to 100 usec as set by the PULSE WIDTH controls, and PRF of 100 Hz to 10 kHz as set by the FREQ/PPRF control. **EXT. AM:** Amplitude modulates RF output in accordance with the input to the front panel MOD IN connector. **EXT. FM:** Frequency modulates the RF output in accordance with the input to the front panel MOD IN connector. **EXT. PULSE:** Pulse modulates the RF output in accordance with the input to the front panel MOD IN connector.
△F % OF BAND	1-Turn Pot	Controls sweep dispersion in the Δ F sweep mode from 0 to 10% of the selected band centered about the set frequency.

DESIGNATION	TYPE	FUNCTION
SWEEP	Two Rotary Switches, 1-Turn Potentiometer, Momentary Contact Switch	Sweep time is controlled from .03-100 seconds in four selectable ranges with an associated 1-turn potentiometer to select the time within the selected range. A three position rotary switch directly under the time range switch selects EXT SYNC from the rear panel SWEEP SYNC IN connector, front panel SINGLE SWEEP pushbutton, or free running under the control of the internal sweep time generator.
SWEEP ON	Lamp	Indicates that the RF output is being swept.
PULSE WIDTH	1-Turn Potentiometer and 3-Position Rotary Switch	Sets pulse width from 0.1 to 100usec. The rotary switch selects multipliers of X0.1, X1, and X10 for the potentiometer which is roughly calibrated from 1 to 10. Option 5.
FREQ/PRF	1-Turn Potentiometer with Axial Selector Switch	Sets modulation and pulse repetition frequency from 100 Hz to 1 kHz when pressed in and 1-10 kHz when pulled out. Operates only when internal modulation is selected.
FM DEV	1-Turn Potentiometer	Sets frequency deviation from 0 to ± 5 MHz when INT FM modulation is selected.
DBM	Analog Meter	Displays power level at the RF output connector, or at the input to the RF Attenuator when Option 5 is installed.
RF LEVEL	3-Turn Potentiometer	Adjusts output power.
FREQUENCY GHz	Digital Meter	Reads frequency set by each tuning control. Pushbutton switches F_1/M M_2, M_3, M_4, and F_2/M_5 select the individual frequency to be displayed.
FILTER PEAK	1-Turn Potentiometer	Provides fine tuning of the YIG output filter to peak the RF output. Option 3 or 3A.
FILTER OFF	Toggle Switch	Switches the filter in or out. Option 3 or 3A.

DESIGNATION	TYPE	FUNCTION
UNLEVELED	Lamp	Indicates when the leveling loop is turned off or out of range.
LEVELED/UNLEVELED	Toggle Switch	Activates leveling loop.
PULSE CAL	Pushbutton Switch	Switches pulse modulator to continuous ON state to set the peak power output. Option 5.
ATTENUATOR	Rotary Switch	Provides calibrated attenuation of the output signal power in 10 dB steps. Option 2 or 2A.
POWER	Toggle Switch	Applies power to the internal circuitry.
MARKER	Toggle Switch	Activates video marker pulses at the MARKER OUT jack.

3.2.2 REAR PANEL

DESCRIPTION	TYPE	FUNCTION
RF BLANKING	Toggle Switch	In the ON position the RF output is blanked during the sweep retrace.
ALC INT/EXT	Toggle Switch	Switches the leveling circuit input between the internal and external level detectors.
LOCAL/REMOTE	Toggle Switch	In REMOTE, the SG-811 may be operated under control of the REMOTE CONTROL INPUT. Remote inputs are disabled in LOCAL.
115/230	Slideswitch	Selects 115 VAC or 230 VAC input voltage.
AC/DC	Slideswitch	Selects 115/230 VAC or 12 VDC input voltage. Option 7.

3.3 OPERATING PRECAUTIONS

Certain control circuits of the SG-811 power supply are on at all times when the line cord is plugged in and the AC/DC switch is set to AC. This allows low-voltage on-off switching at the front panel and reduces start-up transients in the switching circuits.

3.4 INITIAL TURN-ON

On the rear panel, place the ALC INT/EXT to its INT position and LOCAL/REMOTE switch to its LOCAL position.

Place the POWER switch on the front panel to its ON position. A four digit number within the frequency range of the band to which the BAND switch is tuned will appear on the digital frequency indicator.

3.5 LOCAL/REMOTE CONTROL

With the rear panel LOCAL/REMOTE switch in its REMOTE position, a remote command overrides the front panel controls. However if a command for a given function is not present, the setting of the corresponding front panel control will govern. In the LOCAL position, remote inputs are disabled.

3.6 TUNING AND OPERATING MODES

This section describes the tuning of the SG-811 in its four operating modes. The modes may be selected remotely by grounding one of four lines and the remote mode enable line. The band may be selected remotely by a BCD input and grounding the remote band enable line. The frequency of the standard SG-811 may be remotely tuned by an analog voltage into the rear panel FREQ CONTROL jack and grounding the appropriate mode enable line. The analog tuning signal varies from 0 to +10 volts into an impedance of 10,000 ohms. With Option 6 or 6A, the SG-811 can be remotely tuned by a BCD digital input and grounding the appropriate mode enable line and the external digital frequency control enable line.

In all sweep modes, the time duration of each sweep is set by the SWEEP TIME controls. The sweep sync selector must be set to its clockwise position for repetitive sweeps. Set this control to SINGLE SWEEP and press the adjacent pushbutton for manually initiating single sweeps. In the EXT SYNC position, the sweep is triggered by a TTL zero pulse (ground) into the rear panel SWEEP SYNC IN jack. If the rear panel RF BLANKING switch is in its ON position, the RF output will be cut off during retrace. The SWEEP ON lamp turns on during the sweep portion of the cycle.

3.6.1 CW

The RF output is a CW signal (unswept) that may be modulated internally or externally. Any of the five tuning controls (F_1/M_1, M_2, M_3, M_4 or F_2/M_5) may be used for CW tuning by depressing the corresponding pushbutton. The digital frequency meter indicates the CW frequency. Normally M_3 is used in the CW mode because of its greater resolution A convenient feature is the capability to set each of the five controls to a separate frequency and to rapidly switch between them by merely depressing the appropriate pushbutton. There are no markers in this mode.

A CW output may be set remotely by grounding the external frequency control (Mode 1) or CW (Mode 3) enable line. In Mode 1, the analog or digital (Option 6 or 6A) input tunes the generator over the selected band, with 0 volts or 0000 at the low end and +10.0 volts or 9999 at the high end. In Mode 3, the output frequency is that selected by the front panel controls.

3.6.2 Δ F

The Δ F mode is a swept RF output. The center frequency of the sweep is tuned in the same manner as a CW signal. The sweep width is variable from zero to 10% of band (ie 200 MHz in the 2 to 4 GHz band, 400 MHz in the 4 to 8 GHz band, etc.) by use of the F control. There are five markers in this sweep mode.

The Δ F mode may be set remotely by grounding the EXT Δ F (Mode 2) or Δ F (Mode 6) enable line. In Mode 2, the analog or digital (Option 6 or 6A) input tunes the generator over the limits set by the Δ F control, with 0 volts or 0000 tuning to the low limit of the Δ F sweep and +10 volts or 9999 tuning to the high range of the Δ F sweep. This is a method of fine tuning over a limited range by use of the external tuning signal. In Mode 6, the generator sweeps in the Δ F mode in accordance with the setting of the front panel controls.

3.6.3 BAND

In this mode the RF output is swept over the entire selected band. There are five markers. The BAND mode may be set by grounding the band enable line (Mode 5).

3.6.4 F_1-F_2

The RF output is swept between any two frequencies in the selected band. The two frequencies are set by the F_1/M_1 and F_2/M_5 controls. Each is set by depressing the corresponding pushbutton and adjusting that tuning control for the desired frequency limit. F_1/M_1 may be set above or below F_2/M_5. but the sweep will always start at the F_1/M_1 frequency. Markers M_2, M_3, and M_4 are provided in this mode.

The F_1-F_2 mode may be set remotely by grounding the EXT F_1-F_2 (Mode 4) or F_1-F_2 (Mode 7) enable line. In Mode 4, the analog or digital (Option 6 or 6A) input tunes the generator over the limits set by the F_1 and F_2 mode in accordance with the settings of the front panel control.

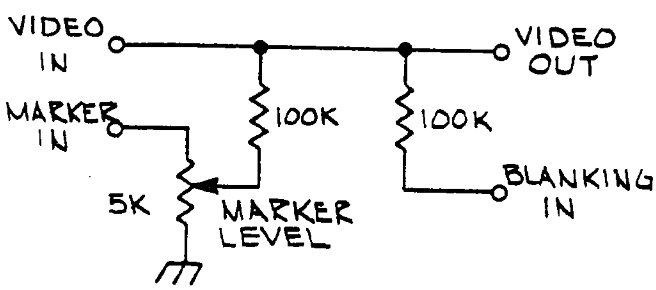
3.6.5 MARKERS

Markers are available in all swept modes as listed below:

BAND	M_1, M_2, M_3, M_4 and M_5
F_1-F_2	M_2, M_3, and M_4
Δ F	M_1, M_2, M_3, M_4 and M_5

Each marker is set by depressing its pushbutton and adjusting the corresponding tuning control to the desired frequency as read on the front panel digital frequency display. The marker frequencies are limited to the selected band. Marker pulses are available at the front panel MARKER OUT jack when the front panel MARKER switch is turned on. The pulse amplitude is -15 volts from a source impedance of approximately 5000 ohms, and the pulse width period varies as sweep speed so that the width of the marker pulse on the swept display appears to be constant at various sweep speeds.

For an oscilloscope display, the marker pulses are normally connected to the Z axis or summed through the second channel of a dual-channel scope. The marker pulses may be summed directly with a video display using the circuit shown in Figure 3.5.



Schematic Diagram, Video Combiner

Figure 3.5

3.7 MODULATION

The standard SG-811 has internal FM and squarewave AM, and external FM and AM modulation. Option 5 adds internal and external pulse modulation.

3.7.1 INTERNAL ⊓⊔

This is squarewave modulation with the frequency adjustable by the front panel FREQ/PRF control to any value between 100 Hz and 10 kHz. Normally the squarewave frequency is set to 1000 Hz. Some waveform distorition will occur at higher frequencies.

3.7.2 EXTERNAL AM

The modulating source connects to the front panel MOD IN jack. Sensitivity is 0.1 volt/dB into 10,000 ohms. First set the MODULATION switch to OFF and reduce the RF output to at least 3 dB less than its maximum output power capability. This level is the carrier power of the modulated output. Switch to EXT AM and incease the modulating signal for the correct percentage AM. The meter reads peak envelope power, so a 3 dB increase is approximately 100 percent AM.

3.7.3 INTERNAL FM

The FM is a sinewave. The modulation frequency is adjustable by the front panel FREQ/PRF control from 100 Hz to 10 kHz, and the deviation is adjustable from zero to ±5 MHz by the FM DEV control.

3.7.4 EXTERNAL FM

The modulating source connects to the front panel MOD IN jack. Sensitivity is 3 volts peak-to-peak for the maximum allowable deviation of ±5 MHz; the function is linear for smaller deviations.

3.7.5 INTERNAL PULSE

Option 5 adds internal and external pulse modulation. The pulse width and pulse repetition rate are set by the respective front panel controls. The pulse width is variable from 0.1 to 100 microseconds, and the pulse rate from 100 to 10,000 pulses per second. Rise time is less than 20 nanoseconds. On-Off ratio is greater than 70 dB. Peak pulse power output is set by pressing the PULSE CAL button and adjusting the RF LEVEL control. Leveling is automatically disabled by the MODULATION switch.

The pulse modulator is a PIN diode. A portion of the modulating pulse will feed through to the RF OUTPUT along with the pulsed RF output. The feed-thru pulse can be eliminated by a high-pass or band-pass filter or by switching in the tracking filter, Option 3 or 3A. Filtering may not be necessary if the SG-811 is driving a device which is frequency selective.

3.7.6 EXTERNAL PULSE

Option 5 adds internal and external pulse modulation. The driving pulse connects to the front panel MOD IN jack and must have a peak value of +5 volts. Input impedance is 50 ohms. There are no limitations to duty cycle, pulse width, and pulse repetition rate except the 20 nanosecond rise time. On-Off ratio is at least 70 dB. Refer to 3.7.5 for setting power level and pulse feed-thru considerations.

3.8 RF OUTPUT LEVEL

The standard SG-811 is supplied with internal and external leveling capability. A power level control provides absolute power level calibration at the RF OUTPUT connector as well as calibrated output power variation over a range of at least 20 dB. Power is set by the front panel RF LEVEL control. The output is calibrated except when externally leveled.

3.8.1 INTERNAL LEVELING

Set the front panel LEVELED/-UNLEVELED switch to its LEVELED position and adjust the RF LEVEL control for the desired level as indicated on the front panel DBM meter. The RF LEVEL control can be set for levels beyond the meter range so long as the limits of the leveling circuits are not exceeded. This will indicated by the UNLEVELED lamp.

3.8.2 EXTERNAL LEVELING

Broadband or limited-coverage directional detectors can be used for external leveling. A negative output of at least 1 millivolt must be developed at the minimum leveled output. The detector should be placed at the location where leveled power is required. The output power calibration of the SG-811 will probably not be correct with an external detector. Relative power variations can be observed on the SG-811 DBM meter.

Set the rear panel ALC switch to its EXT position. If the RF Unit is in the mainframe, connect the detector output to the rear panel EXT ALC IN jack. If the RF Unit is remote, connect the detector output to the EXT ALC IN jack on the RF Unit.

Locate the ALC GAIN control on the RF Unit. If the RF Unit is mounted in the mainframe, it will be necessary to remove the bottom cover for access to the ALC GAIN adjustment. Set it at its midpoint and adjust the front panel RF LEVEL control for an output power equal to or less than that needed. The front panel LEVELED/UNLEVELED switch must be in its LEVELED position. Rotate the ALC GAIN control fully counterclockwise. Slowly sweep or tune the generator over the frequency range being used and rotate the ALC GAIN control clockwise until the output is leveled; a power meter or other detector must be used. The leveling variation decreases as the ALC GAIN control is advanced further clockwise, but an unstable condition may occur if advanced too far. Caution should be exercised if there is no means available for recognizing instability.

3.8.3 ATTENUATOR

Option 2 adds a 70 dB step attenuator, and Option A adds a 110 dB step attenuator. Both step in 10 dB increments and attenuate the level set by the RF LEVEL control. This results in a continuous calibrated output down to -80 or to -120 dBm.

With Option 2 or 2A, the power level may be remotely controlled by grounding the remote attenuator enable line and applying two BCD digits to the correct pins of the rear panel REMOTE CONTROL INPUT connector. One digit controls the 1 dB steps, the other the 10 dB steps within the limitations of the step attenuator.

3.9 DISPLAY OUTPUT

The FREQuency ANALOG, HORIZontal, BLANKING and MARKER outputs provide a convenient means of allowing the versatile SG-811 to be used with an oscilloscope or X-Y recorder to display a frequency amplitude plot of a filter, amplifier or other device.

The output at the rear panel FREQuency ANALOG OUT jack is proportional to the instantaneous frequency of the generator over each band. It varies from zero at the low end to +10 volts at the high end.

The output at the HORIZ OUT BNC connector varies from -5 VDC at the sweep start to +5 VDC at the sweep stop. It does not vary as sweep mode or sweep dispersion is changed, so full deflection of the display may be set initially and remain unchanged as the sweep parameters are varied.

The BLANKING output generates a +10 volt output during sweep retrace. It may actuate the pen lift of an X-Y recorder or blank an oscilloscope display. If the oscilloscope does not have a compatible, separate blanking input, the generator blanking pulse can be combined with the video in most cases to deflect the cathode ray tube beam off the display during retrace. See Figure 3.5.

The MARKER output produces a -15 volt pulse when the sweep goes through a marker frequency. The MARKER switch must be set to ON. The marker output is combined with the vertical display signal to generate a "pip" at each marker frequency. One method of introducting the marker signal on a scope display is to connect it to the second channel of a dual-input oscilloscope, and sum the two channels.

If the vertical display signal is at a low level and high impedance, the combiner shown schematically in Figure 3.5 can add the blanking and marker signals to vertical oscilloscope display. The display is blanked by driving the beam off the screen.

3.10 FILTER

Option 3 adds an output filter covering 2-18 GHz. Option 3A adds a second filter to extend the filtered output down to 0.4 GHz in the .01-2 GHz band. Since the filters have insertion loss, they can be switched out of the circuit by the front panel FILTER switch.

When tuning below 0.40 GHz, the FILTER switch must be in its OFF position.

The filter is intended to operate in the CW mode but will track in the sweep modes with some loss of power output. The less the sweep dispersion, the less the probability of reduced power due to tracking error.

First tune the generator with the FILTER switch OFF. Then turn the FILTER switch on, and adjust the filter peak control for maximum power output. Increase the RF LEVEL control to compensate for the filter insertion loss.

4.0 THEORY OF OPERATION

This section explains in detail the operation of circuits and components of the SG-811 Swept Signal Generator. Reference should be made to the corresponding schematics in Section 7 when reading the following paragraphs. It is recommended that the General Description and Principles of Operation contained in Section 1 be read beforehand. The overall system schematic, Figure 7.1, shows interconnections between the functional modules, boards and subassemblies which are described herein. Front and rear controls, indicators and connectors are included in Figure 7.1.

4.1 SAWTOOTH GENERATOR (A3B2)

The Sawtooth Generator provides the sweep tuning voltage for all sweep modes, and the blanking signal.

The sawtooth voltage is generated by the integrator which consists of operational amplifier U1 and the complementary transistor follows Q4-Q6. The capacitance (C7-C14) selected by the front panel SWEEP TIME switch is in the negative feedback path of the integrator, and is linearily charged and discharged through FET gates Q2 and Q3. During the sweep (charge) portion of the cycle, Q3 is on, and the discharge path is from the +15 volt supply through the resistance (R62-R66) selected by the front panel SWEEP TIME switch. The sawtooth sweep signal is taken from the emitters of Q4 and Q6.

During the sweep cycle, the sweep output from Q4-Q6 increases in the positive direction until it reaches +11 volts. At this point, comparator U28 sets the flip-flop U2C (output positive); this turns Q3 on and starts to discharge the selected capacitance (C9-C19) through the selected resistance (R62-R66). The high output of U2C also turns Q2 off to stop the charging current to the selected capacitance; this occurs through diode D3 inverter Q21, switch Q23 and inverter Q1.

During discharge, the output of Q4-Q6 goes negative. When it reaches -11 volts, the output of comparator U2A resets flip-flop U2C, and turns On Q11. Each time Q11 is turned on, it activates timer U3 to generate a 3-millisecond pulse at its output (pin 3). This pulse connects through diode D2, inverter Q21 and switch Q23 to hold off Q2 and thereby delay the start of the next sweep for 3-milliseconds. Note that the switching signal to Q21 through diode D3 went off when flip-flop U2C was reset. The 3-millisecond delay between sweeps allows time for resetting of other circuits in the unit.

During crossband operation, it is necessary to stop the sweep at intermediate values of the sawtooth sweep output. The sweep is also turned off when the CW mode is selected. Transistor Q16 is turned off when its base is driven positive by the signal from the Crossband Logic (A3B4) at pin 9 or when pin K goes low (CW), turning Q17 off and turning Q16 on through R70 and R75. With Q16 off, Q12 is turned on and Q2 turned off, thereby interrupting the charge cycle.

The blanking signal is present during (1) retrace, (2) the 3-millisecond delay after flyback and before the start of the next sweep, (3) the time that the sweep is held in the crossband mode, and (4) betwen sweeps in the SINGLE SWEEP or EXT SYNC modes. The blanking pulse for the front panel BLANKING output is generated by the transistor switch Q18 and is available at pin 13. The RF blanking signal is generated by transistor switch Q26. Both of these switches are driven by Q19. During retrace, the output from U2C is positive and drives Q19 through diodes D3 and D4. During the 3-millisecond delay, the delay signal on pin 3 of U3 connects to Q19 through diodes D2 and D4. The hold sweep signal at pin 9 drives Q19 through diode D7. Between sweeps in the SINGLE SWEEP or EXT SYNC modes, both FET gates are switched off, so the bases of both Q8 and Q9 are low, and the collectors are high. The positive potential turns Q19 on through resistor R24.

Transistors Q8 and Q9 are connected as an AND circuit. When the sweep is being held after thr retrace, both Q2 and Q3 are turned off, so the bases of Q8 and Q9 are low, and their output is high. When both Q2 and Q3 are off, it is necessary to hold the sweep output very close to -11 volts. As the sweep deviates from -11 volts in the positive direction due to leakage of the integrator, the output of comparator U2A goes negative; this turns off Q11 which turns on FET gate Q7. With Q7 on, current flows into the capacitance to return the sweep signal output back to -11 volts. When -11 volts is reached, comparator U2A goes positive and turns Q11 on and Q17 off.

When the sweep mode switch is set to its SINGLE SWEEP or EXT SYNC position, -15 volts is switched from pin 8 to pin 7, turning Q23 off and Q22 on. This effectively connects flip-flop U2D into the circuit to control the charge FET gate Q2. Flip-flop U2C controls the discharge FET gate U3 as for INT sweep. At the end of the sweep portion of the sawtooth when the sawtooth output reaches +11 volts, the output of comparator U2B goes positive and sets flip-flop U2C and resets flip-flop U2D. U2C initiates the retrace by turning on FET gate Q3. At the end of the retrace when the sawtooth output reaches -11 volts, the output of comparator U2A resets U2C. However U2C does not start a new sweep cycle because the drive to FET gate Q2 is now through Q22 instead of Q23, and therefore Q2 must be turned on by setting flip-flop U2D. This is done by the differentiated output from Q14. Each time the base of Q14 is grounded externally or by the SINGLE SWEEP pushbutton, its collector goes negative. This negative going voltage is differentiated by C6 and R42 to set flip-flop U2D, which in turn switches on FET gate Q2 through Q22 and Q1 to initiate another sweep (charge) cycle.

When pin 9 is switched to +5 volts by the hold sweep input, diode D6 turns Q13 on and thereby prevents FET gate Q7 from turning on and driving the sweep output to -11 volts. Between sweeps in the single sweep mode, the sweep output is held at -11 volts in the same manner as in the automatic mode by transistors Q8 and Q9.

4.2 MARKER/SWEEP GENERATOR (A3B3)

The Marker/Sweep Generator (1) modifies the output of the Sawtooth Generator in accordance with the settings of the sweep controls, and (2) generates the marker controls. In the BAND sweep mode, the output of the Sawtooth Generator is the sweep signal to the tuning circuits.

4.2.1 ΔF

The ΔF sweep mode provides a variable width sweep about a tuneable center frequency. The center frequency is tuned by any of the F/M controls, and the deviation is set by the front panel ΔF control. The composite ΔF signal is the sum of the CW tuning voltage and a variable component of the sawtooth.

The sawtooth from the Sawtooth Generator connects to pin R of A3B3 and is attenuated by R86 in series with the front panel ΔF control. The arm of the latter onnects to pin L of A3B3 and is buffered by operational amplifier U12A.

The CW tuning voltage from the selected front panel F/M control connects to pin 8 of A3B3, and is buffered by operational amplifier U1A. It is summed with the sawtooth component at the input of operational amplifier U5A to generate the composite ΔF sweep signal which connects to pin K of A3B3.

4.2.2 F_1-F_2

The F_1-F_2 sweep mode provides a sweep between the two frequencies set by the front panel F_1 and F_2 controls. There are no restrictions on the frequencies set by each control. The sweep signal for F_1-F_2 mode is generated by summing two components of the sawtooth output from the Sawtooth Generator. One component is taken from the arm of the F_1 potentiometer which is connected directly across the sawtooth. The second is from the arm of the F_2 potentiometer which is connected across the inverted sawtooth.

The F_1 control is connected directly across the output of the Sawtooth Generator, pin R of A3B3, and the signal on the arm of this potentiometer is buffered by operational amplifier U2B. The output of the Sawtooth Generator is inverted by operational amplifier U6B. R18 sets the inverter gain to exactly X1. The inverted DC offset is compensated by the buffered DC voltage from R12. The inverter output drives the F_2 control. The signal on the arm of the F_2 control is buffered by operational amplifier U2A. The outputs from U2A and U2B are summed in operational amplifier U6A. The gain of this summing amplifier is set by R7, and any DC offset is compensated by the buffered DC voltage from R16. The F_1-F_2 sweep signal from U6A connects to pin 13 of A3B3.

4.2.3 HORIZONTAL OUTPUT

The horizontal output to the front panel HORIZ OUT jack is taken from the sawtooth output of the Sawtooth Generator. The sawtooth is attenuated by R83 and R84, and buffered by operational amplifier U11B. The output from U11B connects to the front panel HORIZ OUT jack through pin 18 of A3B3.

4.2.4 MARKERS

This section describes the operation of the marker circuits located on A3B3. In BAND sweep, five markers are available (M_1-M_5), and the marker width remains contstant. In F_1-F_2 sweep, three markers are available (M_2, M_3, M_4), and the marker width decreases with the sweep width to present a constant marker width on a display.

Each marker is generated by comparing the sweep signal, BAND or F_1-F_2, to the DC voltages on the arms of the marker controls, using window comparators. Listed below are the markers and corresponding comparators.

M_1	U3C, U3D
M_2	U14C, U14D
M_3	U4A, U4B
M_4	U14A, U14B
M_5	U3A, U3B

The following explanation applies to the M_3 marker. However all other marker circuits are identical except for component reference numbers. The DC voltage function at the arm of the front panel M_3 potentiometer is the same with respect to frequency as the BAND or F_1-F_2 composite sweep voltage. This DC voltage is buffered by operational amplifier U11A and then connects to one terminal of comparators U4A and U4B. The sweep voltage selected by the mode switch (BAND or F_1-F_2) connects through pin T of A3B3 to the buffer amplifier U8B. The output of U8B drives the second input to comparator U4A. The second input to U4B is the output of U9B; this output is the same as the output of U8B except it is offset by operational amplifier U9. The offset at pin 3 of U9A is buffered by U9A and summed to the output of U8B in the summing amplifier U9B. The amount of offset introduced into pin 3 of U9A determines the marker width because it determines the difference voltage at which comparator U4A operates as compared to comparator U4B.

4.3 CONTROL BOARD (A3A1)

The Control Board contains the logic and switching for remote and local control of the tuning functions. With the rear panel LOCAL-REMOTE switch in its LOCAL position, the generator can be tuned and the sweep mode selected by use of the front panel controls only. With the switch in its REMOTE position, the remote input tunes the generator and selects the sweep mode. However, if there is no remote command for a particular function, the corresponding front panel control is effective for that function only.

The signal and control lines are switched by relays K1, K2 and K3. Individual switching functions are listed below.

K1A, K1B, K2A and K2B together detemine the sweep mode by switching three lines. Pins 6, 10 and L of A3A1 switch the voltage difference to the marker comparators. Refer to section 4.2.4. Pin L is connected to pin 10 for all sweep modes except F_1-F_2, when it is connected to pin 6. The other contacts of these relays select the tuning signals to the oscillators and front panel digital frequency display. With all three relays de-energized, the generator is in its CW position, the markers are inoperative and both the meter (pin N) and oscillators (pin 12) are switched to the voltage at the arm of the selected front panel tuning control through pin M.

In the ΔF sweep mode, K1A is energized to switch the tuning voltage to the F input (pin E). The marker comparator voltage is fixed (pin L switched to pin 10).

In the F_1-F_2 sweep mode, K1B is energized to switch the tuning voltage to the F_1-F_2 input (pin 5). The marker comparator voltage is variable (pin L switched to pin 6).

In the BAND sweep mode, K2A is energized to switch the tuning voltage to the BAND input, which is the output of the Sawtooth Generator at pin 10 of A3A1.

K2B is energized when the generator is to be tuned by an external signal. This external signal is modified to extend from +11 to -11 volts and connects to pin U of A3A1. K2B, when energized, connects pin U to the oscillator tuning (pin 12) and the front panel digital frequency display (pin N).

K3A is energized when the generator ΔF or F_1-F_2 sweep is to be derived from an external signal. This external signal is modified to extend from +11 to -11 volts and replaces the internally generated sawtooth at pin T of A3A1.

K3B, when energized, switches the FM driver input from the internal modulation generator to the external phase-lock input. This occurs when pin H of A3A1 is grounded.

The logic is best explained by describing the selection of the ΔF sweep. One of three inputs must be switched low; (1) pin F if the front panel mode switch is the enable control; (2) pin D if remote mode selection is enabled and the internal tuning voltage is to generate the ΔF sweep, and (3) pin 14 if remote selection is enabled and an external tuning voltage is to generate the ΔF sweep. If the rear panel LOCAL-REMOTE switch is in its LOCAL position, pin J of A3A1 is not grounded, so the output of U6C is low. This drives one input each of NAND gates U7A and U7D low and thereby prevents switching of these two gates by control signals on U7A (pin D and pin 14). At the same time, NAND gate U3C and inverter U6D drive pin K of A3A1 low. Pin K connects to the arm of the front panel mode switch, which in its ΔF position connects pin K to pin F and operates K1A. If the LOCAL-REMOTE switch is in its REMOTE position, pin J of A3A1 is low. When the remote enable line (pin 43) of the REMOTE CONTROL input is grounded, the output of inverter U6B goes high, along with one input to NAND gates

U7A and U7B. The other input to each gate is high until switched low by an external control signal; this drives one input to U1B high and energized K1A. If pin 14 is grounded, NAND gates U4A and U4B energize relay K3A to select the external tuning voltage in place of the internal sawtooth as the basic sweep source. If none of the remote control lines are grounded, the output of NAND gate U5 is low, so the output of U3C is high; the arm of the front panel mode switch (connected to K) is low, and it will select the sweep mode even though the rear panel switch is in its REMOTE position. However, any remote mode command will drive the output of U8 high and thereby disable the front panel mode switch.

The operation of the F_1-F_2 logic is identical to the above. The BAND logic is similar except in the BAND mode an external tuning voltage is not used to generate the sweep because the identical operating mode is available in the CW mode with external tuning voltage.

If pin 7 of A3A1 is grounded, relay K2B is energized and the external tuning voltage tunes the generator.

4.4 CROSSBAND TUNING GENERATOR (A3B6)

In the crossband mode, the basic sawtooth or CW tuning voltage, both of which vary between -11 and +11 volts, is divided into separate successive excursions of -11 to +11 volts, one for each band.

The function of the Crossband Tuning Generator is to convert the tuning signal into successive sweeps for the crossband mode only. Four voltage comparators divide the tuning signal into a segment for each band. Each segment is offset and amplified to extend from -11 to +11 volts, the same as the original sweep. The comparators are located on the Crossband Logic Board (A3B4) and generate the bandswitch signals in the crossband mode.

The selected tuning signal connects to pin R of A3B6 and will vary from -11 to +11 volts for all sweep modes, with -11 volts tuning the lowest frequency and +11 volts tuning the highest frequency. For single band operation, relay K1 is unenergized, and the tuning signal goes directly through pin U of A3B6 to the Tuning Generator (A3B7). In crossband operation, the -11 to +11 volt input signal at pin R of A3B6 is modified to extend from 0 to +12 volts by operational amplifiers U1 and U2. U1 buffers the DC offset which is summed with the signal in U2. The gain of U2 is varied by R8. Adjustment of R2 sets the output of U2 at zero with the input at -11 volts; adjustment of R8 sets the output of U2 at +12 volts with the input at +11 volts.

The 0 to +12 volt output from U2 connects through Pin N of A3B6 to the Crossband Logic Board (A3B4) which generates switching points at the voltage levels which correspond to band edge frequencies. The BCD band switching signal connects to pins K, L and M of A3B6 to drive the integrated circuit switches U6 and U7. Each segment of the 0 to +12 volts, as defined by the switch points, is converted by operational amplifiers U4 and U5 to an excursion of -11 to +11 volts. Therefore in the crossband mode, the original tuning signal is divided into sequential tuning signals of the same voltage excursion. The DC offset for each segment is switched by U7, buffered by operational amplifier U3, and summed with the variable tuning voltage in operational amplifier U4. There is no DC offset of the first segment because it starts at zero. The total excursion of each segment is determined by the gain of operational amplifier U5; switch U6 selects the feedback resistance to U5 and therefore switches its gain. At the low frequency end of each segment, the corresponding offset trimmer is adjusted for -11 volts output at TP2. At the high frequency end of each segment, the corresponding gain trimmer is adjusted for

+11 volts at TP2. Note that each segment in the crossband mode tunes a single band oscillator over the normal limits of its coverage.

4.5 CROSSBAND LOGIC BOARD (A3B4)

The circuits on this board generate bandswitch information from the composite tuning signal in the crossband mode only. In the crossband mode, the composite tuning signal must tune the generator over its entire frequency range rather than a single band. Therefore the composite tuning signal must be divided into the voltage segments, each of which is proportional to the frequency coverage of the band it tunes.

In the crossband mode, the tuning signal is converted by circuits on the Crossband Tuning Generator (A3B6) to extend from 0 to +12 volts. Zero volts represents zero frequency, and +12 volts represents the maximum frequency, or 18 GHz in most generators. Bandswitching must occur at voltages equal to 2.0, 4.0, 8.0 and 12 GHz. The 0 to +12 volt output from the Crossband Tuning Generator (A3B6) connects to pin 9 of A3B4 and is buffered by operational amplifier U1B, which drives voltage comparators U4A, U4B, U4C and U4D. With the tuning voltage at zero, the outputs of all comparators are high. U3D goes low at the tuning voltage which represents the changeover point from band 1 to band 2 (2.0 GHz), U3C goes low at the tuning voltage which represents the changeover point from band 2 to band 3 (4.0 GHz). U3B switches at 8.0 GHz, and U3A at 12.0 GHz. If a generator is supplied with one or more bands deleted, the corresponding comparators are disabled. Each comparator has positive feedback (R37 for example) to insure hysteresis between the switchover going up in frequency and the switchover going down in frequency. The comparator outputs are converted to BCD bandswitch signals by the encoder U5.

The BCD output from U5 is inverted by U8 to connect to one input of the 3 pole, 3 position switch formed by integrated circuit switches U6 and U7. The output from this switch connects to integrated circuit driver U9. The output of U9 is the BCD bandswitch command to the other generator circuits (pins T, U and S).

With pin 15 of A3B4 grounded, the bandswitch command is taken from the crossband logic. With pin 14 of A3B4 grounded, the bandswitch command is taken from the remote control input which connects to pins 12, 13 and 16 of A3B4. If neither pin 14 or pin N is grounded, the bandswitch command is taken from the front panel BAND switch which connects to pins K, L and M of A3B4. If pin N is grounded, the BCD band information is taken from the crossband circuitry.

When switching bands, it is necessary to allow a short interval for circuits to switch and oscillators to start up. Therefore at each band change command, a sweep hold command is generated. The least significant digit of the BCD band code changes at each band change command, so the input or output of inverter U8A will go positive at this time. Both the input and output of U8A connect to the base of switching transistor Q3 through diodes D1 and D2 respectively. Therefore at each band change command, Q3 triggers one section of the retriggerable, resettable monostable multivibrator U3. The hold sweep command connects to pin 17 of A3B4 and is set for approximately 3 milliseconds by C6 and R15. Both sections of U3 are enabled only in the crossband mode through inverter U8D.

4.6 TUNING GENERATOR (A3B7)

The Tuning Generator converts the composite -11 to +11 volt tuning signal to one extending from 0 to +9 volts. This output signal drives the tracking networks and has a low source impedance so that adjustments in the tracking networks will not cause changes in level. This board also contains the precision -11 and +11 voltage regulators, and the circuits for conditioning the external tuning voltage to extend from -11 to +11 volts.

The composite -11 to +11 volt tuning signal connects to pin N of A3B7 and is buffered by operational amplifier U1. The output of U1 is summed with the DC offset in operational amplifier U2. The DC offset is adjusted by R18, and operational amplifier U6 buffers this DC offset. The offset is adjusted so that the output of U2 is zero when the input tuning signal is -11 volts. R9 is a gain control which adjusts the input to U3 to +9.0 volts when the input tuning signal is +11 volts. Thus the input to U3 varies from 0 to +9 volts as the input tuning signal varies from -11 to +11 volts. Operational amplifiers U3 and U4 are connected as a unity gain power amplifier and drive the oscillator and filter tracking networks.

Operational amplifier U5 and transistor Q1 comprise the low-noise, precision voltage regulator having an output adjustable to exactly +11.0 volts. The precision zener diode D1 is the voltage reference and connects to the inverting input of U5. This is compared to the supply output through the voltage divider R14, R16 and R17. Any error is amplified by U5 to drive the base of Q1 in the direction to cancel this error. Capacitor C8 filters noise generated across D1. R17 adjusts this regulator output to exactly +11.0 volts. Operational amplifier U7 and transistor Q2 comprise the low-noise, precision negative 11.0 volt regulator.

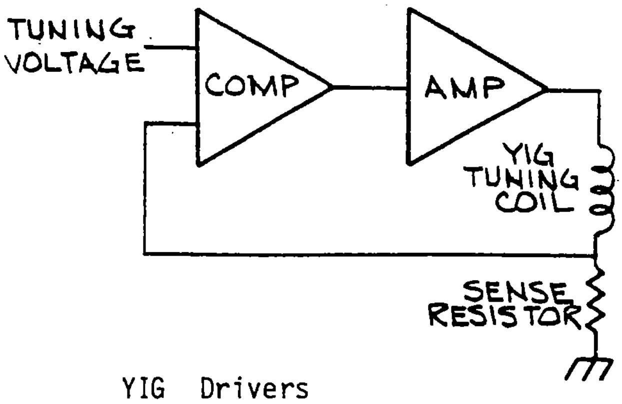
Operational amplifier U8A buffers the Tuning Generator output to drive external or optional circuits.

Operational amplifiers U9A, U9B and U8B condition the external tuning voltage to tune the generator in any of its operating modes. The external tuning voltage is normally specified as 0 to +10 volts, but may be specified differently for special applications. It must be converted to swing from -11 to +11 volts to be compatible with the internal tuning circuits. The external tuning voltage connects through pin 14 of A3B7 to the non-inverting input of operational amplifier U9B. The voltage swing is varied by changing the gain of this amplifier through feedback to the inverting input, ie R40, R41 and R42. The output of U9B is summed to the DC offset in operational amplifier U9A. This amplifier has gain, and the signal at its output (pin 13 of A3B7) goes from -11 to +11 volts as the external tuning input varies over its full range. Operational amplifier U8B buffers the DC offset. With the external tuning voltage at zero, R32 is adjusted for -11 volts at pin 13. With the external tuning voltage at its maximum (normally +10 volts), R40 is adjusted for +11 volts at pin 13.

4.7 OSCILLATOR TRACKING/DRIVER (A3B5)

The Oscillator Tracking/Driver circuits modify the 0 to +9 volt tuning signal from the Tuning Generator to match the tuning function of each YIG oscillator. A separate tracking adjustment is necessary for bands 1 and 2, which use the same YIG oscillator, because this oscillator covers a different frequency range for each band. The oscillator driver circuits convert the modified tuning voltage to a corresponding current through the YIG tuning coil.

Refer to Figure 4.1 which is the simplified schematic of the oscillator driver. The modified tuning voltage is applied to one input of the comparator. The second input to the comparator is the voltage across the sense resistor. This sense voltage is directly proportional to the current through the YIG oscillator tuning coil. The output of the comparator drives the power amplifier with the correct polarity to equalize the voltage across the sense resistor, and current through the YIG (pin 18) directly follows the tuning voltage.



YIG Drivers

Figure 4.1

The input to this board (pin 18) is the 0 to +9 volt tuning signal from the Tuning Generator. This is applied to the five "HI" networks (R16-R30) which allow individual amplitude adjustments for each band. The "LO" networks (R1-R15) connect across the precision +11.0 volt supply and allow individual DC offset adjustments for each band. Integrated circuit switches U2 and U3 select the correct "HI" and "LO" network for each band. The output of the switches are buffered by operational amplifiers U4 and U8 respectively, and then summed at the non-inverting input of operational amplifier U5. The inverting input to U5 is the voltage across the YIG sense resistor as switched by U9 and buffered by operational amplifier U7. Operational amplifier U5 functions as a comparator, and its output is buffered by U5 to drive the oscillator. tuning coil. Relay K1 switches in C8 to lower the amplifier response in the CW mode to reduce the amplifier noise output and therefore the oscillator FM noise.

4.8 METER/ANALOG TRACKING BOARD (A3B5)

The circuits on this board provide two functions. One is to generate the voltage to drive the front panel Digital Frequency Display (A5). The other is to provide the output voltage signal that is proportional to the generator frequency.

The rear panel FREQuency ANALOG OUTput is derived from the tuning signal output of the Tuning Generator (A3B7). This varies from 0 to +10 volts for each band and for the full crossband coverage. The tuning signal connects through pin R of A3B5 to the non-inverting input of operational amplifier U8A. The amplifier output connects to the rear panel connector through pin 18 of A3B5. The output is proportional to the input, i.e. frequency, and the proportionality factor is determined by the gain of U8A which is set by R28, R19, and R30. Normally the output varies from 0 to +10 volts, but may be adjusted by selection of these resistors.

The front panel digital display indicates (1) generator output frequency in the CW mode only, (2) sweep limits in the F_1-F_2 sweep mode, and (3) marker frequencies. In each case, the voltage output from the selected front panel tuning control connects through pin P of A3B5 to the non-inverting input of operational amplifier U1B. The particular tuning control is selected by the five front panel pushbuttons, and varies from -11 to +11 volts for each band. In single band operation, the voltage is -11 volts at the low end of the band and +11 volts at the high end of the band. In crossband operation, the voltage is -11 volts at the low end of the frequency coverage and +11 volts at the high end of the frequency coverage.

U1B buffers the input which is then summed with a DC offset in operational amplifier U2B. The DC offset, which is buffered by U1A, changes the -11 to +11 voltage variation to a positive variation, and adjusts band 1 LO; negative levels cannot be switched by integrated circuits U4 and U5. For bands 2 thru 4, an adjustable DC offset is switched by U5 and buffered by U6A, and an adjustable voltage swing is switched by U4 and buffered by U6B. Both are summed in U7B. This allows setting both end points. The summed output is buffered by U7A to drive the Digital Frequency Display (A5). In the crossband mode, the DC offset and variable component are buffered by U3A and U3B respectively, and summed in U8B. Relay K1 selects the display input for single band or crossband operation.

4.9 MODULATION GENERATOR/LEVEL CONTROL (A3B1)

The components of the leveling loop located in the RF Unit (1) sample the level of the RF output, (2) compare this level to a reference value, and (3) drive the PIN attenuator in the direction to equate the two. Therefore the generator output level can be controlled by varying the amplitude of the reference signal to the leveling loop. The leveling loop includes shaping circuits so that this reference is a linear function of generator output in decibels, with a value of 0.1 volts/ dB.

The circuits described herein generate this reference signal which provides a calibrated output, an attenuation range of 20 dB, internal squarewave modulation, blanking and external amplitude modulation. The FM modulation signal and pulse repetition rate are also generated.

Integrated circuit U2 is a function generator with a squarewave output at pin 9 and sinewave output at pin 2. R8 and R9 adjust for minimum sinewave distortion; R5 adjusts for best squarewave symmetry. The frequency is determined by the resistance value of R5, the capacitance from pin 10 or U2 to ground, and the voltage at pin 8 of U2. The front panel FREQ/PRF control connects between pins P and N of A3B1, with the arm connected to pin 11. The variable voltage at its arm is buffered by operational amplifier U1A and offset by zener diode D1 to provide the adjustable PRF and modulation frequency. The X10 switch on this control grounds pin 7 of A3B1 to turn transistor Q1 off and thereby disconnect capacitor C1 from ground.

The sinewave output from U2 is buffered by operational amplifier U1B to provide internal FM. It is switched by relays K1 and K2 to pin 8 of A3B1, and from there to the FM driver in the RF Unit. The output of the FM driver connects to the auxiliary tuning coils of the YIG oscillators. For itnernal squarewave modulation, the squarewave output of U2 is switched by K2 to the base of Q2 which drives the level control signal to its blanking or off state.

The level control signal, which is the reference signal for the leveling loop in the RF Unit, consists of the following components.

1. Power Level Control
2. External AM Modulation
3. Remote Attenuator Control
4. Slope Control
5. Internal Squarewave Modulation
6. RF Blanking

Items 1 through 4 above are analog singals and are summed at the non-inverting input of the operational amplifier U6B. Items 5 and 6 are switching signals and connect to the base of switching transistor Q2.

The front panel RF LEVEL control sets the power output level and connects from pin M of A3B1 to ground. Its arm connects to pin R of A3B1, and the variable voltage is buffered by operational amplifier U7B and summed through R33. If external AM is selected, the modulating signal is summed through R32.

The RF outut has an uncompensated error component caused by variations in cable and connector loss after the sampler, and this error ;increases with frequency. The generator tuning voltage connects through pin V of A3B1 to five paralleled potentiometers, R17-R21, one for each band, and five parallel potentiometers R66-R77 which are switched by the BCD band input to solid-state switch U3. The output of U3 is therefore a voltage which increases linearly with the tuning voltage, and the total deviation is adjustable over each band. The output of U3 is buffered by U4A and summed through R31. It varies the level control signal to compensate for the small changes caused by increasing the losses with increasing frequency. The same signal is subtracted from the level meter (DBM) signal in operational amplifier U4B. This is necessary so that the meter does not indicate the small changes in output power at the sampler which are necessary to compensate for the loss variations between the sampler and generator RF OUTPUT connector.

The BCD remote attenuator control command connects through pins 14, 15, 16 and 17 of A3B1 to the integrated circuit switch U9. This switch, with summing amplifier U8A and resistors R53, R54, R55 and R56, comprise a 4-bit D/A converter with the reference voltage supplied by zener diode D8 and buffer U8B. The D/A output is summed through resistor R34. The remote attenuator control is enabled by grounding pin 18 of A3B1 to turn Q4 on and thereby connect D8 to the +6 volt supply. In local operation, the 10 dB attenuation range is provided by the front panel RF LEVEL control and DBM level meter.

The output of summing amplifier U6B is inverted by operational amplifier U6A and buffered by U5. Switching transistor Q2 clamps the input of U5 at a slightly negative potential during the RF blanking pulse and during the off portion of the internal squarewave modulation signal. Transistor Q3 is saturated to provide a slightly negative emitter supply for Q2 and assure that the collector of Q2 goes to at least zero potential when Q2 is turned on by the blanking or squarewave signals.

4.10 RF UNIT (A4)

The RF Unit houses the RF sources, the leveling components, and associated circuits. It may also contain other components and circuits for various options as shown on the wiring diagram Figure 7.13.

The RF sources are YIG-tuned transistor and Gunn osillators which are multiplexed to the single output by the single-pole, four-throw PIN switch Z9. The PIN diodes of this switch are used both for switching the sources and for adjusting the level of the "on" port to level, attenuate and amplitude modulate the RF output.

If no options are included, the common port of the PIN switrch Z9 (J1) connects through the directional detector Z14 directly to the RF OUTPUT jack. The rectified output from the directional detector Z15 is amplified by A4B7A1 (2-18 GHz DET PRE-AMP) and compared to a preset reference level. The difference is amplified in the level board (A4B7) to drive the leveler input to the PIN switch Z9 to maintain the corresponding RF output level.

Option 1 adds coverage from .01 to 2.0 GHz. The output of YIG oscillator Z1 (2.31 to 4.4 GHz) connects through relay K3 to mixer Z16. It is heterodyned by the 2.3 GHz oscillator Z17 to the output frequency of .01 to 2.0 GHz. The mixer output is amplified by the broadband amplifier Z18. The low-pass filter Z19 attenuates the other mixer products. The low frequency sampler Z21 and detector Z22 provide the rectified output to the leveling circuits for this band.

Options 2 and 2A add the step attenuator Z15 and its driver circuits A4B12.

Option 3 adds the 2 to 18 GHz tracked YIG filter Z13 which is switchecd in by relay K2. This option also requires the relay driver circuits A4B5 in the RF Unit and the filter tracking and driver circuits A3B9 in the mainframe. Option 3A also includes filter Z20 for the low band (Option 1) but coverage is only from 0.40 to 2 GHz. This filter is switched between amplifier Z19 and sampler Z21 by relay K4. This option adds relay driver circuits A4B10. Filter tracking is included in A3B9 (Option 3).

Option 4 adds Z9A and 4 couplers to provide a sample of the output from the YIG sources.

4.10.1 OSCILLATOR ASSEMBLY (A4B1)

The RF sources are YIG tuned oscillators Z1, Z3, Z5 and Z7. When a Yitrium-Iron-Garnet sphere is placed in a magnetic field, it exhibits a resonant frequency which varies linearily with the intensity of the magnetic field. This sphere is the resonant element of the oscillator, and is placed in the gap of a magnetic circuit having a tuning coil to vary the flux through the gap. The current through the tuning coil is varied, and produces a linear function of frequency vs. tuning current. A second, smaller (FM) coil is added to allow fast frequency changes over a small deviation.

High fundamental power output and lower harmonic output can be achieved by varying the oscillator supply voltage with frequency. Therefore these voltages are programmed by sampling the tuning current and using this sample to vary the supply voltages as required.

4.10.2 OSCILLATOR CONTROL BOARD (A4B2)

This board contains the circuits which switch the tuning current and oscillator voltage to the four YIG oscillators, including programming of the voltage.

One YIG oscillator is used for both band 1 (.01-2 GHz) and band 2 (2-4 GHz). For band 1, pin S of A4B2 is grounded. Q10 is turned off through diode D12, and turns Q11 on to switch pin 13 to ground. This lead switches portions of the .01-2 GHz converter circuits when band 1 components (Option 1) are included in the RF Unit. Transistors Q7, Q8 and Q9 are turned on through diode D11 for band 1 and through diode D9 for band 2. Q8 switches the tuning coil input (pins 9 and K of A4B2) to the YIG tuning coil (pin R). Q7 switches the +15 volt supply (pin X) to the YIG oscillator (pin 20). Q9 is turned on through D10 and switches the +18 volt supply to the YIG oscillaotr through the integrated circuit regulator U7.

U7 programs the oscillator supply voltage with frequency in the following manner. The tuning coil current from the oscillator is returned to the tuning generator through R50, so the voltage across R70 varies linearily as the frequency to which the oscillator is tuned. The voltage is buffered by operational amplifier U3A and amplified by U8B to drive regulator U7. Trimmer R63 adjusts the variation of the supply voltage as the oscillator is tuned over the band, and R59 adjusts the voltage at the low end of the band.

The circuits for bands 3, 4 and 5 are identical to those of band 2.

NOTE

The regulators for bands 4 and 5 are located on the main chassis in the RF Unit.

4.10.3 LEVEL BOARD (A4B7)

Three functional circuits are included on this board. The leveler circuits amplify and calibrate the output of the level detector Pre-Amp (A4B7A1), and process this signal to drive the input of the PIN Driver (A4B14). The other two are the FM coil driver and the BCD band decoder for the RF Unit.

4.10.3.1 LEVELER

The RF output of the SG-811 is sampled by a negative-going, square-law crystal detector. The standard SG-811 covers 2-18 GHz and has an internal detector, as well as provisions for connection to an external detector. If coverage from .01-2 GHz (Option 1) is included, an additional internal detector is supplied. Therefore there are three selectable inputs to the level circuits; A4B7 pin D for the 2-18 GHz Detector Pre-Amp (A4B7A1), and A4B7 pin E for the

.01-2 GHz Detector Pre-Amp (A4B7A3), and A4B7 pin Z for the EXT Detector Pre-Amp (A4B7A2). K2B selects between internal and external leveling, and is energized by Q3 when pin Y of A4B7 is grounded. K1B selects between the .01-2 GHz Detector Pre-Amp and the 2-18 GHz Detector Pre-Amp, and is energized by Q1 when pin A of A4B7 is grounded

The selected detector Pre-Amp output drives U4 which contains several individual log amplifiers having a dynamic range of about 15 dB each. Two are summed together to increase the range to 30 dB. One log amplifier is driven by U1 to generate the low level portion of the range. The second log amplifier is driven directly to generate the high level portion of the output. The two outputs are summed in operational amplifier U5. The voltage output of U5 is a linear function of the dBm output of the square-law crystal detector. For the SG-811A, +3 volts at pin 6 of U4 equals +10 dBm; for th SG-811B, +3 volts equals +13 dBm. The voltage decreases one volt for each 10 dB decrease in output.

One output from U5 drives the buffer U8A which in turn drives the peak detector consisting of C18 and D10. R41 and D11 generate a bias voltage to offset the junction bias of D10. If the RF output is pulse modulated by a squarewave or at a high duty cycle, the output from this peak detector will be the same as for a continuous wave having its amplitude equal to the peak amplitude of the pulse wave. The peak detector output is buffered by operational amplifier U8B to drive the front panel level meter circuit. This output at pin 20 of A4B7 is a linear voltage function of power sampled at the crystal detector and varies from 0 to +3 volts as the RF output level varies over a 30 dB range.

The output from U5 also drives comparator U9, which compares the output of U5 to the level control signal at J1. In the leveled mode, K2A is not energized, so the comparator output is amplified by U6 and U7 to drive the PIN leveler in the direction which sets the generator RF output at the RF level which makes the output voltage of U5 equal to the input voltage at J1. The input voltage at J1 therefore sets the leveled RF output of the SG-811; it also amplitude modulates the RF output in AM modes. A second comparator U10B is connected in parallel with U9. If the leveler loop is out of range, the input from J1 will go more positive than the output of U5, so the output of U10B will go positive and turn Q4 on to illuminate the front panel UNLEVELED lamp.

In the unleveled mode, relay K2B is energized, and the input to J1 is amplified directly by U6 and U7 to drive the PIN leveler and therefore change the SG-811 RF output. The inverting input to the comparator U10B is switched by K2A to -15 volts to hold the UNLEVELED lamp on.

The comparator output in the leveled mode, or the input to J1 in the unleveled mode is inverted and offset by operational amplifier U6. The output of U6 drives the unity voltage gain, current amplifier U7. R53 adjusts the gain of U6 for a minimum of 20 dB control in the unleveled mode.

4.10.3.2 FM DRIVER

The signal for FM connects between pins B and I of A4B7 to drive buffer amplifier U2 when relay K1A is energized by a ground at pin C. The output of U2 drives the four fast FM coils, one for each YIG oscillator, in parallel through resistors R17, R19, R21 and R23.

4.10.3.3 BAND DECODER

The band command BCD signal connects to pins F, H, and J of A4B7. U3 is a BCD/Decimal decoder and driver which converts the BCD to one-of-five switch lines, one for each band.

4.10.4 PIN DRIVER (A4B14)

This circuit drives the single

pole, four-position PIN switch. The PIN switch has two functions, one is to switch the correct oscillator to the common RF output port, and the other is to vary the level of the selected signal in accordance with the input from the Leveler/Driver circuits. The latter provides leveling, amplitude modulation, power setting and an adjustable 20 dB of attenuation.

Each of the four positions of the PIN switch has its own driver, U2-U5. Negative output from the driver turns the PIN section on, and the on section is selected by grounding the corresponding input line, i.e. pin 6, 7, 8 or 9. For band 3, pin 7 is grounded to turn Q2 off. This drives pin 6 of quad line driver U1 negativ and disconnects the quad line drive from U3 because of diode D2. The input from the Leveler then controls the conduction of the PIN section connected to E12 of A4B14. Pins 6, 8 and 9 are high, so transistors Q1, Q3 and Q4 are turned on. Each corresponding output of the quad line driver is therefore positive, and the outputs of U2, U4 and U5 are positive. This drives each of the three PIN sections to the off position.

Q5 and R25 set a voltage reference to the common port of the PIN switch.

E15, E16, E17 and E18 are used to switch Z9A (option 4) for the RF sample output.

4.11 DIGITAL FREQUENCY DISPLAY (A5)

The Digital Frequency Display is a 3 1/2 digit voltmeter using dual ramp analog-to-digital conversion and incorporating special ancillary circuitrs for this application. Integrated circuits U3 and U4 are specifically designed to operate together to form the ananlog-to-digital conversion. The input signal to the basic meter function connects between pins 1 and 2 of U3 and at this point has a range of 0 to +1.999 volts. The multiplexed digital output appears at pins 11, 12, 13 and 14 of U4 with the digit select output at pins 1, 2 and 15. The 1/2 digit output is at pin 10 of U4. U5 converts the BCD output of U4 to drive the 7-segment LED displays through the display drivers U6 and U7.

Integrated circuits U8, U9 and U10 comprise an autopolarity circuit to detect when the analog input to U3 goes below zero, i.e. negative. In the basic measurement system (U3 and U4), 5 percent of full scale current is always added to the ramp-up period to insure noise immunity. The first 100 counts of the down ramp are subtracted to calibrate out this added current. If the input is below zero, there will be less than 100 counts. The clock output at pin 3 of U4 connects to the input of the dual BCD counter U8. An output pulse appears at pin 14 of U8 after each 100 counts. Integrated circuit U9 is connected as a gated, low-frequency oscillator with the frequency determined by C16 and R38. Integrated circuit U10 contains two flip-flops for the oscillator switching logic. At the start of the down-ramp, the ramp control signal at pin 7 of U4 goes high and connects to U9 and U10 to generate the low-frequency oscillator start command. However C19 and R40 delay this command long enough to allow an output from counter U8 to reset a flip-flop and negate the command. If an output from U8 does not occur, i.e. the input votlage is negative, the low-frequency oscillator turns on and switches the LED display on and off, because the oscillator output connects to pin 7 of U5.

Transistors Q5, Q6 and Q7 are switch drivers, and are necessary to control the LED displays from the digit select output of U4.

The input voltage from the meter tracking circuits varies from about 0 to +9 volts as the generator frequency tunes from .01 to 18 GHz. Resistors R41 and R4 divide this input by 5 to bring it within the range of the basic circuit. Operational amplifier U1 buffers the input to U3.

Trimmers R5 and R6 adjust the full scale meter range. Trimmer R7 is the zero calibration. Regulator U2 stabilizes the voltage to the meter circuits.

The basic meter circuit has a digital output from 0000 to 1999, and the most significant digit (1/2 digit) normally switches on the "1" to obtain this range. However, if the SG-811 has an option to cover 18-26 GHz, the 1/2 digit line must switch from "1" to "2". Transistors Q1, Q2, Q3 and Q4 provide this function. If the "18-26" line is ungrounded, Q4 is switched on and turns Q3 off regardless of the signal from pin 10 of U4 (1/2 digit select). Q1 is also on so that its collector is near ground potential, and no current flows through D1. In this condition when the 1/2 digit select line goes high, Q2 is turned on and the "1" digit of DS1 is turned on. If the "18-26" line is grounded and the 1/2 digit select line is low, Q1 is turned off and current flows through R42 and diode D1 to turn Q2 on and therefore turn on the "1" digit. Q4 is off because the "18-26" line is low. If the 1/2 digit line goes high, Q3 is switched on and the "2" digit is turned on. With Q3 on, its collector switches the base of Q2 low and therefore turns Q2 off to shut off the "1" digit.

4.12 POWER SUPPLY (A2)

The Power Supply uses a switching regulator to maintain a high efficiency over the specified range of voltage inputs. Series voltage regulators are used for some regulated outputs in order to improve regulation and reduce source impedance.

In the AC mode, the line voltage is rectified by DA1. With S1A in its 230 volt position, DA2 is connected as a full wave bridge rectifier. With S1A in its 115 volt position, D1A is connected as a voltage doubler. In either configuration the high-voltage primary winding is switched alternately between a positive and negative potential by transistors Q5 and Q7. In the DC mode, the DC input is switched by transistors Q9 and Q10. The switching transistors are driven by Q1 and Q2 through transformer T2.

4.12.1 CONTROL CIRCUITS (A2B2)

The control circuits generate the driving waveform to transistors Q1 and Q2 and therefore the drive to the primary switching transistors. Operation is as follows. Timer U2A is connected as an RC oscillator operating at approximately 40 kHz. Timer U2B is connected as a voltage-controlled, one-shot multivibrator which generates variable-width pulses. U3 is a 2:1 frequency divider. The output of U2B is gated by the 20 kHz output from U3 by NAND gates U4A and U4B. The resultant drive signal to Q1 and Q2 has its on time varied by the voltage into pin 11 of U2B.

Transistors Q3 and Q4 are turned on during the period that Q1 and Q2 are off. This shorts one winding of the transformer and prevents noise from turning the primary switching transistors on. NAND gates U4C and U4D are connected as a buffer-driver to the bases of Q3 and Q4.

The on time of the primary switching transistors is proportional to the voltage at pin 11 of U2B, so this voltage can be used to regulate the rectified output of the switched DC. A sample of the rectified output is compared to a zener reference in operational amplifier U6A, and the error is fed back to U2B in the correct polarity to reduce the error. The error output from U6A is further amplified by operational amplifier U6B and U5. Optical coupler AT-1 is driven by emitter follower Q11 and prevents any ground current flow from the ouput rectifiers into the control circuit board. Diode D9 supplies voltage to U6 before the output voltage across the rectifier rises.

4.12.2 SWITCHING

In the DC mode, transistors Q9 and Q10 switch the low-voltage DC input alternately through each side of the center-tapped primary winding of T3. Q5 and Q7 are driven directly from T2.

In the AC mode, transistors Q5 and Q7 alternately switch the single primary winding across the positive and negative voltages rectified from the AC line. This permits Q5 and Q7 to have a lower breakdown voltage than if a conventional center-tapped winding were used. As the current through this primary alternately reverses, capacitor C3 prevents core saturation of T3. In order to insure minimum turn-off time for each high-voltage switch, a turn-off circuit is included. For example, when Q5 is on, its base current is limited by R20, and the potential across R20 charges C18; Q6 does not conduct because it is biased off by the drop across D10. When the drive winding goes to zero to turn Q5 off, Q6 is forward biased by R21 and conducts to force a reverse current through the emitter-base junction of Q5.

In the AC mode the bases of Q9 and Q10 are grounded by relay K3 which is energized by the rear panel AC-DC slide-switch.

4.12.3 RECTIFIERS/FILTERS

The output of the full-wave rectifiers DA3, DA4, and DA5 are constant-amplitude pulses with varying duty cycle. It is necessary to use inductor input filters if the filtered DC output is to be proportional to duty cycle.

4.12.4 REGULATORS

Series integrated circuit regulators provide additional filtering, as well as regulation of individual outputs and a low source impedance. Dissipation in these regulators is minimized because the input levels to the regulators are held essentially constant by the switching regulator.

4.13 10 MHz TO 2 GHz - OPTION 1

This option adds coverage from 10 MHz to 2 GHz in a single band. Output is from the same RF OUTPUT connector as used for 2 to 18 GHz, with manual bandswitching at 2 GHz. Automatic switching at 2 GHz with full crossbanding from 10 MHz to 18 GHz is not included with Option 1.

4.13.1 GENERAL

Refer to Figure 7.13. In this band, YIG oscillator Z1 tunes from 2.13 to 4.30 GHz, and its output through PIN switch Z9 is switched by relay K3 to one input of mixer Z16. The second input to Z16 is the fixed-frequency 2.3 GHz oscillator Z17 which heterodynes the output of Z1 to the frequency range of 10 MHz to 2.0 GHz. The mixer output is amplified by Z18, and the unwanted mixer output products are filtered by Z19. Sampler Z21 and detector Z22 provide the input to the leveling circuits. Relay K3 switches the output of this low frequency converter to the RF output connector through directional detector Z14. Z14 has no effect on this output, and is not part of Option 1.

All assemblies of this option except Relay Driver A4B8 are replaceable as components.

4.13.2 TRANSFER RELAY DRIVER (A4B8)

Transfer relay K3 requires power to its pin 1 for contact between J1 and J2, and J3 and J4, i.e. for the bands from 2 to 18 GHz. It requires power to its pin 2 for band 1, 10 MHz to 2 GHz. Relay DRiver (A4B8) switches K3 accordingly.

When band 1 is selected, E5 is grounded. Transistor Q5 is cut off, and its collector goes high to turn Q3 off and remove the power from pin 2 of K3. With the collector of Q5 high, Q4 is turned on by the current flowing through R6 and R5. The collector of Q4 goes low to turn on Q2 and apply +24 volts to pin 1 of K3.

E5 is open for other bands. Q5 is turned on by the current flowing through R10 and R9. The collector of Q5 goes low to turn Q3 on and Q4 off. Q3 applies +24 volts to pin 2 of K3. The collector of Q4 goes high to turn Q2 off and remove power from pin 1 of K3.

4.14 STEP ATTENUATOR OPTIONS 2 and 2A

These options add a step attenuator in series with the RF output line of the SG-811. The range is 70 dB for Option 2 and 110 dB for Option 2A. Each has 10 dB steps.

4.14.1 ATTENUATOR

The 70 dB attenuator consists of three switched sections of 10, 20 and 30 dB. The 110 dB attenuator has four switched sections of 10, 20, 40 and 40 dB. Each section must be switched in or out by the momentary application of +24 volts to the appropriate terminal for each section.

4.14.2 ATTENUATOR DRIVER (A4B12)

The digital command to the attenuator driver is BCD positive true. Driver U2 (10 dB), U3 (20 dB), and U4 (40 dB) are used for Option 2. These plus driver U5 (40 dB) are used for Option 2A. With Option 2A, it is necessary to convert the 10-20-40-80 BCD input command to the 10-20-40-40 attenuator steps. This is done by activating both 40 dB sections when the 80 command is received.

The operation of all drivers is identical. For the 10 dB driver, E1 is open for zero attenuation, and is held high by R1. Both pins 1 and 2 of U2 are high so E6 is driven low to actuate the attenuator relay which provides zero attenuation across the 10 dB section. Pin 6 of U2 is driven low by inverter U1A to open E5 and prevent actuation of the attenuator relay which provides 10 dB attenuation. When E1 is switched low, pin 2 of U2 goes low and E6 is opened. At the same time, inverter U2A drives pin 6 of U2 high, which drives E7 low to actuate the attenuator relay which provides 10 dB attenuation.

E3 is switched high for the 40 dB step. Inverter U1E and U1F in series drive pin 2 of U4 high. U1C drives pin 6 of U4 low.

E4 is switched high for the 80 dB step of Option 2A. Driver U5 is operated directly by E4. The output of inverter U2D drives the input of inverter U2E low through diode D17, and the output of U2E drives pin 2 of U4 high, thus actuating both 40 dB sections of the attenuator.

4.15 OUTPUT FITLER - OPTIONS 3 and 3A

These options add a tracked YIG filter in series with the RF output to reduce the harmonics to at least 60 dB below the fundamental. Option 3 covers 1.9 to 18 GHz. Option 3A covers 0.4 to 18 GHz. Since the filter has an insertion loss of 6 dB or less which decreases the maximum RF output accordingly, a switch in provided to bypass the filter. With the Internal Pulse Generator, Option 5, the YIG filters eliminate the pulse feedthrough at the RF output. Option 3A can be included only if the SG-811 has Option 1, coverage from .01-2 GHz.

4.15.1 YIG FILTERS

Option 3 adds the 2-18 GHz YIG Filter Z13 as shown in Figure 7.11. The filter is switched in series with the 2-18 GHz output by relay K2. Option 3A adds a second filter Z20 which covers

0.40-2 GHz and is switched in series with the .01-2 GHz output by relay K4. The YIG filters are current tuned and tracked with the composite generator tuning signal. Any tracking error can be compensated by the front panel FILTER PEAK control.

4.15.2 FILTER TRACKING/DRIVER (A3B9)

The Filter Tracking/Driver circuits are part of Option 3 and 3A. The tracking circuits modify the 0 to +9 volts tuning signal from the Tuning Generator to match the tuning function of each YIG filter. With Option 3 there is a single YIG filter that operates from 2-18 GHz. Option 3A is supplied only with Option 1 and adds a second filter covering 0.40 to 2 GHz. The filter driver circuits convert the modified tuning voltage to a corresponding current through the YIG tuning coils.

Refer to Figure 4.1, which is the simplified schematic of the YIG driver. The modified tuning voltage is applied to one input of the comparator. The second input ot the comparator is the voltage across the YIG filter sense resistor. This sense voltage is directly proportional to the current through the YIG filter. The output of the comparator drives the power amplifier with the correct polarity to equalize the voltage across the sense resistor, and current through the YIG directly follows the tuning voltage.

The input to this board (pin 18) is the 0 to +9 volt tuning signal from the Tuning Generator. This is applied to the five "HI" networks (R16-R30) which allow individual amplitude adjustments for each band. The "LO" networks (R1-R15) connect across the precision +11.00 volt supply and allow individual DC offset adjustments for each band. Integrated circuit switches U2 and U3 select the correct "HI" and "LO" network for each band. The output of the switches are buffered by operational amplifiers U4 and U8 respectively, and then summed with the voltage from the front panel FILTER PEAK control at the non-inverting input of operational amplifier U5. The inverting input to U5 is the voltage across the YIG sense resistor as switched by U9 and buffered by operational amplifier U7. Operational amplifier U5 functions as a comparator, and its output is buffered by U6 to drive the filter tuning coil.

4.15.3 2-18 GHz FILTER RELAY DRIVER (A4B5)

Transfer relay K2 requires power to its pin 1 for switching the filter in the circuit, and to its pin 2 for switching the filter out of the circuit.

When the front panel FILTER switch is set to its ON position, E5 is grounded. Transistor Q5 is cut off, and its collector goes high to turn Q3 off and remove the power from pin 2 of K3. With the collector of Q5 high, Q4 is turned on by the current flowing through R6 and R5. The collector of Q4 goes low to turn on Q2 and apply +24 volts to pin 1 of K2. Transistor Q1 is also turned on to connect the YIG tuning coil to the YIG driver which is on A3B9. If Band 1 has been selected, E4 is grounded and prevents Q3 from being turned off.

When the front panel FILTER switch is off, Q5 is turned on by the current flowing through R10 and R9. The collector of Q5 goes low to turn Q3 on and Q4 off. Q3 applies +24 volts to pin 2 of K3. The collector of Q4 goes high to turn Q2 off and remove power from pin 1 of K2.

4.15.4 .40-2 GHz FILTER RELAY DRIVER (A4B10)

Transfer relay K4 requires power to its pin 1 for switching the filter in the circuit, and to its pin 2 for switching the filter out of the circuit.

When the front panel FILTER switch

is set to its ON position, E5 is grounded. Transistor Q5 is cut off, and its collector goes high. If Band 1 (.01-2 GHz) has also been selected, E6 is grounded and transistor Q6 is cut off so that its collector goes high. If the collectors of Q5 and Q6 are both high, Q3 is turned off and power is removed from pin 2 of K4. With the collector of Q5 high, Q4 is turned on by the current flowing through R6 and R5. The collector of Q4 goes low to turn on Q2 and apply +24 volts to pin 1 of K2. Transistor Q1 is also turned on to connect the YIG tuning coil to the YIG driver which is on A3B9. If Band 1 has been selected, E4 is grounded and prevents Q3 from being turned off.

When the front panel FILTER switch is off, Q5 is turned on by the current flowing through R10 and R9. The collector of Q5 goes low to turn Q3 and Q4 off. Q3 applies +24 volts to pin 2 of K3. The collector of Q4 goes high to turn Q2 off and remove power from pin 1 of K4.

4.16 RF SAMPLE - OPTION 4

This option provides a signal sample for use with a frequency counter, synthesizer or stabilizer. Directional couplers Z1A, Z4A, Z6A and Z8A sample the output of each YIG oscillator. The outputs of the couplers are switched to a single line by PIN switch Z9A. No sample is provided for the .01-2 GHz band. It is not required for synthesizer or stabilizer operation. A counter with digital offset is recommended.

4.17 INTERNAL PULSE GENERATOR OPTION 5

This option adds a fully self-contained pulse capability to the SG-811. Refering to Figure 7.11, PIN switch Z12 is added in series with the 1.9-18 GHz RF output line. Since this PIN switch has some insertion loss, it is switched out of the line by relay K1 when pulse modulation is not required. This option also pulses the .01-2 GHz output, since Z12 is inserted before relay K3 of Option 1. PIN switch Z12 is driven from the Pulse Generator (A7) which is located in the mainframe.

4.17.1 INTERNAL PULSE GENERATOR (A7)

The Internal Pulse Generator (A7) contains two monostable multivibrators, U1A and U1B. U1A generates the pulse to drive the PIN diode which pulses the RF output. U1B generates the sync pulse at the rear panel PULSE TRIGGER OUT connector. The sync for both pulse generators is taken from the Modulation Generator (A3B1) and connects through pin 5 of A7 to the two transistor switches Q2 and Q4. Therefore the pulse repetition rate (PRF) is controlled by the frequency of the Modulation Generator (A3B1). The sync signal to Q2 is delayed by C4 and R6 so that the rear panel trigger pulse precedes the RF pulse.

The width of the RF pulse (U1A) is determined by the front panel PULSE WIDTH controls, which consist of a variable potentiometer and a rotary switch. The potentiometer connects between pin E2 of A7 and the common arm of the pulse width rotary switch. The front panel rotary switch connects the pulse width control to A7-E4 for the X.1 position, A7-E11 for the X1 position, and A7-E12 for the X10 position. This switch also connects A7-E4 to A7-E3 for the X.1 position, A7-E9 for the X1 position, and A4-E10 for the X10 position. The output of U1A is amplified by the complementary transistor amplifier Q5 and Q6 to drive the PIN diode through J1. Relay K1A connects J1 directly to J2 for external pulse modulation. Relay K1B connects J1 directly to the +5.4 volt supply, which holds the PIN diode in its "on" position for calibrating the RF output in the pulse modulating mode.

4.17.2 PULSE MOD RELAY DRIVER

Transfer relay K1 requires power to its pin 1 for inserting the PIN switch Z12 into the RF line; contact is made between J1 and J4, and between J2 and J3. Power to pin 2 of K1 connects J1 to J3.

When pulse modulation is selected, E5 is grounded. Transistor Q5 is cut off, and its collector goes high to turn Q3 off and remove the power from pin 2 of K1. With the collector of Q5 high, Q4 is turned on by the current flowing through R6 and R5. The collector of Q4 goes low to turn on Q2 and apply +24 volts to pin 1 of K1. The collector of Q4 turns Q1 on through diode D1 to apply +15 volts to the PIN switch Z12.

E5 is open when pulse modulation is not selected. Q5 is turned on by the current flowing through R10 and R9. The collector of Q5 goes low to turn Q3 on and Q4 off. Q3 applies +24 volts to pin 2 of K3. The collector of Q4 goes high to turn Q2 off and remove power from pin 1 of K1.

4.18 DIGITAL FREQUENCY CONTROL (A8) OPTION 6

Option 6 adds external digital frequency control over each band. This is in addition to the external analog frequency control available as a standard feature.

The external analog tuning signal from the rear panel FREQ CONTROL IN jack connects to Pin V of A8. If the digital cotnrol is not enabled, this analog voltage connects through relay K1 and Pin 18 of A8 to the Tuning Generator A3B7 (Pin 14). The external digital control is enabled by grounding Pin 17 (Pin 42 of the rear panel REMOTE CONTROL INPUT connector) which turns on transistor Q1 and energizes relay K1. This connects the output of the digital-to-analog converter DAC-1 to the Tuning Generator and disconnects the external analog input. The analog output from DAC-1 varies from 0 to +10.000 volts as the digital input (TTL positive true) varies from 0000 to 9999.

5.0 ALIGNMENT AND MAINTENANCE

This section contains instructions for alignment and maintenance of the SG-811. The procedures and drawings within this section are supplementary to the other sections of the manual. Alignment and maintenance should be done only by a qualified technician who is familiar with the principles and theory of operation.

The first and most important step in any troubleshooting procedure is to isolate the fault to a subassembly or function. Any failure may be the cause or the effect of improper power supply performance. Therefore the power supply should be checked prior to and following any other procedures.

The power supply voltages may be quickly checked. Test points for all voltages are accessible on the power supply by removing the bottom cover of the SG-811. If the voltage is lower than normal, the fault may be in the power supply or in the circuits connected to that voltage.

All voltages are measured using a digital voltmeter with a high impedance input. Waveforms are observed using an oscilloscope with a low capacitance probe.

Where applicable, alignment data for each subassembly is included in this section. For periodic alignment, the units should be aligned in the order presented in this section, starting with the Power Supply (A2).

NOTE

Always keep as many subassemblies as possible connected to the mainframe so as to load the power supply correctly.

Use the extender board, located near the middle of the printed circuit rack, when measuring waveforms or voltages of the individual boards. With the extender board in its own socket, the following voltages can be measured at its top edge counter.

PINS	VOLTAGES
1-A	GND
2-B	+15
3-C	+6.0
4-D	-6.0
5-E	-15
6-F	+11.00
7-H	-11.00

Band information is available on pins 15, 16 and 17 of the extender board in its own socket. The code is listed below.

	Pin 15-S	Pin 16-T	Pin 17-U
Band 1 .01-2	+5	0	0
Band 2 2-4	0	0	+5
Band 3 4-8	+5	0	+5
Band 4 8-12	0	+5	0
Band 5 12-18	+5	+5	0

5.1 POWER SUPPLY (A2)

All power supply voltages can be checked by removing the bottom cover of the SG-811. The voltage test points are accessible on the bottom cover of the power supply.

NOTE

When the power supply is electrically connected to the mainframe and the SG-811 is connected to an AC power source, the power supply control circuits operate at all times and are not controlled by the power switch.

The power supply is removed from the mainframe by the following procedure.

1. Remove the top and bottom covers of the mainframe.

2. Remove the 4 screws holding the power supply to the back panel.

3. Remove the left side inlay cover to expose the screws holding the power supply to the left side of the mainframe.

4. Remove the 7 screws holding the power supply to the left side of the mainframe.

5. Slide the power supply from the mainframe and disconnect the connector going to the power supply.

The power supply contains a switching regulator with pulse width modulation. It is therefore necessary that the power supply be operated within its normal load limits. Otherwise the switching regulator and inductance-input filters will not operate properly. Abnormal voltage readings and ripple values will most likely appear on the +24 and +18 unregulated voltage outputs. Other outputs are regulated by series, linear regulators.

5.1.1 ALIGNMENT

Before adjusting any of the regulated voltages, check the +18(1) volt unregulated output. It should remain within the limits of 17.8 to 18.2 volts as the power supply AC or DC input is varied over the limits of 105 to 125 VAC and 11.5 to 13.5 VDC. If not, adjust R35 which is available through the side cover of the power supply.

All other regulated voltages are adjusted by the trimmer potentiometer adjacent to the respective test point.

5.1.2 REPAIR

Any fault occurring in the power supply must be carefully analyzed before corrective measures are started. Review its theory of operation, section 4.12.

The first step is to determine whether the fault is in the power supply or whether excessive current is being drawn by other circuits of the SG-811. Any external fault on the regulated lines will cause the voltage on that line to drop and will not cause component failure within the power supply because the series regulators are self protected. Any monemtary overload will latch the regulator in an off state, and it can be reset by turning off the primary power input momentarily. If one of the regulated output voltages is low, remove cards and subassemblies, one at a time, to determine if the overload can be isolated. If not, unsolder the wire at the power supply connector. If the voltage is still low, the fault is in the power supply.

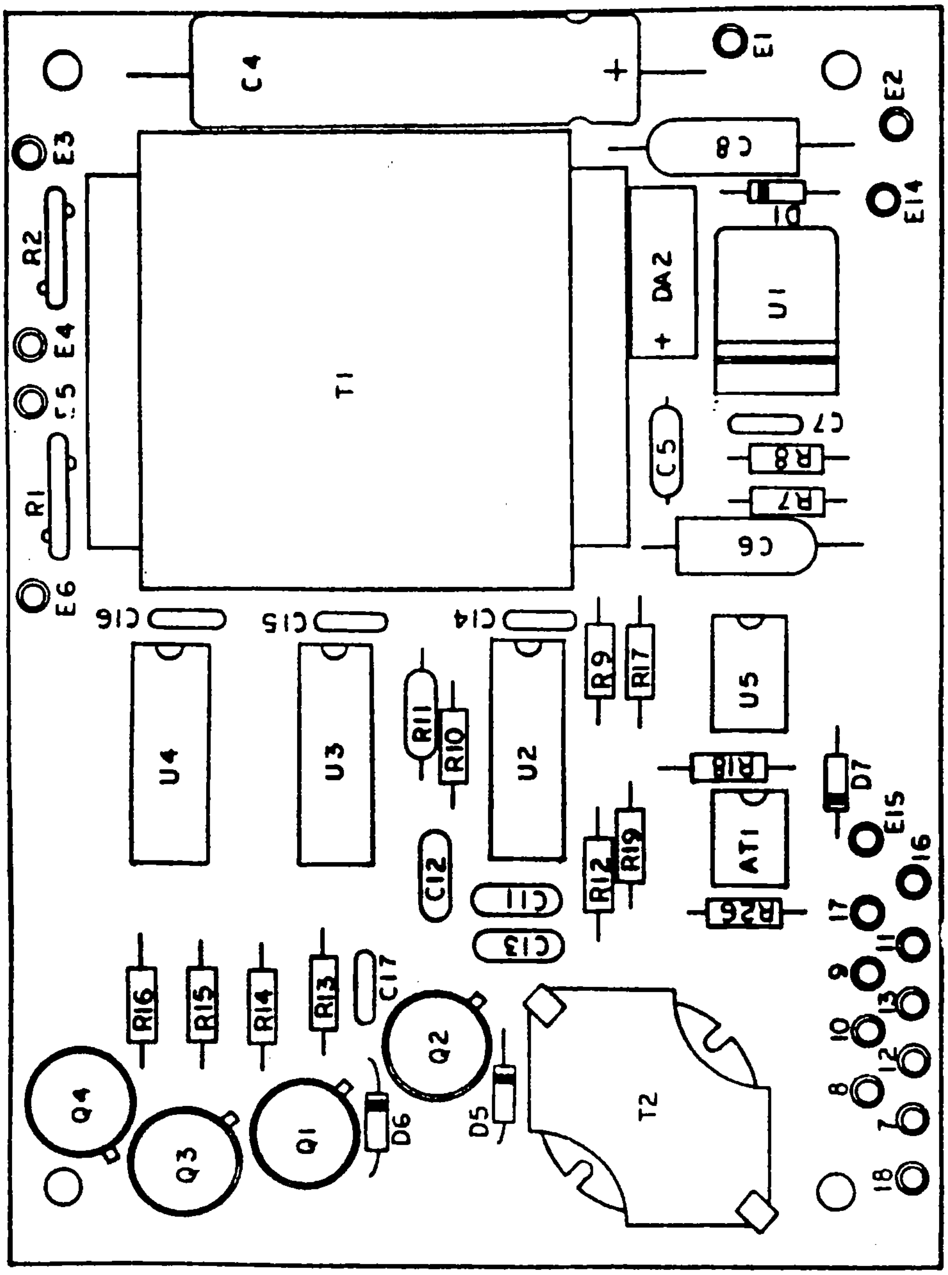
An overload on one of the unregulated lines may cause a blown fuse or fault within the power supply. A quick check is to substitute an external power supply, with current limiting, for each unregulated voltage. Maximum currents are listed below.

+24 VDC	0.5 amp
+18(1) VDC	2.5 amp
+18(2) VDC	2.0 amp

The external supply may be connected directly to the test point. If the fault is not isolated to an external circuit, the following test procedures must be undertaken in the order listed.

5.1.2.1 CONTROL CIRCUITS

Remove the power supply from the mainframe and disconnect the multi-pin connector which connects the power supply



Component Location, Power Supply Control Circuits

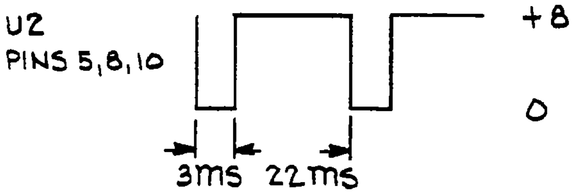
79-B-22-061 (A2B2)

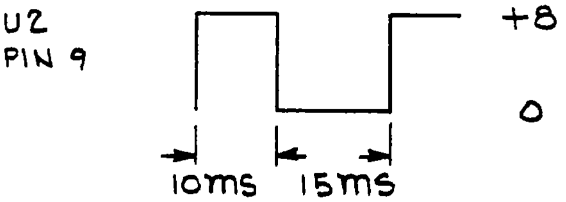
Figure 5.1

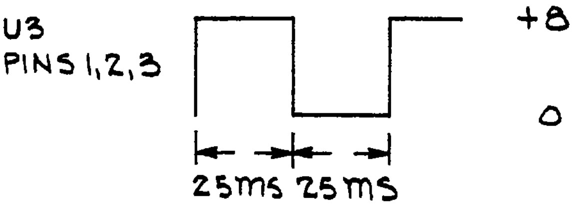
to the mainframe. Remove the side plates from the power supply. Connect the power supply to an AC power source. Check the voltages at U1.

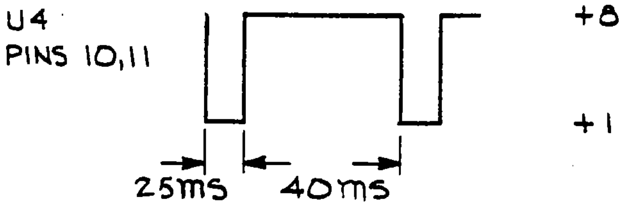
PIN	VOLTAGE
1	GND
2	+14
3	+9
4	+5

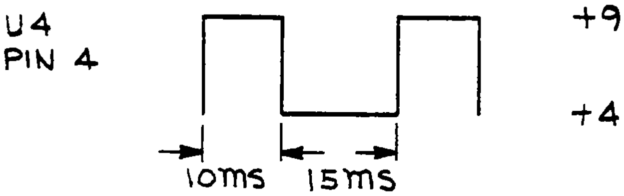
Ground pin 1 of AT1 and observe the following waveforms. Pin 1 of AT1 is available at the terminal of R16 nearest to AT1.

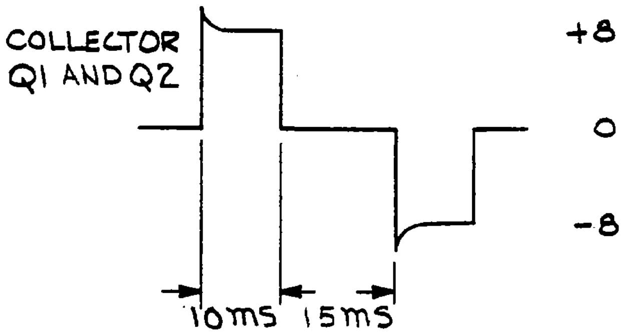


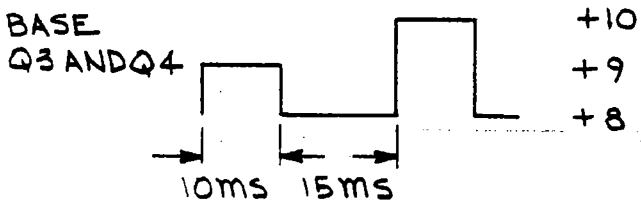








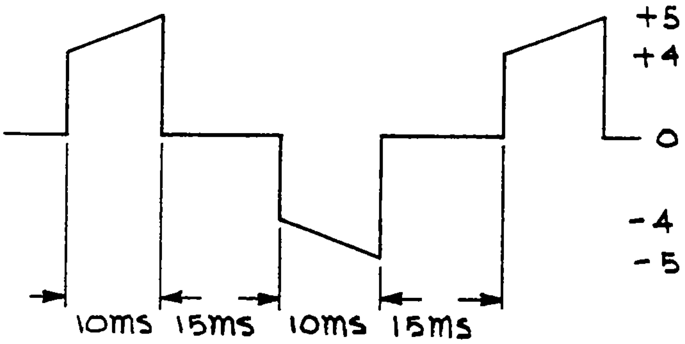




The waveforms at the collectors of Q1 or Q2 and the bases of Q3 or Q4, may be distorted due to a failure of the switching circuits.

5.1.2.2 SWITCHING CIRCUITS

Check the waveforms at the base of the switching transistors. CAUTION: These waveforms must be checked with the power supply detached from the multipin connector of the mainframe. Set the AC-DC switch to AC if the power supply includes Option 7. Set the 115/230 switch to the proper position. Check that relay K1 is not energized, otherwise one or more terminals used to check these wave forms may be connected to one side of the power line. Check the base drive of Q5 and Q7 one at a time, to prevent shorting the secondary windings. The base of Q5 is checked by connecting the scope ground to E4 and the probe tip to E1. The base of Q7 is checked by connecting the scope ground to E3 and the probe tip to E2.



Further analysis of the switching circuits requires that the switched DC input be gradually increased while the control circuits are operated at full voltage to drive the switching transistors. This is done in the following manner.

1. Disconnect the power supply from the AC line.

2. Connect +12 volts to the positive terminal of C6.

3. Connect -12 volts to E1 of A2B2.

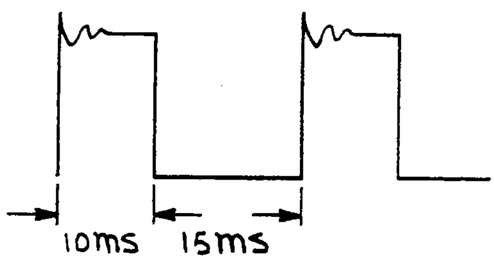
4. Connect the power supply to the mainframe multipin connector and check that K1 operates from the front panel POWER switch. Place it in the off position.

5. Connect a DC voltmeter between the positive terminal of C1 and the negative terminal of C2. CAUTION. HIGH VOLTAGE EXISTS AT THESE POINTS.

6. Connect a scope to the rectifier side of L2.

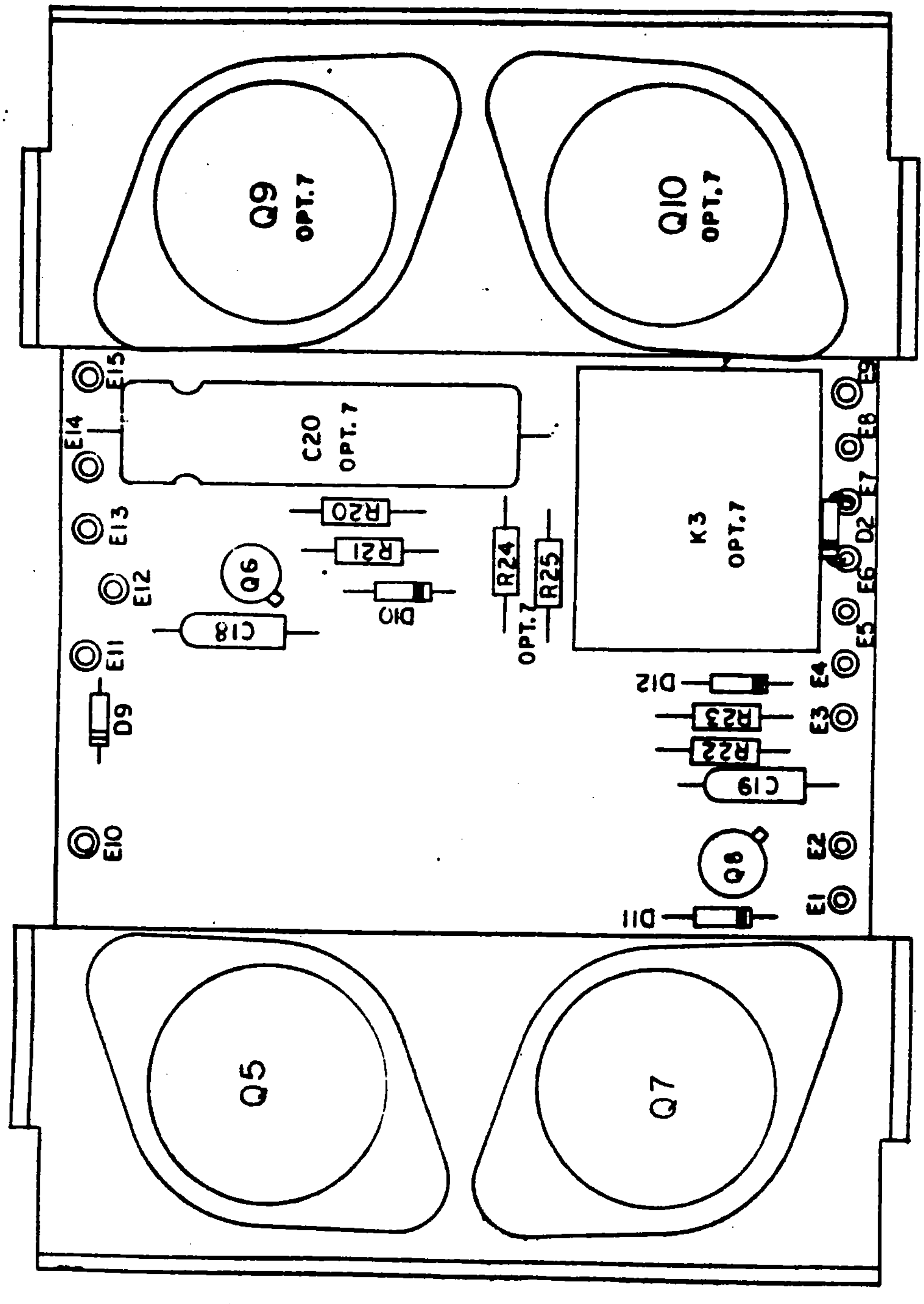
7. Connect the AC line cord to a variable voltage source with provisions for monitoring AC voltage and current.

8. Turn the power switch on and gradually increase the AC voltage while monitoring the AC current, AC voltage, DC voltage and scope waveforms.



As the AC voltage is increased to 115 volts, the AC current should not exceed 0.9 amperes. The DC voltage across the capacitors will rise to 300 VDC. The scope waveform will increase to +30 volts peak. If the AC line voltage can not be raised to 115 volts without exceeding a line current of 0.9 amperes, raise the voltage part way and check the unregulated output voltages to determine which is overloaded. If no switched waveform is obvserved at any level, the fault is probably in the switching transistors Q5, Q6, Q7 and Q8.

REMOVE THE GROUND FROM PIN L OF AT1 BEFORE REPLACING THE POWER SUPPLY IN THE MAINFRAME



Component Location, Power Supply Switching Circuits

79-B-23-066 (A2B3)

Figure 5.2

5.1.2.3 RECTIFIERS AND REGULATORS

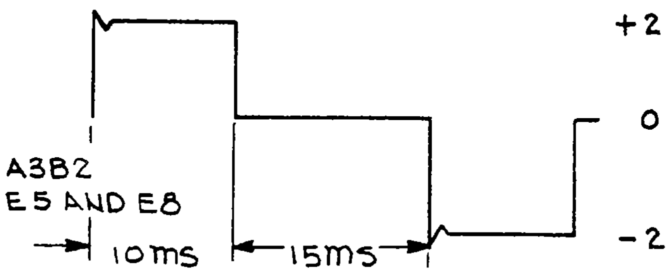
Check the following voltages. Access to both sides of the regulator boards is achieved by disconnecting the adjacent end plate of the power supply.

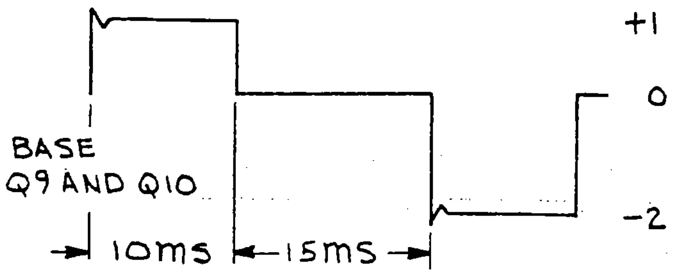
Terminal	1	2	3	4
U7	+18	+15	+5	GND
U8	GND	-2	-15	-18
U9	+18	+6	+5	GND
U10	GND	-2	-6	-18
U11	GND	-2	-5	-18

5.1.3 DC INPUT - OPTION 7

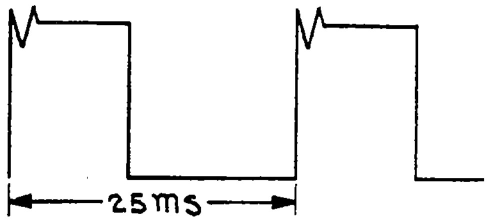
Option 7 adds +12 VDC input to the SG-811. This requires no additional alignment procedures. All alignment procedures should be done using the AC input. Also the power supply should be repaired to operate satisfactorily on AC input before checking DC operation. The +12 VDC input is activated by switching the AC-DC switch to its DC position.

First connect a +12 volt supply to the positive terminal of C4 on A2B2 and check the waveforms shown below.

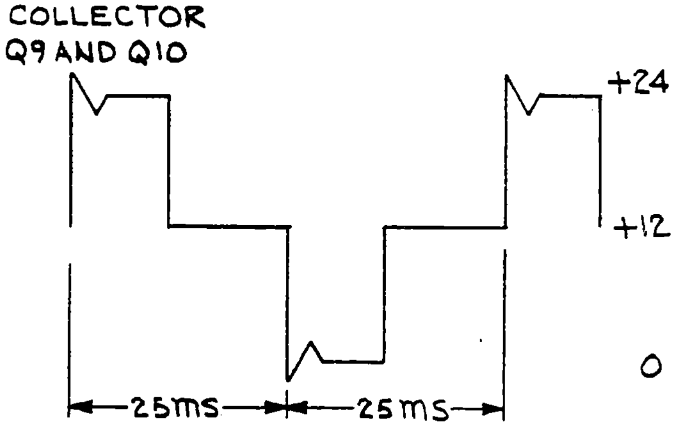




Leaving the external supply connected as previously described, connect the power supply DC input to a variable voltage supply capable of supplying +12 VDC at 10 amperes. The SG-811 supply must be connected to the mainframe through the multipin connector. Connect a scope to the rectifier side of L2. Hold relay K2 in its closed position and gradually increase the supply voltage while monitoring the DC voltage, DC current and scope waveform. Maximum current at +12 VDC input should be 10 amperes or less.

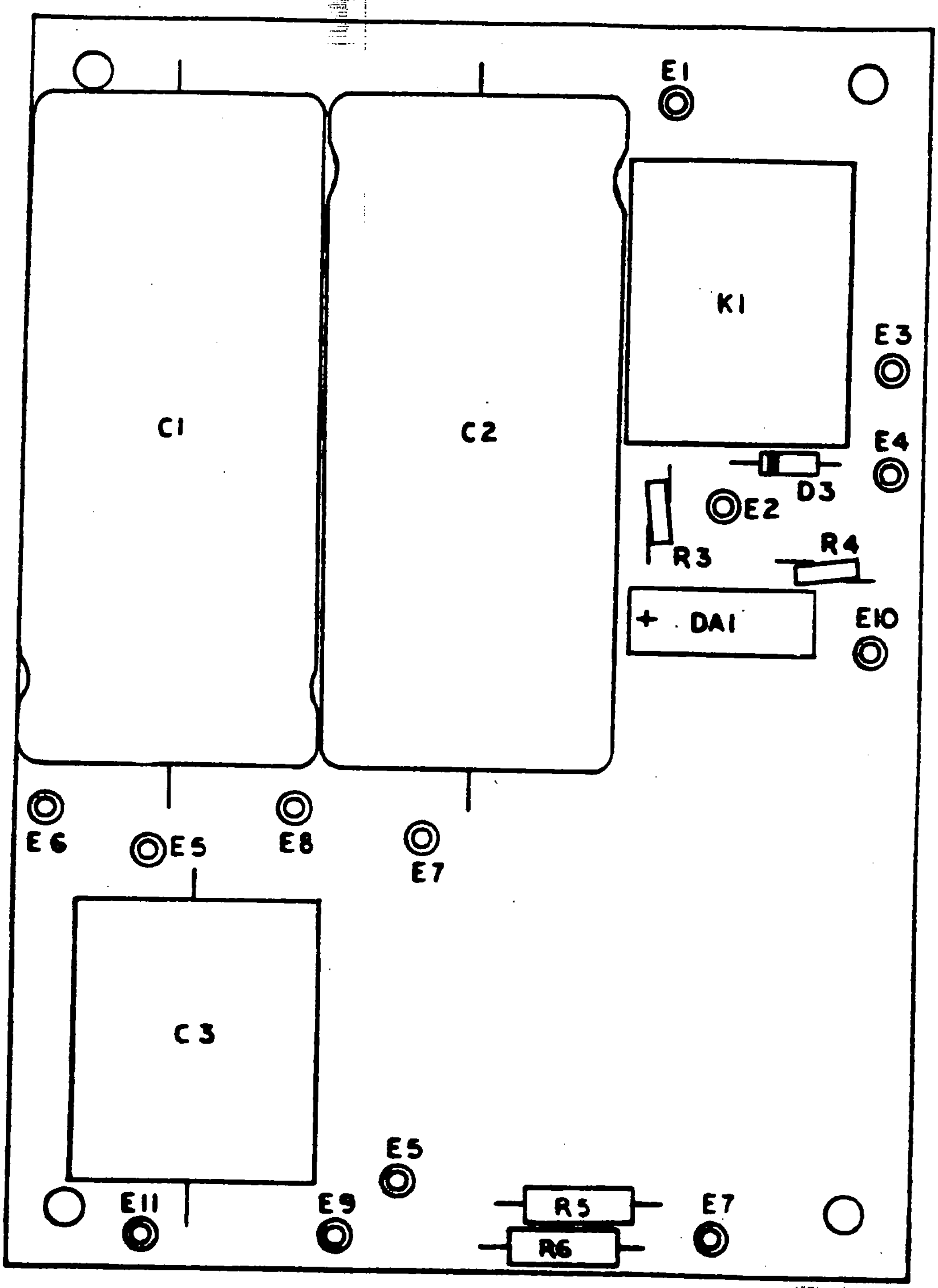


The waveforms at the collectors of Q9 and Q10 are shown below.



5.2 TUNING GENERATOR (A3B7)

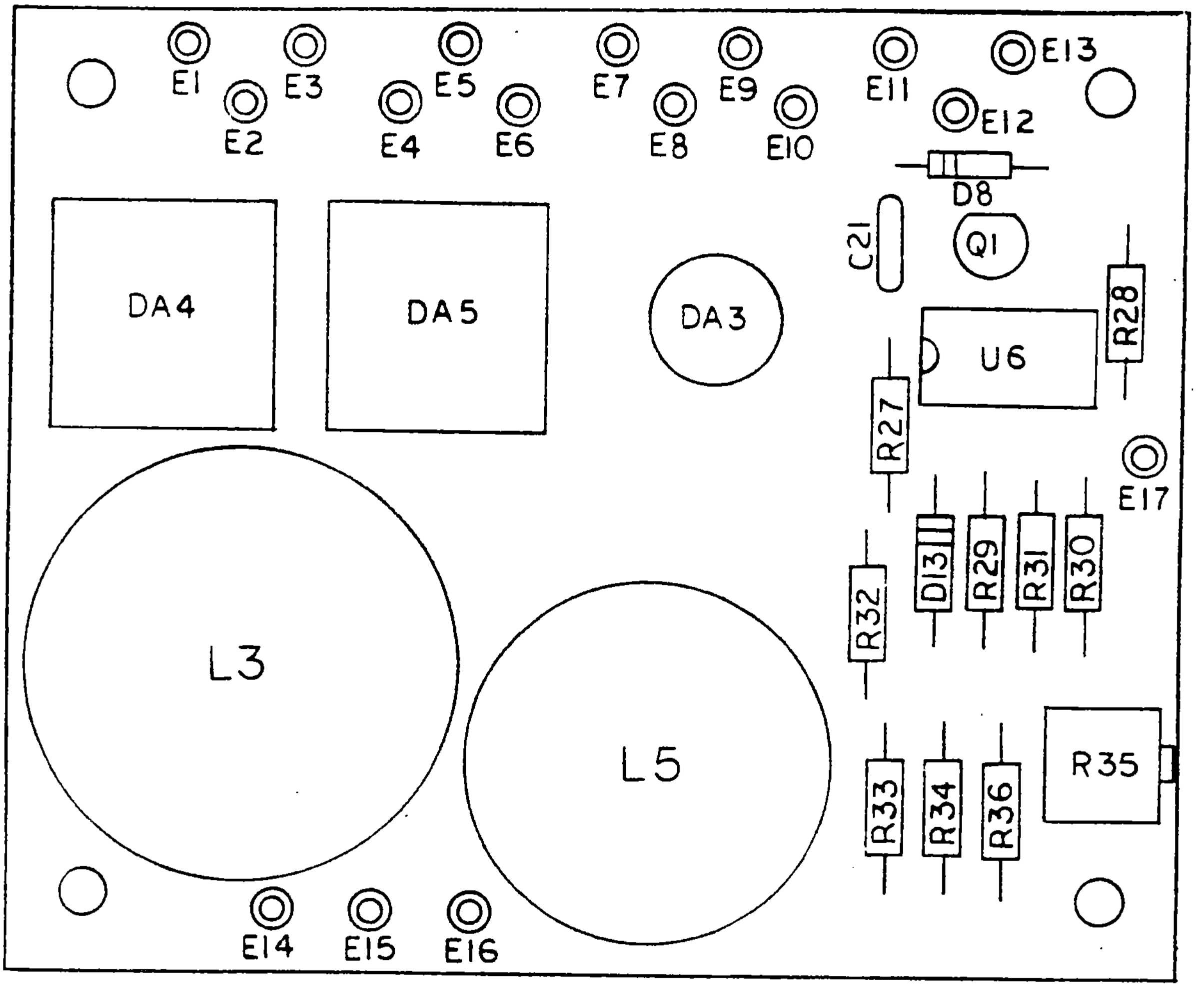
Alignment and repair of this board is done with the mode switch in CW. The Oscillator Tracking/Driver board (A3B8) must be in place.



Component Location, Power Supply AC Rectifier

79-B-21-062 (A2B1)

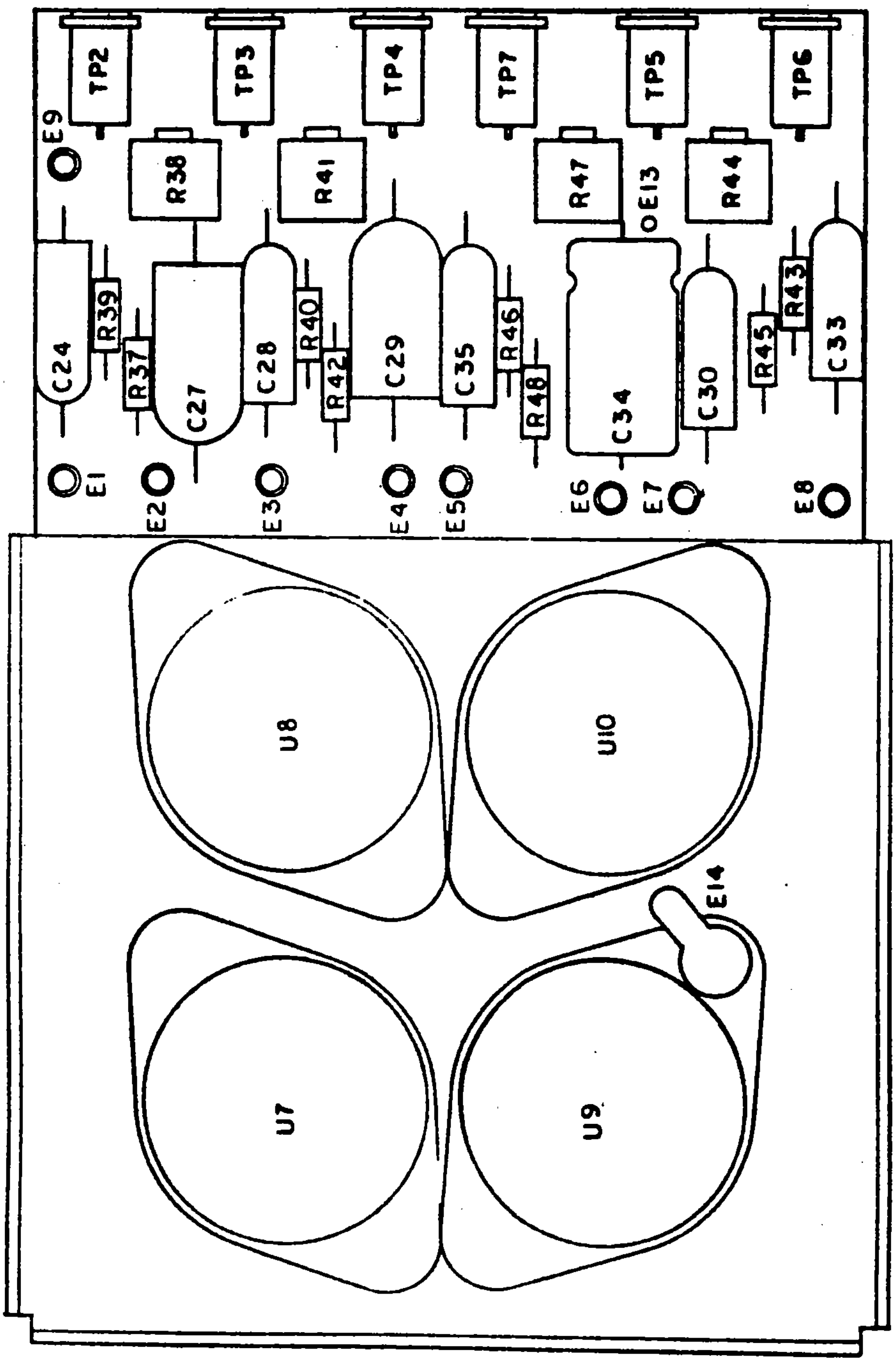
Figure 5.3



Component Location, Power Supply Rectifier

79-A-24-068 (A2B4)

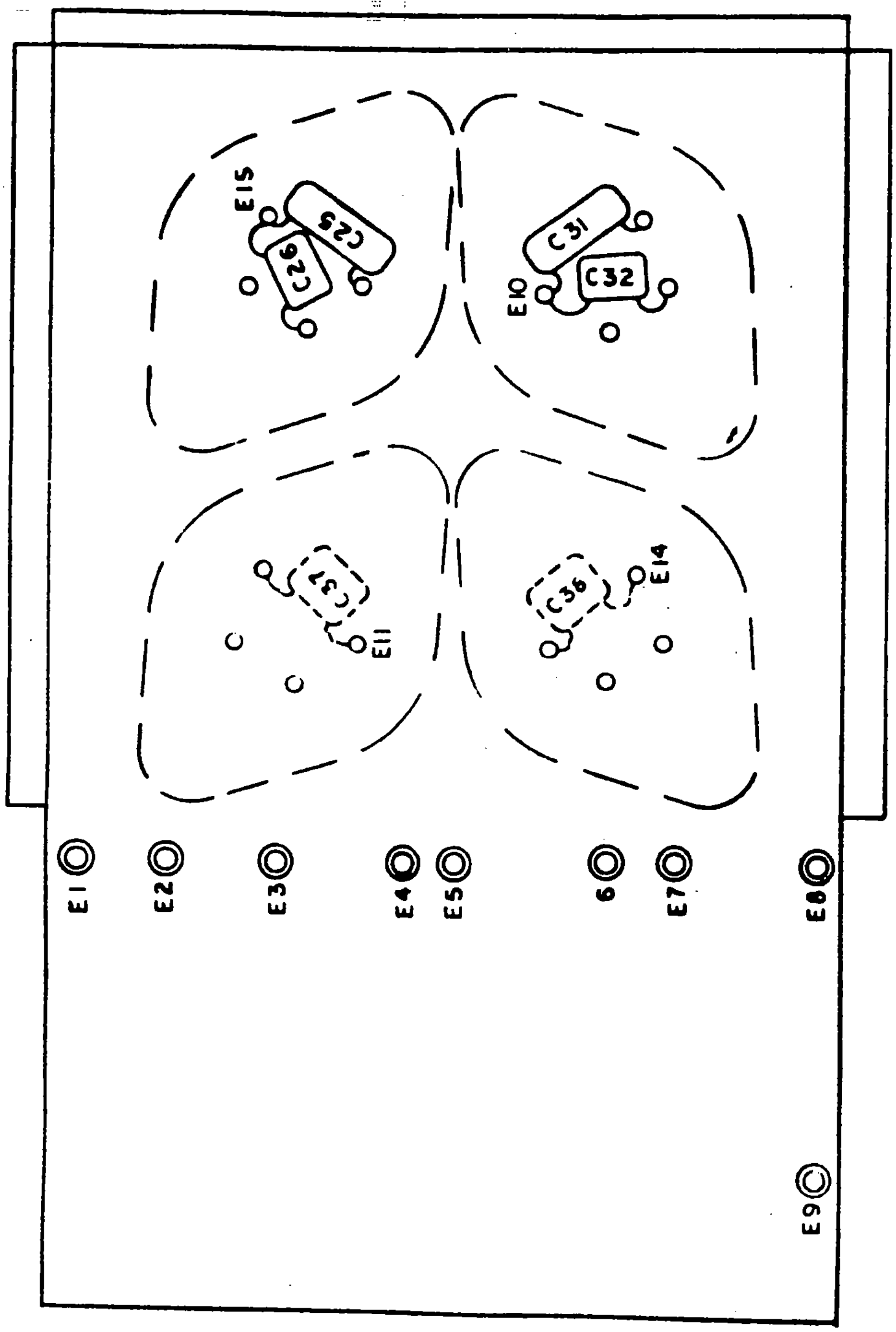
Figure 5.4



Component Location, Power Supply Regulator

79-B-25-070 (Sheet 1 of 2) (A2B5A1)

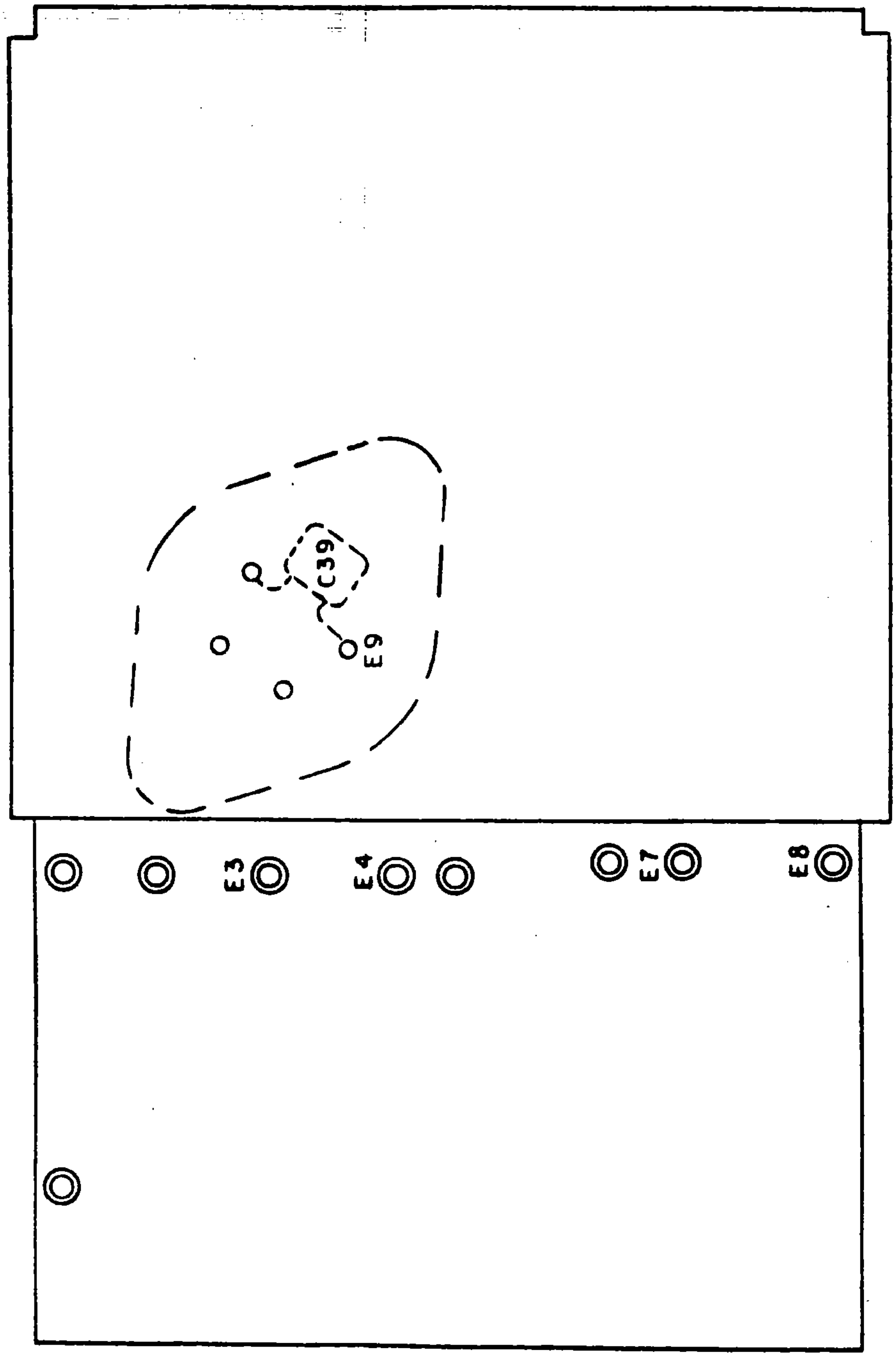
Figure 5.5



Component Location, Power Supply Regulator

79-B-25-070 (Sheet 2 of 2) (A2B5A1)

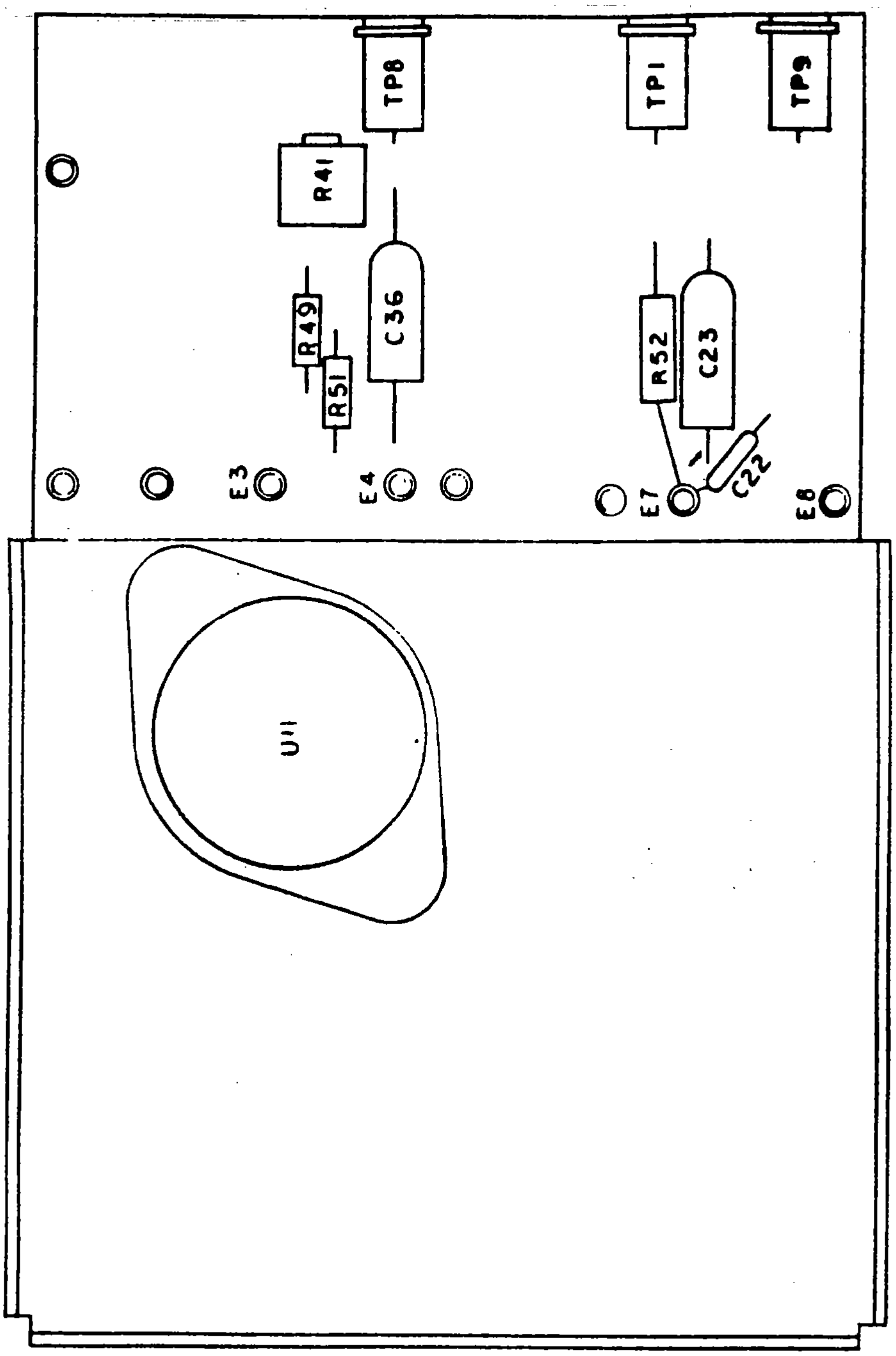
Figure 5.5



Component Location, Power Supply Regulator

79-B-25-071 (Sheet 1 of 2) (A2B5A2)

Figure 5.6



Component Location, Power Supply Regulator

79-B-25-071 (Sheet 2 of 2) (A2B5A2)

Figure 5.6

5.2.1 ALIGNMENT

Adjust R17 for +11.000 volts at pin 6 or F of A3B7. Adjust R26 for -11.000 volts at pin 7 or H of A3B7.

Select the F_1 control and adjust it so that -10.950 volts is at pin N; then adjust R18 for 0 volts at pin T. Select the F_2 control and adjust it so that +10.950 volts is at pin N; then adjust R9 for +9.00 volts at pin T. Switch between the controls to confirm that the voltage at pin T varies exactly from 0 to +9.00 volts as the signal at pin N is varied from -10.950 to +10.950 volts.

Connect a variable voltage source to the rear panel FREQ CONTROL IN jack. With this input voltage at 0, adjust R32 for -10.950 volts at pin 13. Change the input voltage to +10.000 volts and adjust R40 for +10.950 volts at pin 13. Switch between 0 and +10.000 volts input and repeat the above until the voltages at pin 13 are exactly -10.950 and +10.950 volts.

5.2.2 REPAIR

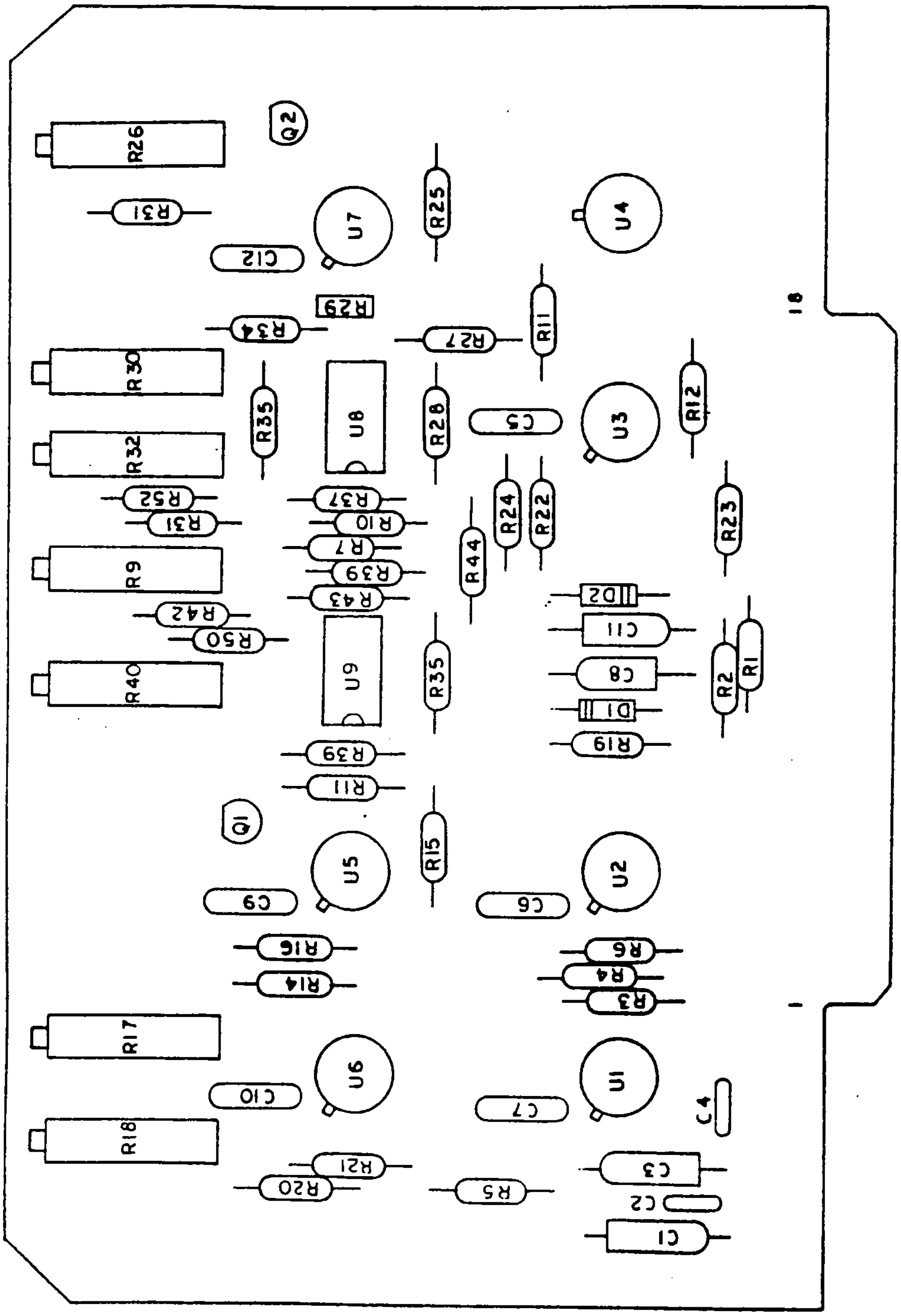
Select one of the five front panel tuning controls, M_1 thru M_5, and adjust it for +5.0 volts at pin N of A3B7. Check the following voltages.

A3B7 PIN	VOLTS	A3B7 PIN	VOLTS
1	GND	A	GND
2	+15	B	+15
5	-15	E	-15
6	+11.0	F	+11.0
7	-11.0	H	-11.0
8	GND	J	GND
13	-10.8	N	+5.0
14	0	T	+6.6
18	GND	V	GND

	1	2	3	4
U1	—	+5.0	+5.0	-15
U2	—	+7.8	+7.8	-15
U3	—	+6.5	+6.5	-15
U4	+15	+15	+6.6	+6.6
U5	—	+6.3	+6.3	-15
U6	—	+10.5	+10.5	-15
U7	—	-6.3	-6.3	-15
U8	—	—	—	-15
U9	-10.8	-2.7	-2.7	-15

	5	6	7	8
U1	—	+5.0	+15	—
U2	—	+7.8	+15	—
U3	—	+6.5	+15	—
U4	—	-15	-15	—
U5	—	+11.6	+15	—
U6	—	+10.5	+15	—
U7	—	-11.6	+15	—
U8	-5.4	-5.4	-5.4	+15
U9	0	0	0	+15

	E	B	C
Q1	+11.00	+11.6	+15
Q2	-11.00	-11.6	-15



Component Location, Tuning Generator

79-B-37-042 (A3B7)

Figure 5.7

5.3 METER/ANALOG TRACKING BOARD (A3B5)

Alignment and repair of this board is done with the mode switch in CW. All other boards must be in place.

5.3.1 ALIGNMENT

Select and adjust the F_1 control for -10.950 volts at pin P of A3B5. Select and adjust the F_2 control for +10.950 volts at pin P. Check that the voltage at Pin 9 equals that at pin P for both controls. For each band, adjust the "HI" and "LO" controls for the following readings on the front panel digital frequency display (A5).

BAND	CONTROL	TRIMMER	READOUT
.01-2	F_1	1 LO	0.00
.01-2	F_2	1 HI	2.00
2-4	F_1	2 LO	1.90
2-4	F_2	2 HI	4.10
4-8	F_1	3 LO	3.90
4-8	F_2	3 HI	8.10
8-12	F_1	4 LO	7.90
8-12	F_2	4 HI	12.10
12-18	F_1	5 LO	11.90
12-18	F_2	5 HI	18.20
2-18	F_1	86 LO	1.90
2-18	F_2	86 HI	18.20

If the frequency display is not operating, the voltage at pin V of A3B5 will be one-half the listed display reading.

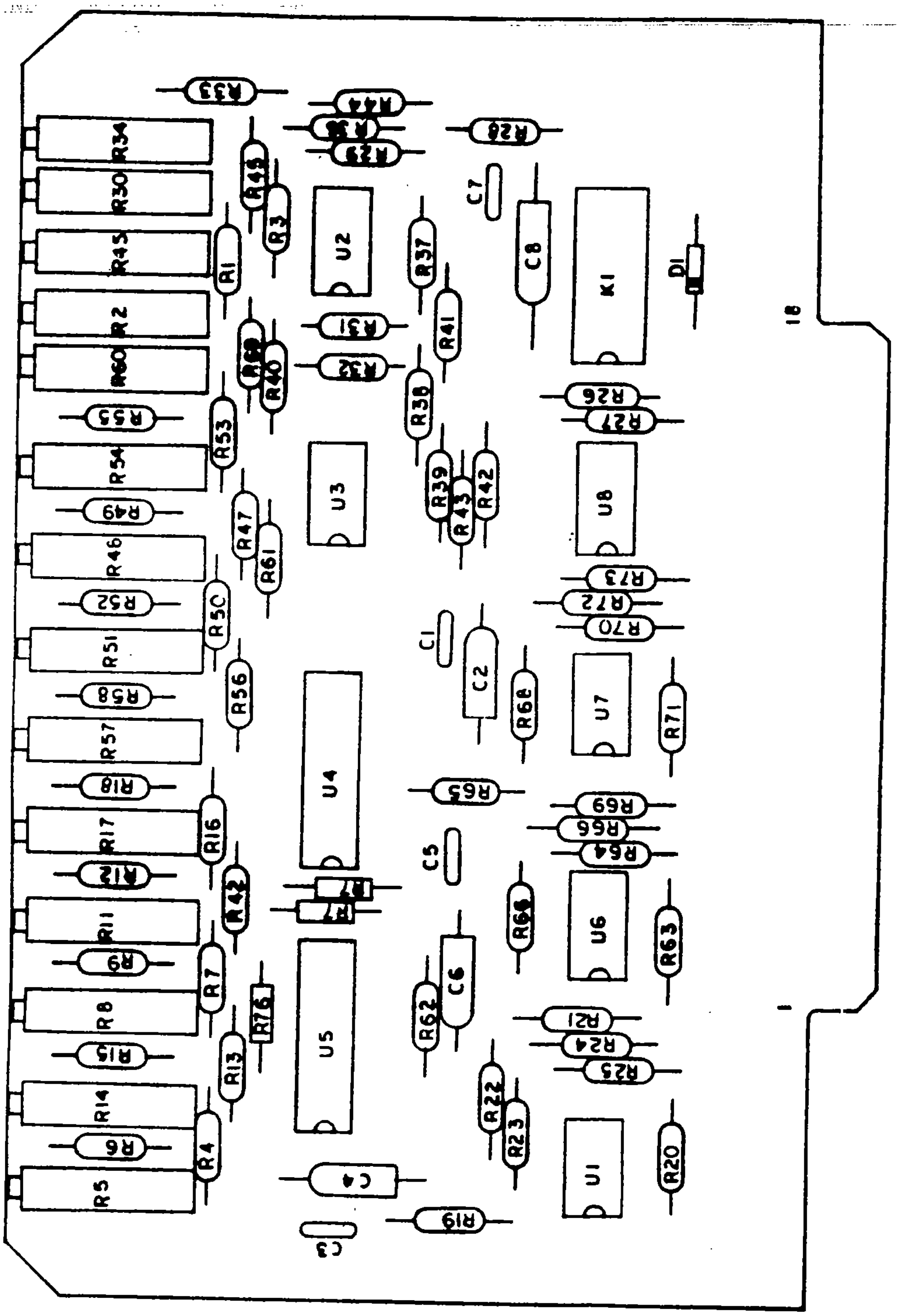
The following procedure requires that a portion of A3B6 be aligned beforehand. Press F_1 and adjust R2 of A3B6 for 0 volts at pin R of A3B5. Press F_2 and adjust R8 of A3B6 for +12.000 volts at pin R of A3B5. Then adjust R30 of A3B5 for +10.000 volts at pin 18 of A3B5. Press F_1 and check that the voltage at pin 18 of A3B5 is between +0.1 and -0.1 volts.

5.3.2 REPAIR

Select and adjust any of the front tuning controls and adjust it for exactly +5.000 volts at pin P of A3B5. Set the bandswitch to the 2-4 GHz band. Check the voltages listed below.

A3B5 PIN	VOLTS
1	GND
2	+15
3	+6.0
4	-6.0
5	-15
6	+11.00
9	+5.0
13	+6.0
15	+0.1
16	+0.1
17	+6.0
18	+7.3

A3B5 PIN	VOLTS
A	GND
B	+15
C	+6.0
D	-6.0
E	-15
F	+11.00
K	+0.1
L	+6.0
M	+0.1
P	+5.0
R	+8.7
V	+1.8



Component Location, Meter/Analog Tracking Board

79-B-35-036 (A3B5)

Figure 5.8

	1	2	3	4
U1	+10	+10	+10	-15
U2	+6.0	+6.0	+6.0	-15
U3	+1.0	+1.0	+1.0	-15
U6	+0.9	+0.9	+0.9	-15
U7	+1.7	+0.8	+0.8	-15
U8	+6.9	+3.4	+3.4	-15

	5	6	7	8
U1	+5.0	+5.0	+5.0	+15
U2	+7.7	+7.7	+7.7	+15
U3	+5.9	+5.9	+5.9	+15
U6	+0.7	+0.7	+0.7	+15
U7	+0.8	+0.8	+0.8	+15
U8	+4.4	+4.4	+7.3	+15

	1	2	3	4
U4	+1.5	GND	*	GND
U5	+3.7	GND	*	GND

	5	6	7	8
U4	+2.1	GND	-6.0	GND
U5	+5.5	GND	-6.0	GND

	9	10	11	12
U4	+0.1	+5.8	+0.1	+1.7
U5	+0.1	+5.8	+0.1	+1.7

	13	14	15	16
U4	GND	+0.9	+0.9	+6.0
U5	GND	GND	+0.9	+6.0

*This reading will vary with the band selected as listed below.

BAND	U4, PIN 3	U5, PIN 3
.01-2	+0.7	0
2-4	+0.7	+0.9
4-8	+1.4	+1.8
8-12	+1.4	+3.7
12-18	+2.1	+5.5
2-18	+2.1	+5.5

5.4 CROSSBAND LOGIC BOARD (A3B4)

Alignment and repair of this board is done with the mode switch in CW and the BAND switch set to the 2-18 GHz band unless otherwise noted.

5.4.1 ALIGNMENT

Select the front panel M_3 tuning control and adjust it for approximately +1.4 volts at pin 9 of A3B4. The voltage at pin T of A3B4 should be near zero. Adjust R22 so that pin T switches from 0 to +5 volts as the M_3 control increases the voltage at pin 9 to exactly +1.546 volts. Next adjust R20 so that pin T switches from +5 to 0 volts when the voltage at pin 9 is increased to exactly +4.491 volts by the M_3 control. Then adjust R18 so that pin T switches from 0 to +5 volts when the voltage at pin 9 is increased to exactly +7.436 volts by the M_3 control.

5.4.2 REPAIR

This board contains three functional circuits; bandswitching, sweep hold and tuning voltage buffer. The following voltages at the connector pins of A3B4 are common to all circuits and should be checked first.

A3B4 PIN	VOLTS
A	GND
B	+15
C	+6.0
E	-15
J	GND
V	GND

A3B4 PIN	VOLTS
1	GND
2	+15
3	+6.0
5	-15
8	GND
18	GND

5.4.2.1 TUNING VOLTAGE BUFFER

This circuit buffers the voltage at the arm of the selected tuning control. A fault is indicated if the generator sweeps correctly in the BAND mode only and if the digital frequency display is in error.

Select any front panel tuning control. As it is rotated from its fully counterclockwise position to its fully clockwise position, the voltages at pins P and 10 of A3B4, as well as the voltages at pins 1, 2 and 3 of U1 will vary from at least -10.95 to at least +10.95 volts.

5.4.2.2. BANDSWITCH

This board supplies the BCD band command to other generator circuits. The command appears on pins S, T and U of A3B4 as shown in the following chart.

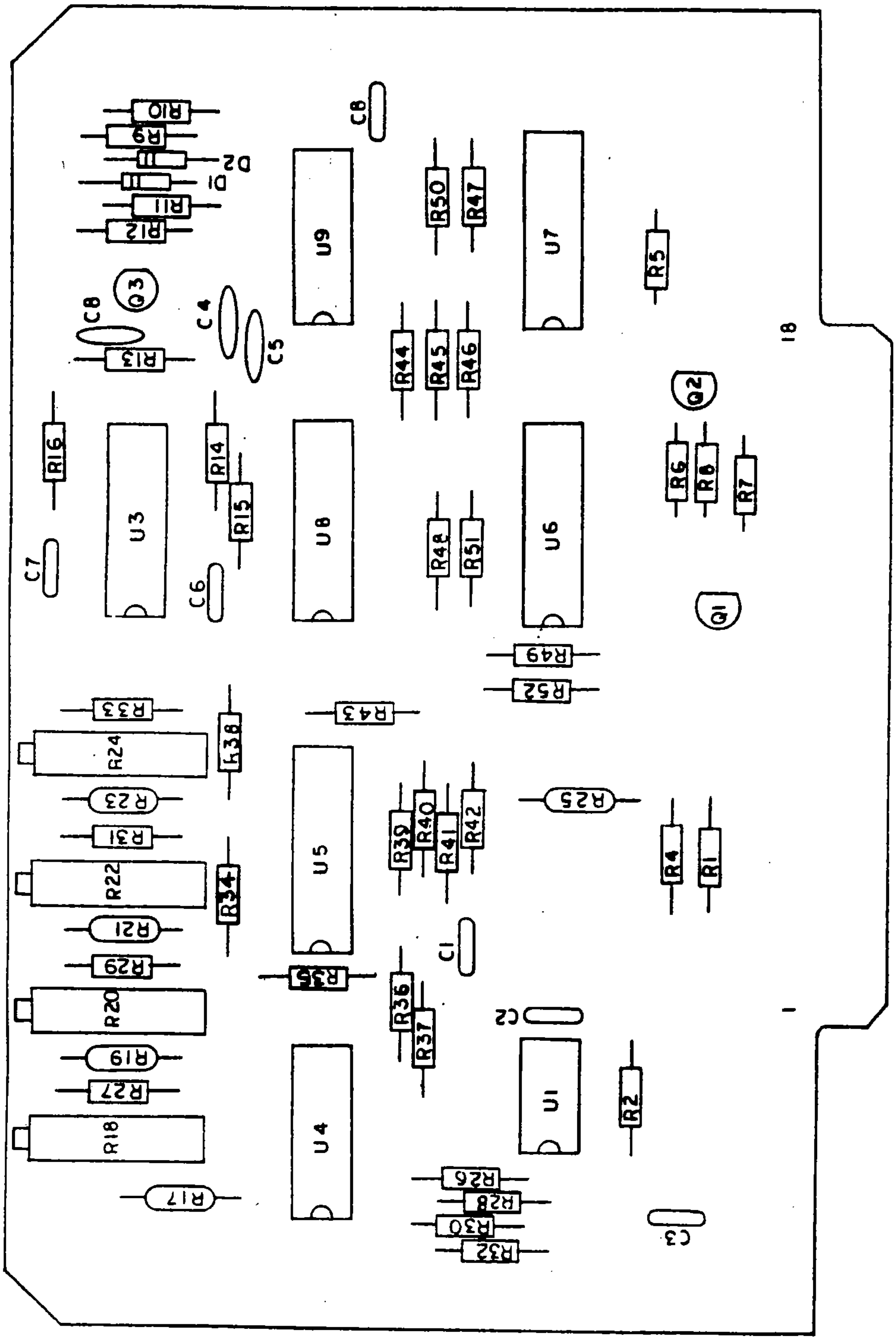
BAND	PIN T	PIN U	PIN S
.01-2	+5.5	0	0
2-4	0	+5.5	0
4-8	+5.5	+5.5	0
8-12	0	0	+5.5
12-18	+5.5	0	+5.5

If an error is found in the preceding table, then check the following inputs to inverter U9.

BAND	PIN 3 U9	PIN 5 U9	PIN 1 U9
.01-2	+5.5	0	0
2-4	0	+5.5	0
4-8	+5.5	+5.5	0
8-12	0	0	+5.5
12-18	+5.5	0	+5.5

One of three inputs determine the BCD band command; the front panel BAND switch, the crossband logic on this board, or the remote digital band input.

With no remote input, or the remote input disabled, the front panel BAND switch directly selects the band command in all positions except its 2-18 position. A BCD input from this switch connects to pins K, L and M and is switched to the output lines through integrated circuit switches U6 and U7. The input code is listed in the following chart.



Component Location, Crossband Logic Board

79-B-34-033 (A3B4)

Figure 5.9

BAND	PIN K	PIN L	PIN M
.01-2	+5.5	0	0
2-4	0	+5.5	0
4-8	+5.5	+5.5	0
8-12	0	0	+5.5
12-18	+5.5	0	+5.5

With external digital control, the band select signal connects to pins 13, 12 and 16. It is switched to the output lines through integrated circuits U6 and U7. The input code is as follows:

BAND	PIN 13	PIN 12	PIN 16
.01-2	+5.5	0	0
2-4	0	+5.5	0
4-8	+5.5	+5.5	0
8-12	0	0	+5.5
12-18	+5.5	0	+5.5

In the crossband mode (2-18 GHz), the band select signal is generated from the comparators on this board. Remove any remote control inputs and set the generator to its CW mode in the 2-18 BAND. Select the M_3 tuning control and verify that the voltage at pin 9 goes from 0 to +12 as this control is varied through its entire range. Check that the voltage at pins 6 and F is +11.0. Start at the low frequency end and tune upwards.

1. Pin 14 of U4 should switch from +5.7 to 0 as the voltage at pin 9 of A3B4 increases through +1.546.

2. Pin 1 of U4 should switch from +5.7 to 0 as the voltage at pin 9 of A3B4 increases through +4.491

3. Pin 2 of U4 should switch from +5.7 to 0 as the voltage at pin 9 of A3B4 increases through +7.436.

The following voltages are read as the M_3 knob is tuned well within the listed band. They should not be checked at the switchover points on pin 9 as noted above.

BAND	PIN 9 U5	PIN 7 U5	PIN 6 U5
2-4	+5.8	0	+5.8
4-8	0	0	+5.8
8-12	+5.8	+5.8	0
12-18	0	+5.8	0

BAND	PIN 6 U8	PIN 2 U8	PIN 4 U8
2-4	0	+5.8	0
4-8	+5.8	+5.8	0
8-12	0	0	+5.8
12-18	+5.8	0	+5.8

Set the BAND switch to 2-18 and the MODE switch to CW, and check the following voltages:

A3B4	Pin	N	0
A3B4	Pin	R	+4.6
A3B4	Pin	14	+3.4
A3B4	Pin	15	+0.3
U9	Pin	8	+0.3
U9	Pin	9	+0.1

	E	B	C
Q1	0	+0.7	+0.1
Q2	+3.4	+0.7	+0.1

5.4.2.3 HOLD SWEEP

This circuit operates only when the generator is swept in the 2-18 band and the sweep crosses over a band limit. It generates a 3 to 6 millisecond pulse holding the sweep at the band crossover point to allow time to switch bands. A fault in this circuit is indicated by an RF dropout at the band crossover point, and may not be apparent except at high sweep speeds. Set the MODE switch to .1-1 and its vernier fully clockwise. Connect a scope to pin 17 of A3B4. Adjust the scope time base to 5 ms/div and sync to the pulsed signal. There should be three pulses having an amplitude of about +6 volts and a pulsewidth of about 3 to 6 milliseconds.

5.5 CROSSBAND TUNING GENERATOR (A3B6)

Alignment and repair of this board is done with the mode switch in CW and the BAND switch set to the 2-18 GHz band unless otherwise noted. All other boards should be in place.

5.5.1 ALIGNMENT

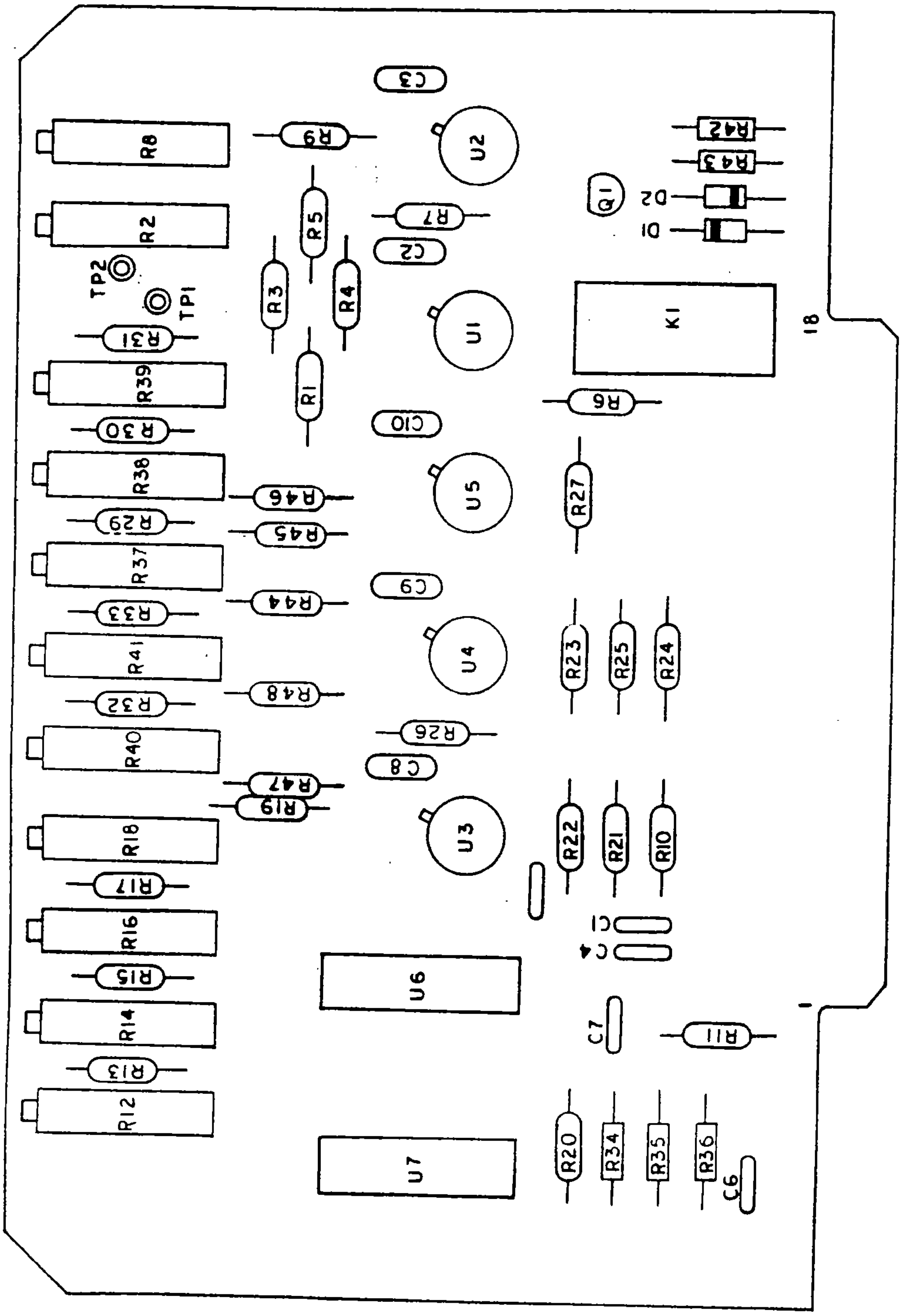
Set the MODE switch to CW. Select the F_1 control and adjust it for -10.950 volts at Pin R of A3B6. Select the F_2 control and adjust it for +10.950 volts at Pin R. Select F_1 and adjust R2 for 0 volts at pin N of A3B6. Select F_2 and adjust R8 for +12.000 volts at Pin N of A3B6.

Set the BAND switch to 2-4. Select the M_3 tuning control and adjust it for +0.810 volts at pin N of A3B6. Adjust R18 for exactly 0 volts at TP2. Next adjust M_3 for exactly 0 volts at Pin N, and adjust R38 for -10.950 volts at TP2. Adjust M_3 for +1.546 volts at Pin N, and check that the voltage at TP2 is between +9.940 and +9.960 volts. If not, readjust R18 and R38 slightly so that the voltage at TP2 varies within the above limits.

Set the BAND switch to 4-8, and adjust the M_3 control for +3.018 volts at Pin N of A3B6. Adjust R16 for exactly 0 volts at TP2. Next adjust M_3 for +1.546 volts at Pin N, and adjust R39 for -10.430 volts at TP2. Adjust M_3 for +4.491 volts at Pin N, and check that the voltage at TP2 is between +10.420 and +10.440 volts. If not readjust R16 and R39 slightly so that the voltage at TP2 varies within the above limits.

Set the BAND switch to 8-12, and adjust the M_3 control for +5.963 volts at Pin N of A3B6. Adjust R14 for exactly 0 volts at TP2. Next adjust M3 for +4.491 volts at Pin N, and adjust R40 for -10.430 volts at TP2. Adjust M_3 for +7.436 volts at Pin N, and check that the voltage at TP2 is between +10.420 and +10.440 volts. If not, readjust R14 and R40 slightly so that the voltage at TP2 varies within the above limits.

Set the BAND switch to 12-18, and adjust the M_3 control for +9.680 volts at Pin N of A3B6. Adjust R12 for exactly 0 volts at TP2. Next adjust M_3 for +7.436 volts at Pin N, and adjust R41 for -10.600 volts at TP2. Adjust M_3 for +12.000 volts at Pin N, and check that the voltage at TP2 is between +10.940 and +10.960 volts. If not, readjust R12 and R41 slightly so that the voltage at TP2 varies within the above limits.



Component Location, Crossband Tuning Generator

79-B-36-039

(A3B6)

Figure 5.10

5.5.2 REPAIR

Check the following supply voltages to the board.

A3B6 PIN	VOLTS
1	GND
2	+15
3	+6.0
4	-6.0
5	-15
6	+11.00
7	-11.00
8	GND
18	GND

A3B6 PIN	VOLTS
A	GND
B	+15
C	+6.0
D	-6.0
E	-15
F	+11.00
H	-11.00
J	GND
V	GND

Rotate the BAND switch through the positions noted below and check the BCD band input to this board on Pins K, L, and M.

BAND	PIN K	PIN L	PIN M
.01-2	+5.9	+0.1	+0.1
2-4	+0.1	+5.9	+0.1
4-8	+5.9	+5.9	+0.1
8-12	+0.1	+0.1	+5.9
12-18	+5.9	+0.1	+5.9

Integrated circuit U7 switches the offset voltage to its output at Pin 3. Check the following voltages on U7 Pins 2, 4, 6, 8, 13, and 14 for ground.

	1	5	7	12	15	16
U7	+3.0	+4.9	-6.0	+1.5	+0.4	+6.0

The voltage at the other pins depend on the position of the bandswitch.

BAND	PIN 3	PIN 9	PIN 10	PIN 11
.01-2	0	+5.9	+0.1	+0.1
2-4	+0.4	+0.1	+5.9	+0.1
4-8	+1.5	+5.9	+5.9	+0.1
8-12	+3.0	+0.1	+0.1	+5.9
12-18	+4.8	+5.9	+0.1	+5.9

Integrated circuit U7 switches the gain of the crossband tuning voltage, and requires that the integrated circuits U1-U5 are operating correctly. These are checked as follows. Set the BAND switch to 12-18. Select the M_3 tuning control and adjust it for +9.4 volts at Pin R of A3B6. Check the following voltages.

	2	3	4	6	7
U1	-9.4	-9.4	-15	-9.4	+15
U2	+3.3	+3.3	-15	+11.4	+15
U3	+4.9	+4.9	-15	+9.7	+15
U4	+5.7	+5.7	-15	+1.7	+15
U5	+1.7	+1.7	-15	+8.0	+15

	6	7	8	16
U7	GND	-6.0	GND	+6.0

The voltages on the other pins of U7 depend on the band selected. The following measurements are made after the M_3 control is adjusted in each band for +8.0 volts at TP2 of A3B6.

BAND	PIN 1	PIN 3	PIN 5	PIN 9
2-4	—	+0.6	—	+0.1
4-8	—	+1.1	—	+5.9
8-12	+1.1	+1.1	—	+0.1
12-18	—	+1.7	+1.7	+5.9

BAND	PIN 10	PIN 11	PIN 12	PIN 15
2-4	+5.9	+0.1	—	+0.6
4-8	+5.9	+0.1	+1.1	--
8-12	+0.1	+5.9	—	--
12-18	+0.1	+5.9	--	--

Relay K1 is energized when the BAND switch is in the 2-18 position. In this position, Pin 17 of A3B6 is held below +0.5 volts.

	E	B	C
Q1, Band 2-18	+6.0	+5.1	+5.8
Q1, Other Bands	+6.0	+6.0	0

5.6 SAWTOOTH GENERATOR (A3B2)

This board operates in the sweep modes only. The most probable indication of a fault in this board is improper operation in one of the sweep modes, yet proper CW operation at the same frequency.

5.6.1 ALIGNMENT

No field alignment procedures are necessary for this board.

5.6.2 REPAIR

If a fault on this board is suspected, the following troubleshooting procedures should be undertaken in the order stated.

Check the following voltages at the connector using the extender board.

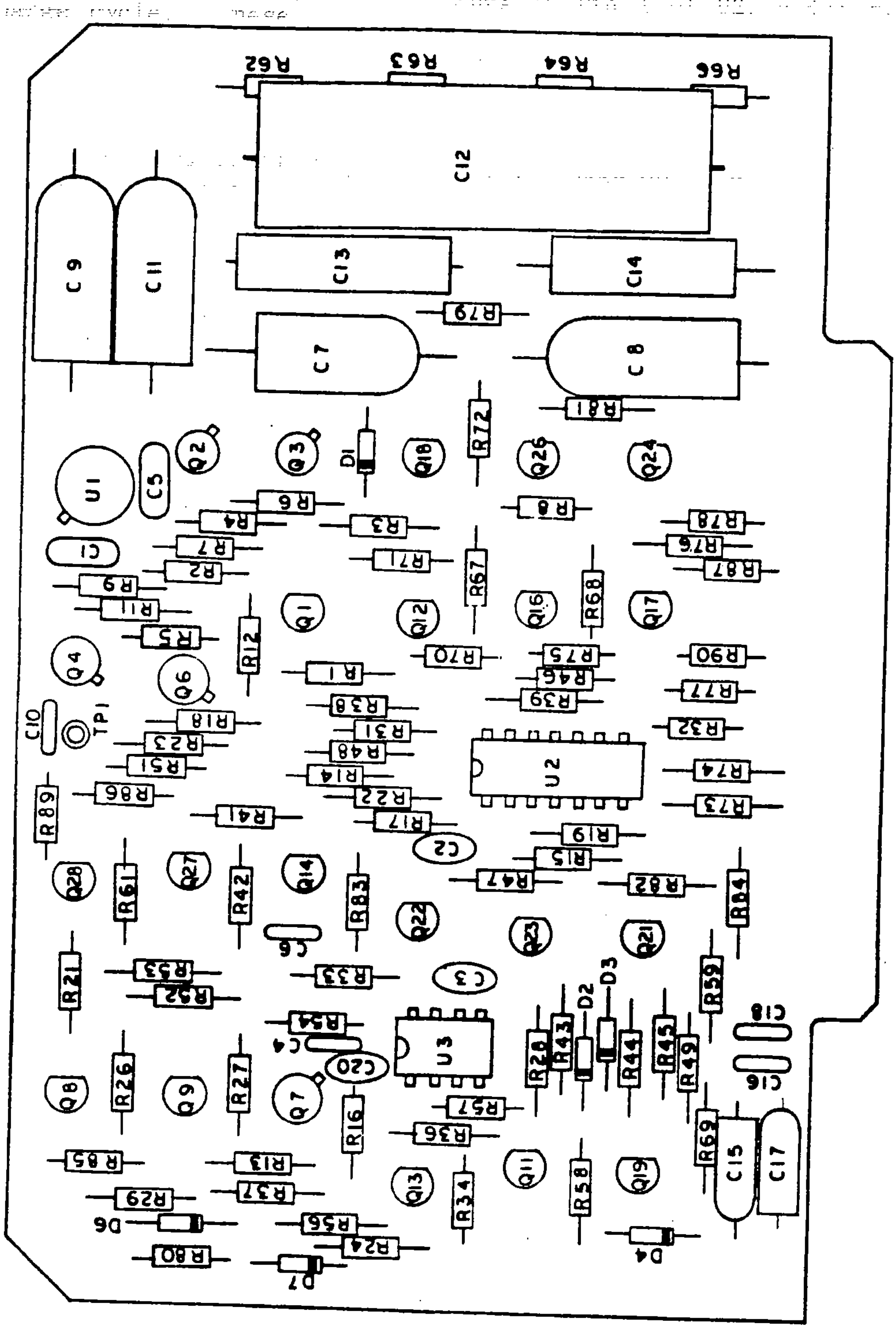
A3B2 PIN	VOLTS
A	GND
B	+15
E	-15
F	+11.00
H	-11.00

A3B2 PIN	VOLTS
P	GND
1	GND
2	+15
5	-15

5.6.2.1 SAWTOOTH

The basic sawtooth waveform generated on this board may be checked by connecting an oscilloscope to TP1 or Pin M. Set the controls as follows.

MODE	BAND
BAND	2-4
SWEEP TIME.	.03-3, vernier counter-clockwise
SWEEP SYNC	Continous (upper position)

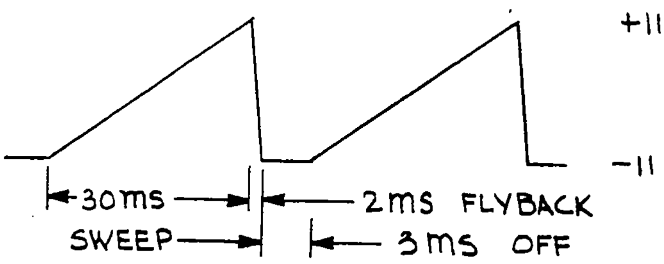


Component Location, Sawtooth Generator

79-B-32-027 (A3B2)

Figure 5.11

The waveform at TP1 is shown below.



As the sweep time is increased from 30 milliseconds, the flyback and off time will remain almost constant.

If there is no sawtooth waveform at TP1, check the voltage at TP1. If it is not latched at about +11 or -11 volts, check operational amplifier U1 and transistors Q4 and Q6.

If the voltage at TP1 is locked at +11 volts, measure the following voltages in the order listed.

U2	Pin 7	-11.00
U2	Pin 6	+11
U2	Pin 2	-15
U2	Pin 14	+15
Q3	Gate	+10

The positive voltage at the gate of Q3 should turn on Q3 to discharge the capacitor selected by the SWEEP TIME switch. This capacitor is discharged through the resistor (R62, R63, R64 or R66) selected by the same switch.

If the voltage at TP1 is locked at -11 volts, measure the following voltages in the order listed.

U2	Pin 1	+15
U2	Pin 14	-15

	E	B	C
Q21	GND	-0.7	-0.5
Q23	-0.5	-15	-0.5
Q1	GND	-0.5	-15

The negative voltage at the gate of Q2 should turn on Q2 to charge the capacitor selected by the SWEEP TIME switch through the vernier sweep time potentiometer in series with R8.

If the generator sweeps continuously, but not when the Sweep Sync control is at SINGLE SWEEP or EXT SYNC, the sawtooth signal at TP1 will be locked at -11 volts. Set for SINGLE SWEEP. Check that the base of Q22 is at -15 volts. When the adjacent pushbutton is depressed, pin 10 of A3B2 is grounded and the collector of Q14 goes to +15 volts. This positive pulse couples through C6 to pin 11 of U2 and causes pin 13 of U2 to go to +15. The positive signal is coupled through Q22 to turn on Q1 and the gate of Q2 to start the charge portion of the sawtooth. Observation of the above may be more easily check with the controls set for a sweep period of several seconds so that the voltages above can be more easily confirmed. When the Sweep Sync control is at EXT SYNC, pin 10 of A3B2 is grounded through the rear panel; otherwise the sequence is the same as when the SINGLE SWEEP button is depressed.

When the SINGLE SWEEP EXT SYNC has been selected, the sawtooth voltage at TP1 should remain at -11 volts between sweeps; if not, connect an oscilloscope to Pin 1 of U2. Set the time base to 5 ms/div. There should be a series of very short negative pulses having a peak amplitude of at least -15 volts. Each time the sawtooth tries to go positive from -11 volts due to capacitor leakage, comparator U2A switches negative to turn off Q11. A positive bias pulse is applied to the gate of Q7 to turn it on and leak current to bring the sawtooth back to

-11 volts. Each time the negative pulse occurs at Pin 1 of U2, a +15 volt pulse should be observed at the collector of Q11, and a +5 volt pulse should be observed at the gate of Q7.

5.6.2.2 SWEEP ON LAMP

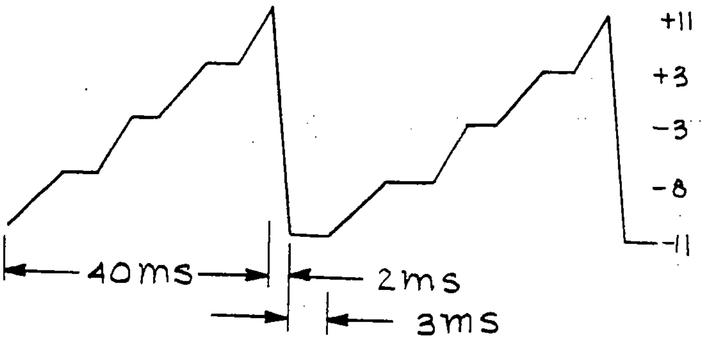
Set the generator to SINGLE SWEEP and a sweep time of about 5 seconds. During each sweep the lamp should come on. If not, check Q27 and Q28.

	E	B	C
Q27 Sweep On	GND	+0.8	+0.2
Q28 Sweep On	GND	-2.5	+0.8
Q27 Sweep Off	GND	+0.1	+6.0
Q28 Sweep Off	GND	+0.5	+0.1

5.6.2.3 HOLD SWEEP

The hold sweep signal is a 3-millisecond pulse generated by integrated circuit timer U3. It occurs at the end of the discharge cycle and holds the sawtooth output at -11 volts for about 3-milliseconds before the start of the charge cycle. Refer to the sawtooth waveform in section 5.6.2.1. At the end of the discharge cycle, Pin 1 of U2 goes to +15 and turns Q11 on. The collector at Q11 triggers the timer U3 to generate a +15 volt, 3-millisecond pulse at its Pin 3. This pulse turns Q21 off and prevents the charge cycle from starting.

Set the BAND switch to 2-18 and adjust the SWEEP TIME controls fully clockwise. Check the waveform at TP1.

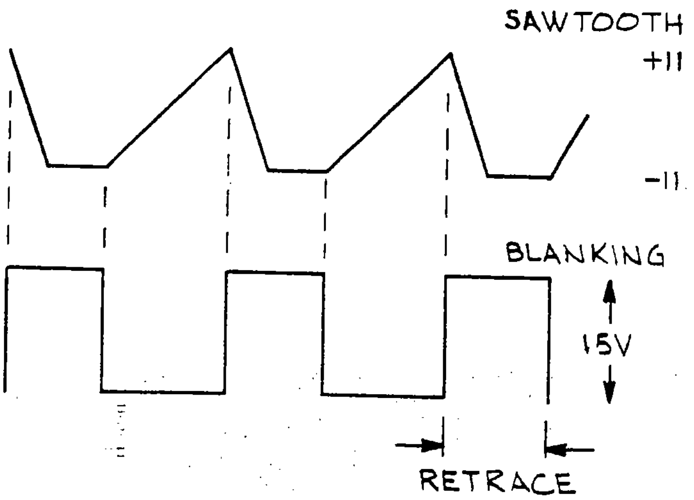


Note the three 3 to 6 millisecond hold periods during the charge cycle. These are generated by hold sweep pulses from the Crossband Logic Board (A3B4). These positive pulses connect through Pin 9 of A3B2 and diode D6 to turn Q13 on. Q13 triggers U3 to generate the additional hold periods during the crossband sweep. These hold periods occur at the band changeover points.

5.6.2.4 BLANKING

The blanking output at Pin 13 and the RF blanking output at Pin 11 are generated by the output of timer U3. Refer to section 5.6.2.3 for its operation. The 3 millisecond output pulse drives Q19 which in turn drives Q18 and Q26.

Set the BAND switch to 2-4, the MODE switch to BAND, the sweep sync control for repetitive sweep, and the SWEEP TIME controls clockwise for the fastest sweep. Connect one trace of a dual trace oscilloscope to TP1 with a sweep of 5 ms/div. The sawtooth should appear as in the following waveform diagram. Connect the second trace to the front panel BLANKING OUT connector. A +15 volt pulse should appear during the sweep retrace and sweep off periods as shown.



Connect the second trace to Pin 11 of A3B2 and set the rear panel RF BLANKING switch to its ON (up) position. A +3 volt blanking pulse should appear on the scope. It should disappear when the RF BLANKING switch is in its OFF (down) position.

If both blanking outputs are not present, check Q19. If the front panel BLANKING output is not present, check Q18. If the RF Blanking is not present, check Q24 and Q26. Pin R of A3B2 will be +0.7 volts when the RF blanking is turned off and at zero when it is turned on.

5.7 MARKER/SWEEP GENERATOR (A3B3)

This board contains the circuits which generate the F_1-F_2 and ΔF sweep, the front panel HORIZontal OUTput, and the markers. Other boards and assemblies should be in place when aligning or troubleshooting this board.

5.7.1 ALIGNMENT

Set the MODE switch to CW, the BAND switch to 2-4 GHz. Select the M_3 control and adjust it for exactly zero volts at Pin R of A3B3. Adjust R12 for exactly zero volts at Pin J of A3B3. Adjust the M_3 control for +10.950 volts at Pin R, and adjust R18 for -10.950 volts at Pin J. Adjust M_3 for -10.950 volts at Pin R and check that the voltage at Pin J is between +10.940 and +10.950 volts. If not, readjust first R12 and then R18 so that the voltage at Pin J varies from $-10.950\pm.01$ to $+10.950\pm.01$ volts as the voltage at Pin R is varied from +10.950 to -10.950 volts.

<u>The procedure in this paragraph requires that all tuning pushbuttons are disengaged, even when the corresponding controls are adjusted.</u> Adjust the F_1 control to -5.475 volts at Pin M, and adjust the F_2 control for -5.475 volts at Pin 9. Adjust R7 for exactly zero volts at Pin 13. Adjust the F_1 control for -10.950 volts at Pin M and the F_2 control for -10.950 volts at Pin 9. Adjust R16 for -10.950 volts at Pin 13. Repeat the procedure until the voltage at Pin 13 is within $\pm.01$ volts at the two settings of the F_1 and F_2 controls.

Connect the X input of a scope to the front panel HORIZ OUT connector, and the Y input to the front panel MARKER OUT connector. Turn the MARKER switch on. Set the MODE switch to BAND and the BAND switch to 2-4 GHz. Five markers should appear on the screen, each having a peak amplitude of -15 volts. Using the five tuning controls, align these markers evenly across the screen with the end ones about 5 percent towards the center from the maximum sweep limits. Adjust R79 for uniform pulse width of all marker pulses.

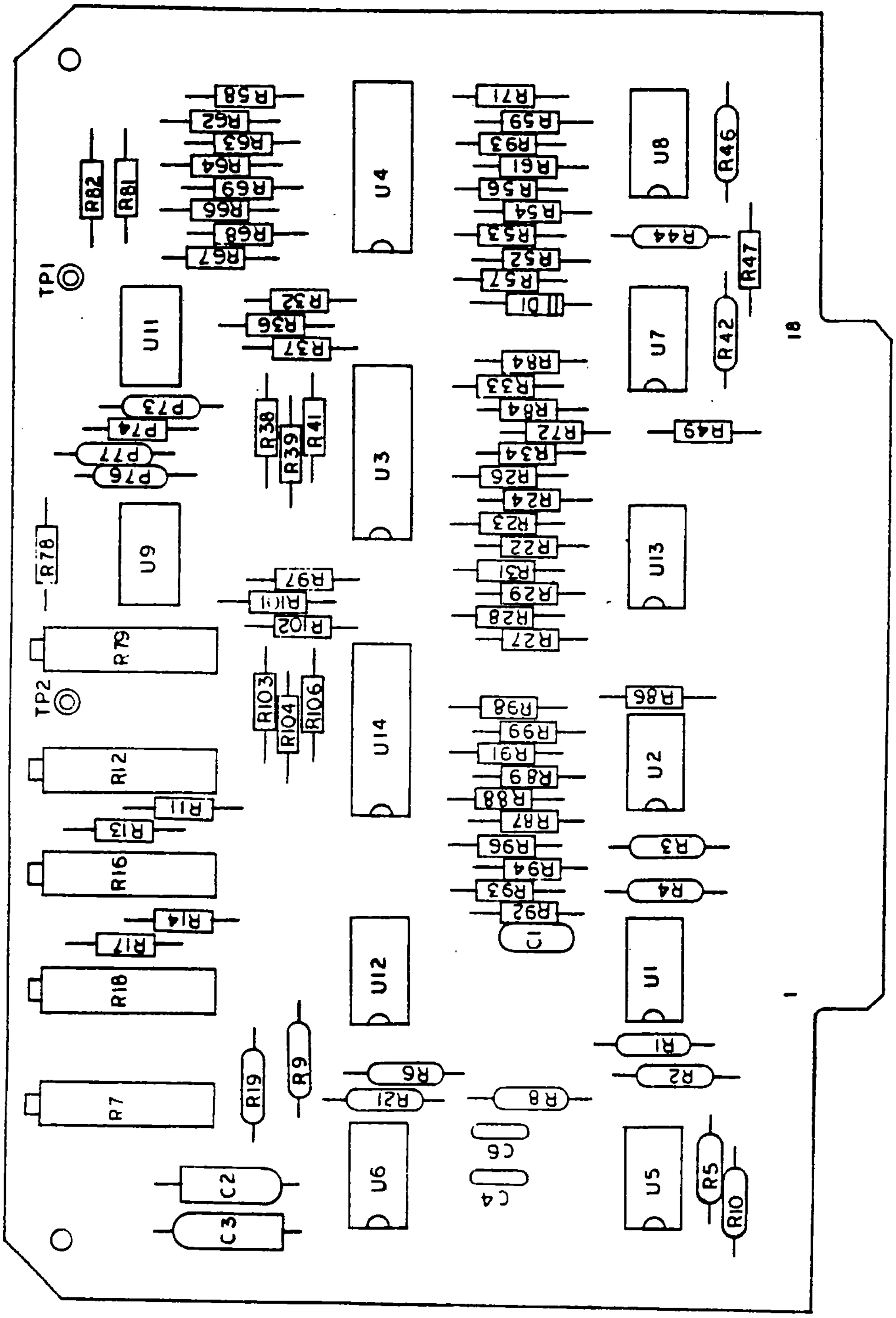
5.7.2.1 HORIZONTAL OUTPUT

In all sweep modes, a sweep voltage of ±5 volts will be at the front panel HORIZ OUT connector. Its amplitude will remain constant for all sweep modes and sweep dispersions.

Set the generator MODE switch to any sweep mode. Set the SWEEP TIME controls for the fastest repetitive sweep. Connect a scope to Pin R. Note the sawtooth waveform with a peak-to-peak amplitude of about 22 volts. This same waveform should appear at TP1 and Pin 18 of A3B3, and the front panel HORIZ OUT jack, but with a peak-to-peak amplitude of about 10 volts.

5.7.2.2 ΔF SWEEP

Set the MODE switch to ΔF, the BAND switch to 2-4 GHz, and the SWEEP TIME controls for the fastest repetitive sweep. Select one of the tuning controls and verify that the voltage at Pin 8 varies from -10.950 to +10.950 volts as the tuning control is varied over its range. Connect a scope to Pin R and verify the presence of the sawtooth on



Component Location, Marker/Sweep Generator

79-B-33-030 (A3B3)

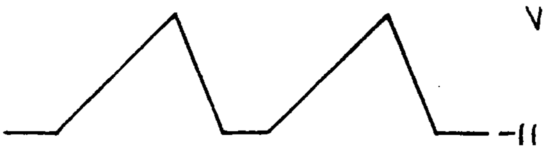
Figure 5.12

Pins R and 10. The peak-to-peak amplitude will be about 22 volts at Pin R and 2.2 volts at Pin 10. Connect the scope to Pin L and verify that the sawtooth signal varies from zero to about 2.2 volts peak-to-peak as the front panel Δ F control is varied from its counterclockwise to clockwise position. The output at Pin K will be a DC voltage with the sawtooth superimposed on it. The DC voltage will vary from -10.950 to +10.950 volts as the selected tuning control is varied over its range, and the superimposed sawtooth amplitude will vary from near zero to about 2.2 volts peak-to-peak as the Δ F control is varied over its range.

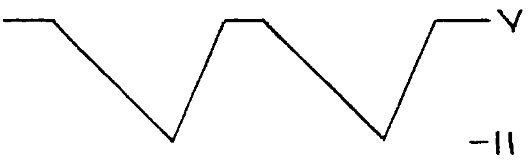
5.7.2.3 F_1-F_2 SWEEP

Set the MODE switch to F_1-F_2, the BAND switch to 2-4 GHz, and the SWEEP TIME controls for the fastest repetitive sweep. Check the following waveforms:

Pin M of A3B3
V will vary from -11 to +11, depending on the position of the F_1 control.



Pin M of A3B3
V will vary from -11 to +11, depending on the position of the F_2 control.



The waveforms at Pin 13 will be similiar to one of the waveforms shown in the two preceding diagrams. The peak-to-peak amplitude may vary from 0 to 22 volts peak-to-peak, and the base line may vary from -11 to +11 volts, depending on the position of the F_1 and F_2 controls.

5.7.2.4 MARKERS

The marker width is determined by a fixed offset voltage (Pin 15) in the ΔF and BAND sweep modes, and a variable voltage (Pin 17) in the F_1-F_2 sweep mode. With the MODE switch in the BAND or ΔF position, the voltage at Pin 11 of A3B3 should be about +0.2 volts. In the F_1-F_2 position, this voltage will vary from zero to +0.2 volts depending on the position of the F_1 and F_2 controls. If one is clockwise and the other counter clockwise, the voltage is +0.2V. If both are clockwise or counterclockwise, the voltage is zero.

Vary the M_1 control over its full range and check that the voltage at Pin S of A3B3 and Pins 5, 6 and 7 of U7 vary from -10.950 to +10.950 volts. Do the same for the other markers.

M_2 Pin P of A3B3 and Pins 5, 6 and 7 of U13.

M_3 Pin N of A3B3 and Pins 2, 3 and 4 of U11.

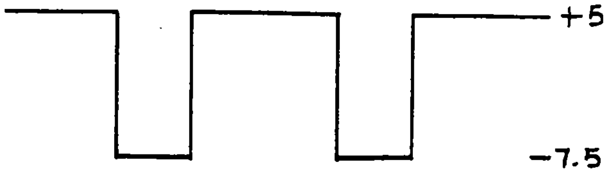
M_4 Pin 12 of A3B3 and Pins 1, 2 and 3 of U13.

M_5 Pin 16 of A3B3 and Pins 2, 3 and 4 of U7.

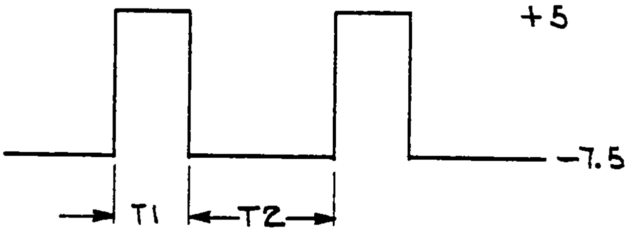
Check that the sawtooth voltage is at Pin T of A3B3, Pins 1, 2 and 3 of U11, and Pins 5, 6 and 7 of U9. Amplitude should be 22 volts peak-to-peak at all points, except 11 volts peak-to-peak at Pins 5 and 6 of U9.

A pair of comparators generate each marker. The waveform at the output of each comparator of a pair is shown in the following text.

M1 Pin 14 U13, M2 Pin 14 U14
M3 Pin 1 U4, M4 Pin 1 U14
M5 Pin 1 U3



M1 Pin 13 U13, M2 Pin 13 U14
M3 Pin 2 U4, M4 Pin 2 U14
M5 Pin 2 U3



The periods of T_1 and T_2 will vary depending on sweep, but T_2 will be about 4 times the width of T_1.

Connect the X input of a scope to the front panel HORIZ OUT connector, and the Y input to the front panel MARKER OUT connector. Set the MODE switch to BAND, the BAND switch to 2-4 GHz, and the MARKER switch on. Five markers should appear on the screen. If the above waveforms are present at the comparator outputs and no markers are observed at the MARKER OUT connector, check U4C and U4D.

5.8 CONTROL BOARD (A3A1)

This board contains the switching logic for the local and remote operating modes. There are no alignment procedures for this board. A fault on this board is indicated if the MODE switch does not operate properly, or if an operating mode cannot be remotely selected. Each troubleshooting procedure is listed by mode, with the corresponding in-out switching function followed by logic levels of the applicable circuits. When continuity is checked between two points, a DC or signal voltage of 20 volts or less may be on these contacts. Pin numbers in parenthesis refer to the rear panel REMOTE CONTROL INPUT connector.

5.8.1 CW

In local CW, the generator is tuned by any of the five selected tuning controls. This CW mode may be selected remotely, or the generator may be remotely tuned in the CW mode by the voltage input to the rear panel FREQ CONTROL IN jack.

5.8.1.1 CW LOCAL

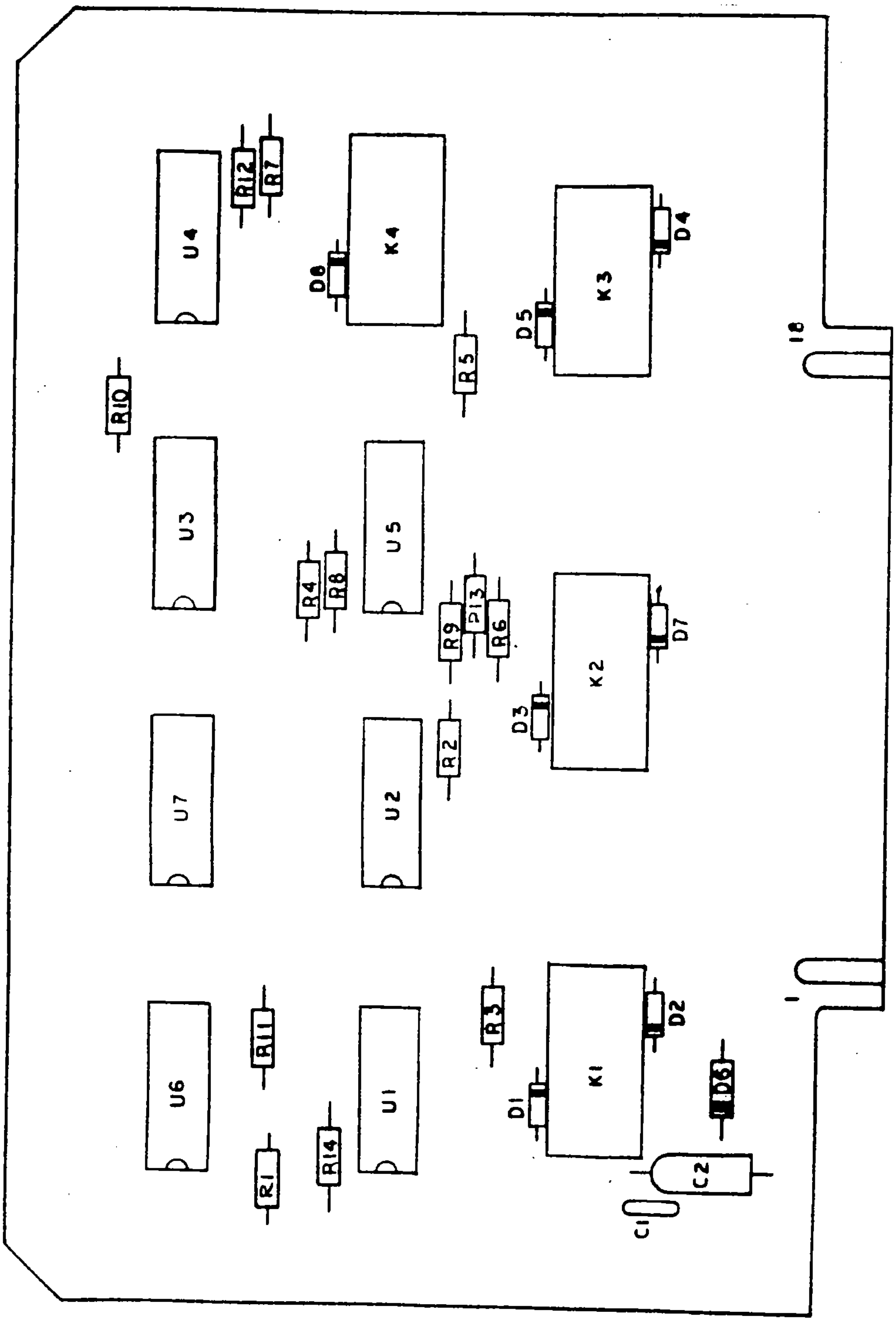
The generator is tuned by the selected front panel tuning control, but the MODE switch must be in its CW position. Set the MODE switch to CW and check continuity between Pins M, N, T and 12 of A3A1. Check the logic level at the following pins.

	U1	U2	U3	U4
LO	8-12-13	8	10	12-13
HI	9-10-11	9-10	8	11

	U5	U6	U7	K4
LO	4	1-9-10	8	16
HI	8	2-8-11	9-10-11	13

5.8.1.2 CW REMOTE, LOCAL TUNING

The generator is tuned by the selected front panel tuning control regardless of the position of the MODE switch. Pin 13 (18) and J (43) are held low. Pin K is high. Check continuity



Component Location, Control Board

79-B-31-074 (A3A1)

Figure 5.13

between Pins M, N, T and 12 of A3A1. Check the logic level at the following pins.

	U1	U2	U3	U5
LO	8-12-13	8	8	4
HI	9-10-11	9-10	9-10	8

	U6	U7	K4
LO	1-5-9	8	16
HI	2-6-8	9-10-11	13

5.8.1.3 CW REMOTE, EXTERNAL TUNING

The generator is tuned by the input voltage applied to the rear panel FREQ CONTROL IN jack regardless of the position of the MODE switch and front panel tuning controls. Pins 13 (18), J (43) and 7 (16) are held low. Pin K is high. Relay K2B is energized. Check continuity between Pins N, U and 12. Check the logic levels at the following pins.

	U3	U4	U5	U6	K2
LO	8	11	4	5-9-11	8
HI	9-10	12-13	8	6-8-10	5

5.8.2 △F

In local △F, the generator center frequency is tuned by the selected front panel tuning control, and the sweep deviation is set by the △F control. This △F mode may be selected remotely, or the generator can be remotely tuned over the same deviation by the voltage input to the rear panel FREQ CONTROL IN jack.

5.8.2.1 △F LOCAL

The generator center frequency is tuned by the selected front panel tuning control. The sweep deviation about this center frequency is set by the △F control and the SWEEP TIME controls. The MODE control must be set to △F. Pin F is held low. Check continuity between Pins E and 12 of A3A1, also between Pins L and 10. Check the logic levels at the following pins.

	U1	U2	U7	K1
LO	1-6	6	2	16
HI	2-3-4-5	5	1-12-13	13

5.8.2.2 △F REMOTE, LOCAL TUNING

The generator is tuned as in 5.8.1.1 regardless of the position of the MODE control. Pins J (43) and D (17) are held low. Pin K is high. Check continuity between Pins E and 12 of A3A1, and also between Pins L and 10. Check the logic level at the following pins.

	U1	U3	U5
LO	2-6	8	12
HI	1-3-4-5	9-10	8

	U6	U7	K1
LO	5-9	1	16
HI	6-8	2-12-13	13

5.8.2.3 △F REMOTE, EXTERNAL TUNING

The generator center frequency is tuned by the selected front panel tuning control, but may be varied about this center frequency by the voltage input to the rear panel FREQ CONTROL IN jack. The total deviation is proportional to the setting of the front panel ΔF control. The MODE switch is disabled. Pins J (43), 7 (16) and 14 (17) are held low. Pin K is high. Check continuity between Pins T and U of A3A1, also between Pins L and 10, and E and 12. Check the logic level at the following pins.

	U1	U3	U4	U5
LO	2-6	8	2-6-11	6
HI	1-3-4-5	9-10	1-3-5-12-13	8

	U6	U7	K1	K2	K4
LO	5-9-11	13	16	8	16
HI	6-8-10	1-2-12	13	5	13

5.8.3 F_1-F_2

In local F_1-F_2, the generator sweeps between the two frequencies set by the F_1 and F_2 controls. This mode may be selected remotely, or the generator may be remotely tuned between F_1 and F_2 by an external tuning voltage.

5.8.3.1 F_1-F_2 LOCAL

The MODE switch must be set to F_1-F_2. The generator will sweep between the frequencies set by the F_1 and F_2 controls at the rate set by the SWEEP TIME controls. Pin 9 is held low. Pin K is low. Check for the continuity between Pins 5 and 12 of A3A1, and also between Pins L and 6. Check the logic level at the following pins.

	U2	U3	U5	U6	U7	K1
LO	3-5	10	8	6-8	3	8
HI	1-2-6	8	—	5-9	4-5-6	5

5.8.3.2 F_1-F_2 REMOTE, LOCAL TUNING

The generator sweeps as in 5.8.3.1 regardless of the position of the MODE switch. Pins 8 (22) and J (43) are held low. Pin K is high. Check continuity between Pins 5 and 12 of A3A1, also between Pins L and 6. Check the logic level at the following pins.

	U2	U3	U4	U5
LO	3-10	8	3-4	1
HI	1-2-8	9-10	1-2-6	8

	U6	U7	K1
LO	5-9	4	8
HI	6-8	3-6	5

5.8.3.3 F_1-F_2 REMOTE, EXTERNAL TUNING

The generator is tuned over the frequency limits set by the F_1 and F_2 controls by the voltage applied to the rear panel FREQ CONTROL IN jack. The MODE and SWEEP TIME controls are inoperative. Pins R (19), J (43) and 7 (16) are held low. Pin K is high. Check for continuity between Pins T and U of A3A1, also between Pins L and 6, and 5 and 12. Check the logic level at the following pins.

	U1	U2	U3	U4
LO	8-10	3-4-10	8	1-6
HI	12-13	1-2-6-8	9-10	3-5

	U5	U6	U7	K1	K4
LO	5	2-5-9	5-10	8	16
HI	8	1-6-8	6-8	5	13

5.8.4 BAND

In local BAND, the generator sweeps over the full range of the selected frequency. This mode may be selected remotely. There is no provision for remotely selecting the BAND mode with external tuning because this is identical to the CW mode with external tuning.

5.8.4.1 BAND LOCAL

The MODE switch must be set to BAND. The generator will sweep over the full range of the selected frequency range at the rate set by the SWEEP TIME controls. Pin 15 of A3A1 is held low. Pin K is low. Check for continuity between Pins T, 12 and 16 of A3A1, also between Pins L and 10. Check the logic level at the following pins:

	U2	U3	U4	U6	K2
LO	10	3-5-9-12	3-4	2-6-8	16
HI	8	1-2-6-8-11	1-2-6	1-5-9	13

5.8.4.2 BAND REMOTE

Operation is the same as in 5.8.4.1 except the MODE switch may be in any position. Pin J (43) and S (20) are held low. Pin K is high. Check for continuity between Pins T, 12 and 16 of A3A1, also between Pins L and 10. Check the logic level at the following pins.

	U2	U3	U4
LO	8	3-4-8-13	3-4
HI	10	1-2-6-9-10-11	1-2-6

	U5	U6	K2
LO	11	2-5-9	16
HI	8	1-6-8	13

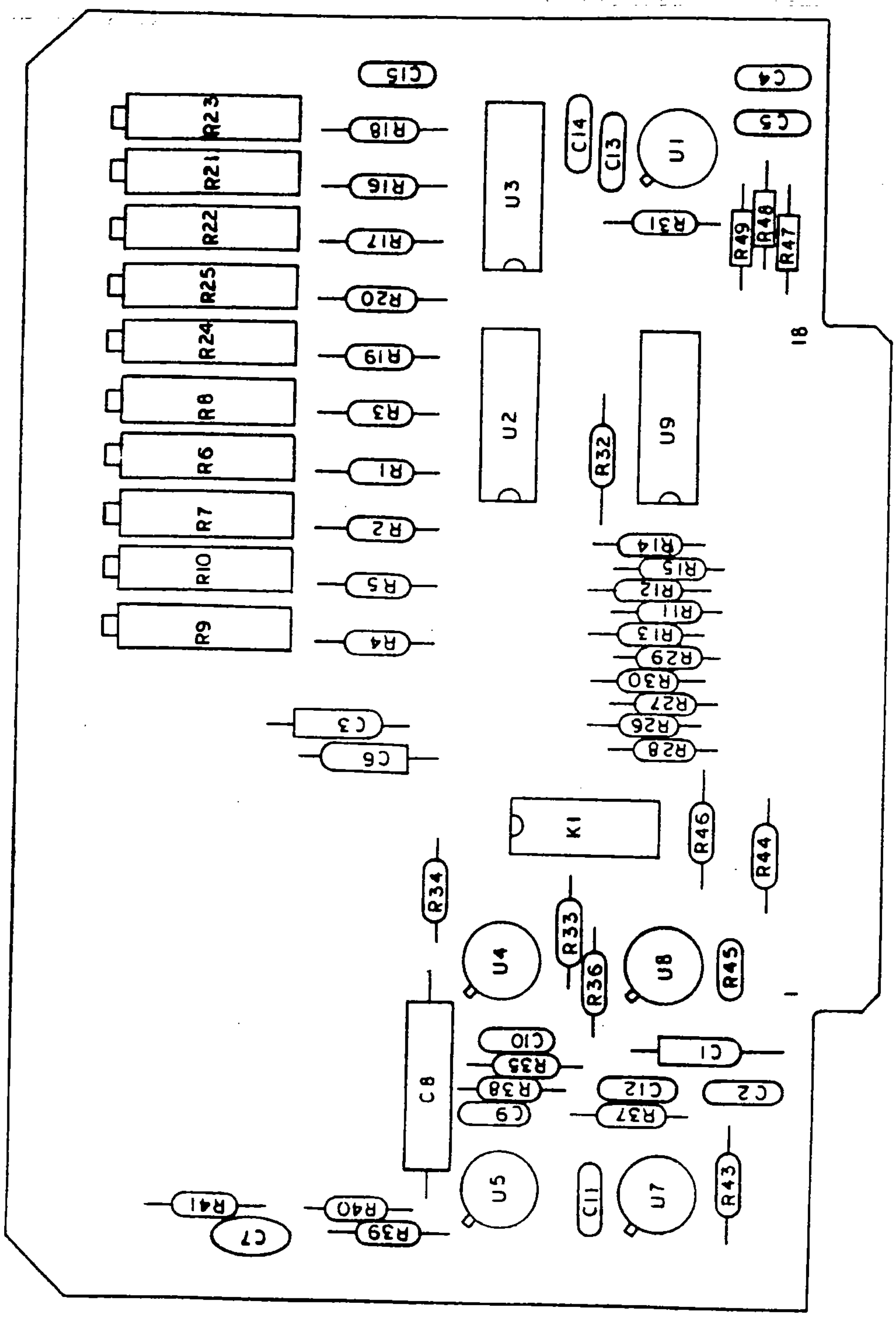
5.8.5 FM - PHASE LOCK

This remote control function switches the FM coils of the YIG oscillators from the internal modulation generator to the rear panel ϕ LOCK IN jack. With no remote input commands, check continuity between Pins V and 18 of A3A1. Then ground Pins H (23) and J (43) and measure continuity between V and 17, and between Pin 11 and ground. Check the logic level at the following inputs.

	U4	U6	K3
LO	8	5-13	8
HI	9-10	6-12	5

5.9 OSCILLATOR TRACKING/DRIVER (A3B8)

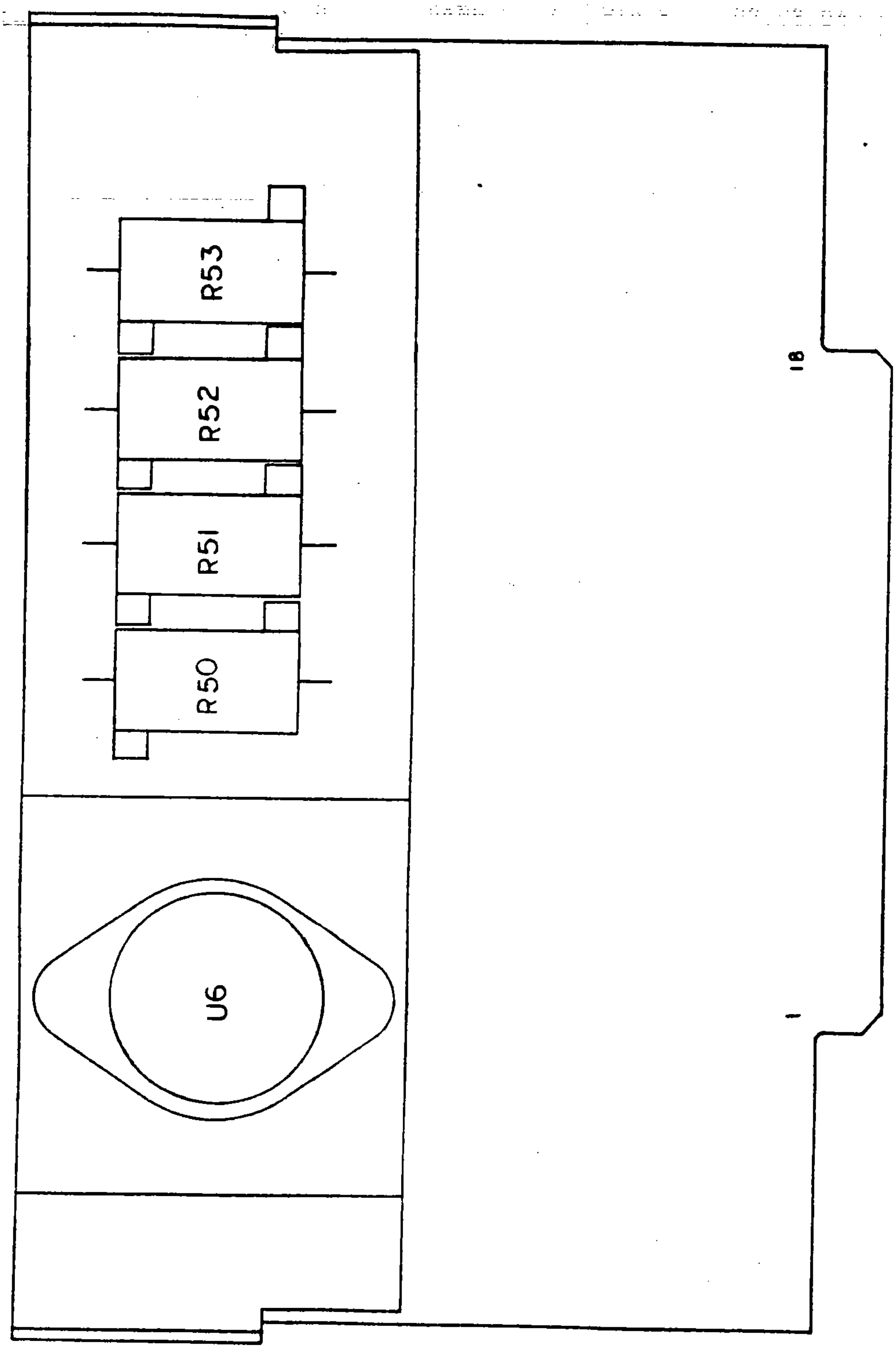
This board connects the 0 to +9 volt tuning signal to the YIG tuning currents for each oscillator. All alignment and repairs must be done with the other boards in place and with the RF Assembly connected internally or remotely. Set the MODE switch to CW for all procedures.



Component Location, Oscillator Tracking/Driver

79-B-38-045 (Sheet 1 of 2) (A3B8)

Figure 5.14



Component Location, Oscillator Tracking/Driver

79-B-38-045 (Sheet 2 of 2) (A3B8)

Figure 5.14

5.9.1 ALIGNMENT

The adjustments on this board compensate for the manufacturing tolerances of the YIG oscillator tuning currents.

Connect a frequency counter to the RF OUTPUT connector. Select the M_3 tuning control and adjust it for the voltages at Pin 18 of A3B8 as listed in the following table. Set the BAND switch as listed. Then adjust the designated trimmers for the correct frequencies.

Band 1 covers .01 to 2 GHz and is included only for generators having Option 1. The YIG oscillator tunes from 2.310 to 4.300 GHz and is heterodyned down to the output frequency by a fixed-tuned 2.3 GHz oscillator.

BAND	VOLTAGE Pin 18	ADJUST	FREQUENCY
.01-2	0.00	1 LO	10.00 MHz
.01-2	9.00	1 HI	2000.00 MHz
2-4	0.00	2 LO	1900.00 MHz
2-4	9.00	2 HI	4100.00 MHz
4-8	0.00	3 LO	3900.00 MHz
4-8	9.00	3 HI	8100.00 MHz
8-12	0.00	4 LO	7900.00 MHz
8-12	9.00	4 HI	12100.00 MHz
12-18	0.00	5 LO	11900.00 MH
12-18	9.00	5 HI	18200.00 MHz

5.9.2 REPAIR

Check the following voltages at the connector pins of the board.

A3B8 PIN	VOLTS	A3B8 PIN	VOLTS
A	GND	K	GND
B	+15	1	GND
C	+15	2	+15
D	+6	3	+15
E	-6	4	+6
F	-15	5	-6
H	+11.00	6	-15

Check that the BCD command is present at the connector pins and at the integrated circuit switches.

BAND	Pin 10 A3B8 / Pin 11 U2,U3,U9
.01-2	+6
2-4	+0.1
4-8	+6
8-12	+0.1
12-18	+6

BAND	Pin 11 A3B8 / Pin 10 U2,U3,U9
.01-2	+0.1
2-4	+6
4-8	+6
8-12	+0.1
12-18	+0.1

BAND	Pin 12 Pin 9 A3B9 U2,U3,U4
.01-2	+0.1
2-4	+0.1
4-8	+0.1
8-12	+6
12-18	+6

With the MODE switch at CW and the BAND switch at 2-4, select the M_3 tuning control. Check that the voltage at Pin 18 of A3B8 varies from 0 to +9 volts as the M_3 control is rotated thru its full range. Then adjust it for +6.0 volts at Pin 18 and check the following voltages.

	2	3	4	6	7
U1	+6	+6	-15	+6	+15

	1	5	12	14	15
U2	+4.3	+4.6	+3.9	+4.5	+3.7
U3	+1.6	+1.7	+2.8	+2.8	+2.9

Pins 2, 4, 6, 8 and 13 of U2, U3 and U9 are ground. The voltage at Pin 3 depends on the position of the BAND switch. These circuits are switches. Switching logic and typical voltages are shown below.

BAND	Pin 3 To	Pin 3 U2	Pin 3 U3	Pin 3 U9
.01-2	Pin 14	+4.5	+2.8	+3.6
2-4	Pin 15	+3.7	+2.9	+3.3
4-8	Pin 12	+3.9	+2.8	+3.3
8-12	Pin 1	+4.3	+1.6	+2.9
12-18	Pin 5	+4.6	+1.7	+3.1

Set the BAND switch to 2-4 and check the following voltages.

	2	3	4	6	7
U4	+3.7	+3.7	-15	+3.7	+15
U5	+3.3	+3.3	-15	+3.3	+15
U6	+18	0	+1.5	+5.4	-15
U7	+3.3	+3.3	-15	+3.3	+15
U8	+3.0	+3.0	-15	+3.0	+15

Check that Pin P of A3B8 is grounded only when the MODE switch is in its CW position. When Pin P is grounded, check for continuity between Pin 1 and 7 of relay K1.

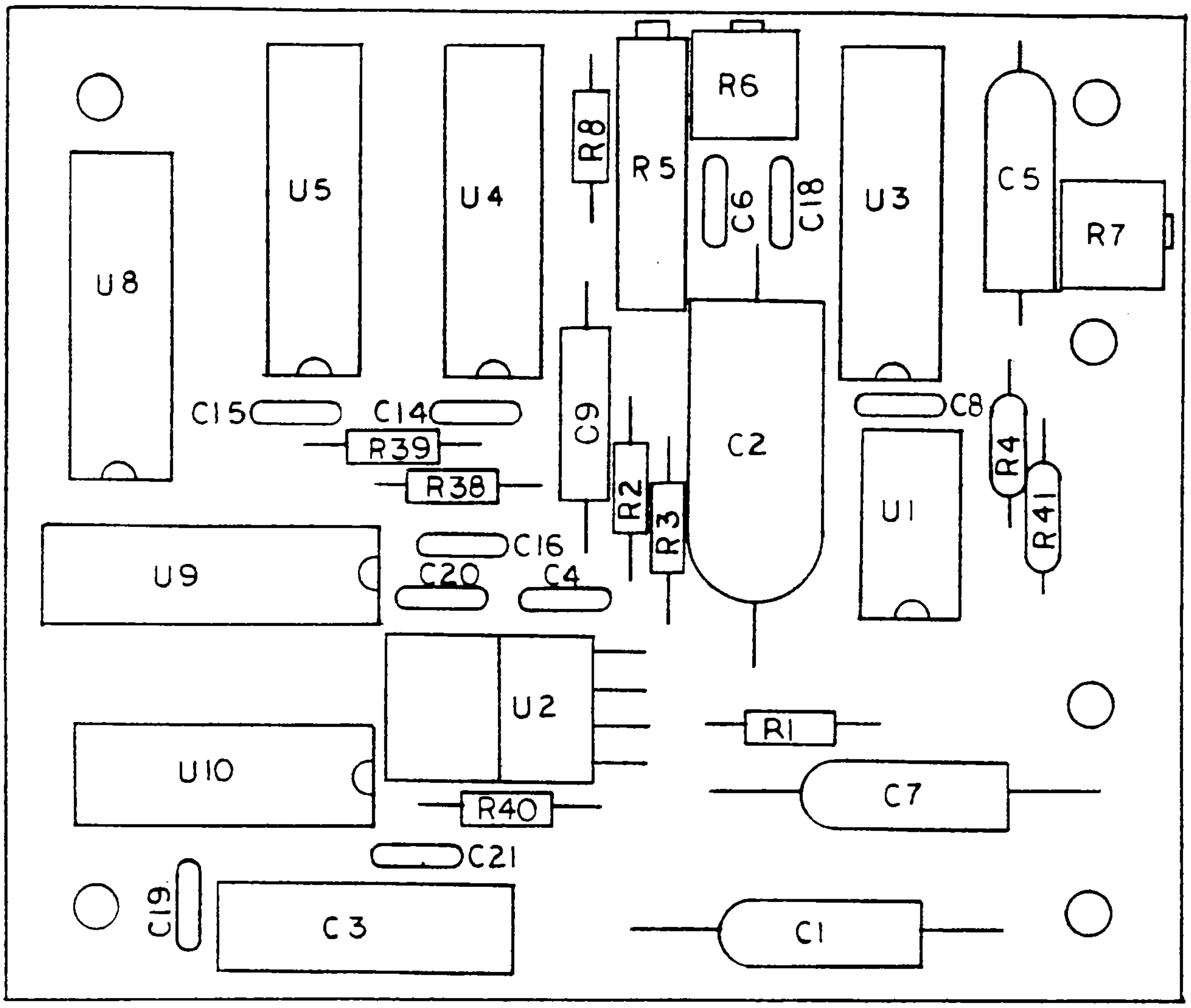
5.10 DIGITAL FREQUENCY DISPLAY (A5)

The digital frequency display is a digital voltmeter which displays 0.01 to 18.00 as the input voltage varies from +.005 to +9.0 volts.

The display is disengaged from the mainframe by removing the top cover of the SG-811 and the four knurled screws holding the display to the mainframe. Access to its components requires removing the 11 flat head screws which join the two sections of its case.

5.10.1 ALIGNMENT

Check that the input to the display is correct by measuring the generator output frequency using a frequency counter and measuring the voltage input to the display at pin 6 of its connector or at pin V of A3B5, using a digital voltmeter. Tune the generator for a frequency output of 18.00 GHz as read on the counter. The voltage should be between +8.91 and +9.09 volts. If not, the problem is in the tuning curcuits.



Component Location, Digital Frequency Display

79-B-51-056 (A5B1)

Figure 5.15

The display is aligned by tuning the generator to its lowest frequency and adjusting R7 so that the display equals the frequency counter readout. Tune to the highest frequency but no greater than 18.00 GHz, and adjust R5 and R6 for the correct readout. R5 is a coarse adjustment, R6 a fine adjustment. repeat the above until the readings at both frequencies are correct. Any negative voltage input will cause the digits to flash.

5.10.2 REPAIR

Check the inputs to the display at connector A5P1. The voltage at pin 6 should vary as the generator frequency and equal 0.5 volts/GHz.

A5P1	VOLTAGE
1	+15
2	-15
3,4,9	GND

Check the following internal voltages. The voltage at the positive terminal of C13 will vary from +4 to +6 volts, depending on the numbers displayed on DS-1, DS-2, DS-3 and DS-4. Next check regulator U2.

U2	VOLTAGE
1	GND
2	+8.5
3	+6.6
4	+5.0

5.10.2.1 INPUT BUFFER U1

The voltage at pin 6 of J1 is divided by a factor of 4.5 to pin 3 of U1. U1 is connected as a unity gain amplifier. Its output at pin 6 should vary as the input to pin 6 of J1, and be reduced by a factor of 4.5. The voltage at pin 6 of U1 should not exceed +2.0 volts.

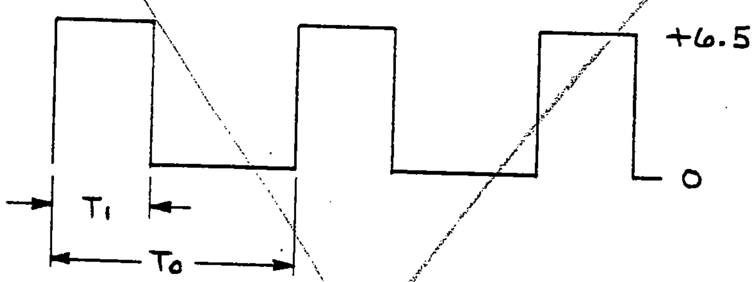
5.10.2.2 A/D CONVERTER U3

U3 contains a voltage reference output at pin 11 which should measure between +1.1 and +1.4 volts.

Connect a scope to pin 7 of U3 (positive terminal of C5). The waveform is a triangular ramp. The base of the ramp is +1 volt; the height and period of the ramp vary as the input voltage. The height varies from about +1.5 volts at zero volts input to +4 volts at +9 volts input.

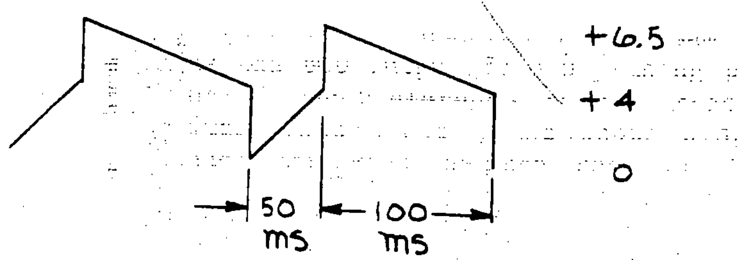
5.10.2.3 DIGITAL SUBSYSTEM, U4

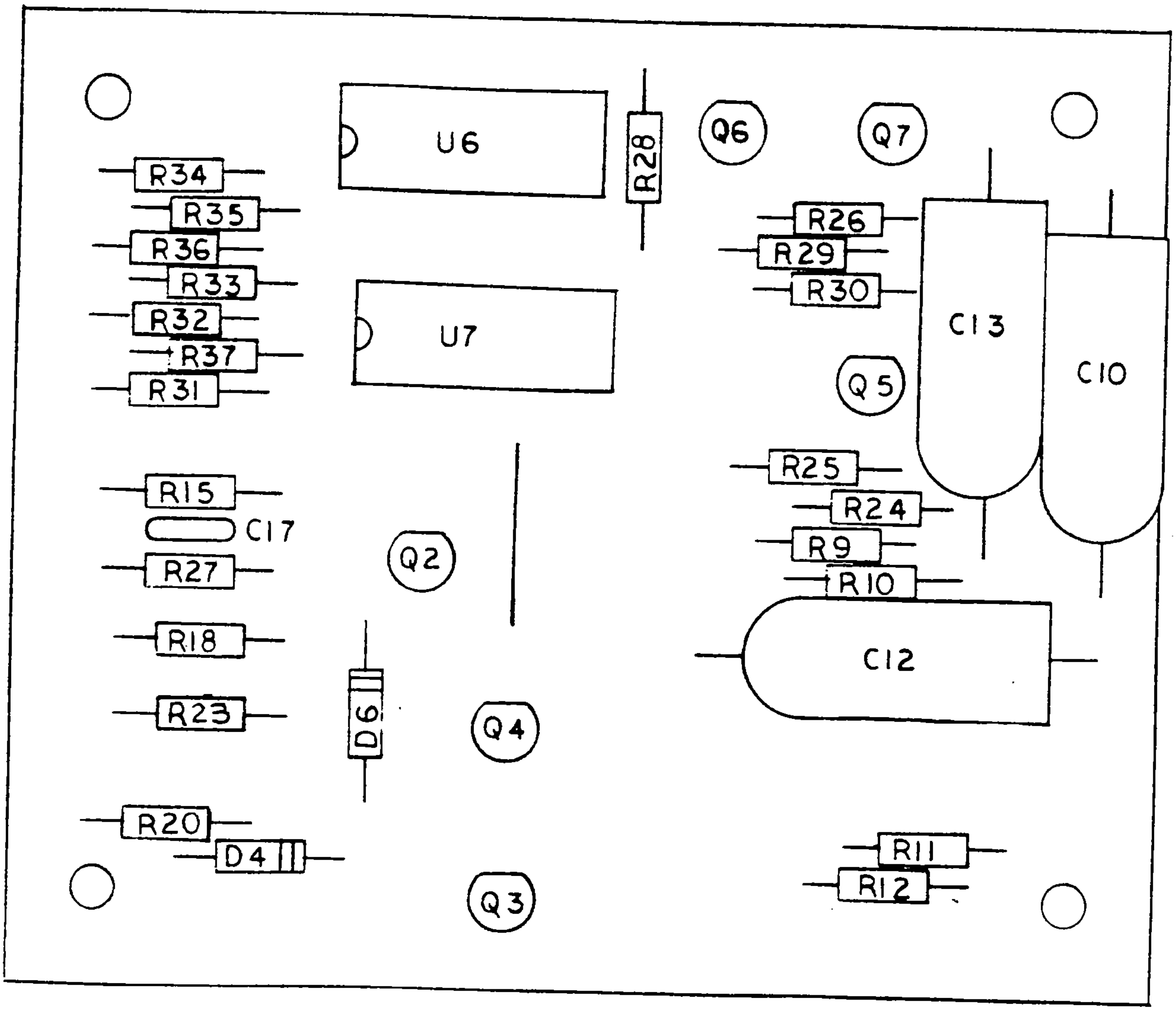
The ramp control signal may be checked at either terminal of R8.



T_1 varies from 20 ms at an input of zero to 380 ms at an input of +9 volts. The corresponding range of T_0 is 220 to 450 ms.

The clock signal at pin 3 of U4 is shown below and does not vary with input signal.



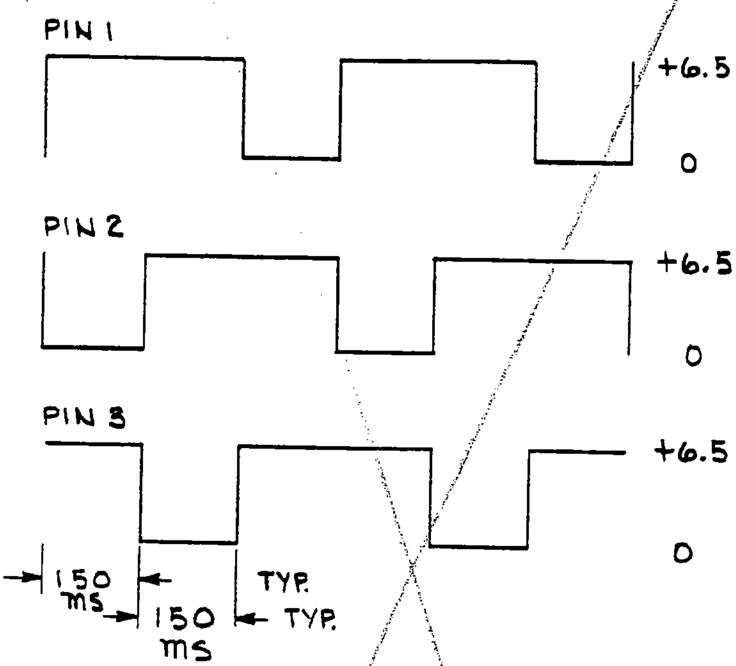


Component Location, Digital Frequency Display

79-B-52-058 (A5B2)

Figure 5.16

The three least significant digits to the display appear sequentially as a BCD output at pins 11, 12, 13 and 14 of U4. The output at pins 1, 2 and 15 of U4 are synchronized with the BCD outputs to scan the display across these three digits. Each digit is on for about 150 ms and off for about 300 ms.



The outputs at pins 11, 12, 13 and 14 may be checked by synchronizing one trace of a dual-trace scope to pin 1 of U4 and connecting the second trace to pin 11, 12, 13 or 14. On each of these pins there will be three sequential bits at 0 or +6.5 volts. The value of each bit, i.e. 0 or +6.5 volts, will depend on the digits from U4. Each bit will be 150 ms in length and synchronized with the digital signals at pins 1, 2 and 15.

5.10.2.4 DISPLAY

U5 is a BCD/7-Segment converter. Its outputs at pins 9, 10, 11, 12, 13, 14 14 and 15 are checked in the same manner as the BCD output from U4, using pin 1 of U4 as the reference to one trace of a dual-trace scope. The scope display at each pin will be the same as for the outputs from pins 11, 12, 13 and 14 of U4.

U6 and U7 are inverters, so the outputs can be checked as above and the scope display will be the same but inverted.

The display drivers Q5, Q6 and Q7 are checked as follows. Connect one trace of a dual trace scope to pin 1 of U4 and the second trace to the collector of Q5. The two traces are inverted waveforms with the collector switching between zero and +5 volts. Repeat for pin 2 of U4 and Q7, and pin 15 of U4 and Q6.

Each segment of the LED displays can be checked by grounding the terminal of the corresponding current limiting resistor in series with the segment. The ground must be placed at the end which does <u>not</u> connect to the LED.

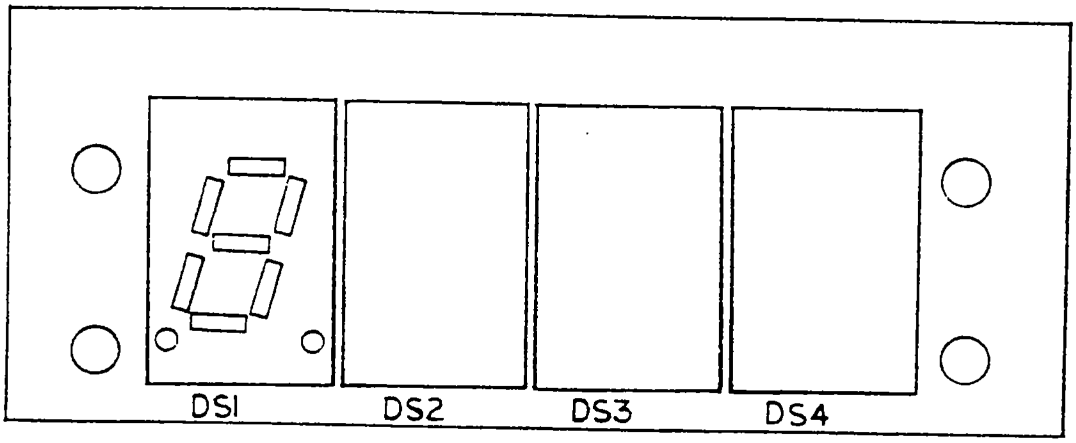
Display digit DS-1 is normally switched from "0" to "1" by the output at pin 10 of U4 which switches from zero to +6.5 volts at the correct voltage. For generators covering 18-26 GHz, point E13 is grounded through pin 7 of J1, and DS-1 switches from "1" to "2" when pin 10 goes high.

5.11 MODULATION GENERATOR/LEVEL CONTROL BOARD (A3B1)

This board contains the following five functional circuits:

1. Generation of the reference signal for the leveling loop. This composite signal contains one or more of the following components: (1) Level control which is proportional to the setting of the front panel RF LEVEL control; (2) Compensation signal for leveling errors which are proportional to frequency; (3) AM modulation; and (4) Remote attenuator control of 10 dB in one dB steps.

2. Remote digital control of attenuation over a 10 dB range in one dB steps.



Component Location, Digital Frequency Display

79-B-53-060 (A5B3)

Figure 5.17

3. Meter amplifier for the front panel DBM meter.

4. Oscillator for generating the frequency of the internal AM and FM, and the pulse repetition rate of the internal pulse modulator.

5. Switching between internal and external modulation.

5.11.1 ALIGNMENT

5.11.1.1 MODULATION GENERATOR

Connect a scope to Pin F of A3B1. Set the front panel MODULATION switch to INT AM and the FREQ/PRF control fully counterclockwise and pushed in. Adjust R5 for best symmetry of the squarewave on the scope.

Connect a distortion analyzer to Pin 8 of A3B1. Set the front panel MODULATION switch to INT FM. Adjust the FREQ/PRF control for a 1000 Hz signal. Adjust R8 and R9 for minimum distortion.

Connect a frequency counter to Pin 8 of A3B1. Check that the front panel FREQ/PRF control is pushed in. Then rotate it counterclockwise to its ".1" position and adjust R59 for a frequency of 100 Hz. Next rotate it clockwise to its "1" position and adjust R60 for a frequency of 1000 Hz. These controls are interactive, so repeat the adjustments until both positions are calibrated.

5.11.1.2 REMOTE 10 DB ATTENUATOR

Set the SG-811 to 6 GHz, and place the MODE switch to CW. If a remote attenuator input is available set the one dB units to 0. Otherwise ground Pins 14, 15, 16, 17 and 18 of A3B1. Connect an RF power meter to the RF OUTPUT connector, and adjust the RF LEVEL control for a reference leveled power output of 0 dBm or greater. Set the remote attenuator input to 9 dB, remove the ground Pins 14, and 15 of A3B1, and adjust R50 for exactly 9 dB less than the reference.

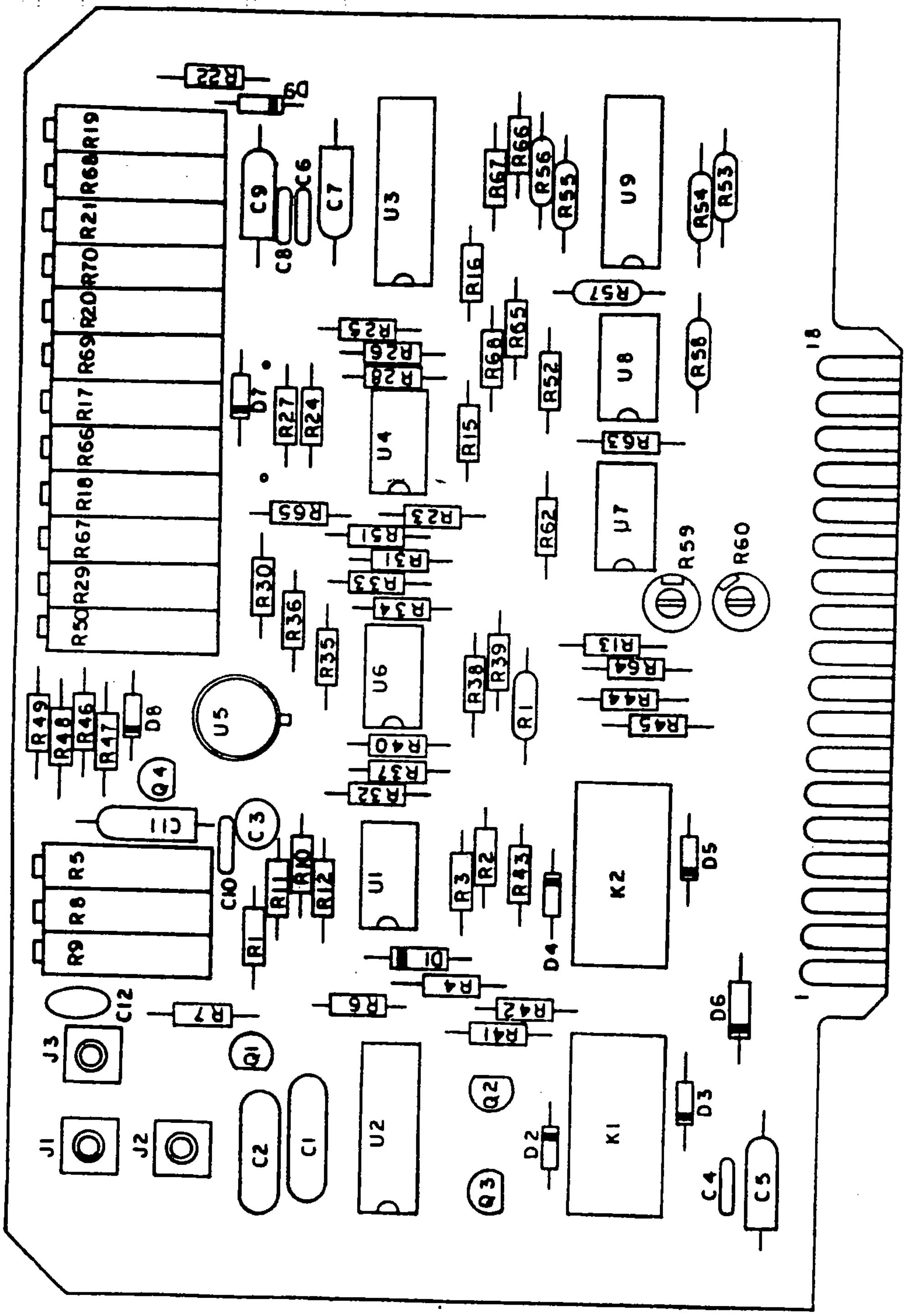
5.11.1.3 LEVEL COMPENSATION

This circuit compensates for leveling errors which are proportional to frequency and which are not corrected by by the leveling loop. In many generators this error is negligible, and the following adjustments are not required; for these units set R17, R18, R19, R20, R21, R66, R67, R68 and R70 fully counterclockwise.

If leveling compensation is required, connect an RF power meter to the RF OUTPUT. Tune the SG-811 to 3 GHz in the 2-4 GHz band, and adjust the RF LEVEL control for exactly 0 dBm on the front panel DBM meter and adjust R20 for exactly 0 dBm on the RF power meter. Switch the BAND selector to the .01-2 GHz band and adjust R21 for exactly 0 dBm output. Tune to 15 GHz in the 12-18 GHz band and adjust R17 for exactly 0 dBm output.

Connect the RF OUTPUT connector to a broadband Rf detector, and the detector output to the vertical input of a scope. Connect the scope horizontal input to the front panel HORIZ OUT jack. Set the MODE switch to BAND, and observe the swept trace on the scope. For each band, first adjust the corresponding trimmer fully counterclockwise. Then slowly adjust it clockwise to obtain the flatest response.

BAND	ADJUST
.01-2	R70
2-4	R69
4-8	R68
8-12	R67
12-18	R66



Component Location, Modulation Generator/Level Control Board

79-B-31-024

(A3B1)

Figure 5.18

5.11.1.4 METER AMPLIFIER

Set the SG-811 to 3 GHz. Set the MODE switch to CW and the MODULATION switch to OFF. In the LEVELED mode, adjust the front panel RF LEVEL control for exactly +3.00 volts at Pin 13 of A3B1. For the SG-811A, adjust R29 for a reading of exactly +10 dBm on the front panel DBM meter. For the SG-811B, adjust R29 for a reading of exactly +13 dBm.

With the inclusion of various options the maximum power output is reduced by losses in the additional RF cabling and relays. For each of the options listed below, the maximum power output set by R29 is reduced by the following amounts:

OPTION	
1	1 dB
2/2A	2 dB
3/3A	1 dB
4	1 dB
5	1 dB

Also with the inclusion of Option 2 or 2A, the leveling flatness is altered to ±1.5 dB.

5.11.2 REPAIR

If a fault is suspected on this board, first check the following supply voltages.

A3B1 PIN	VOLTS
B	+15
C	+6.0
D	-6.0
E	-15

A3B1 PIN	VOLTS
2	+15
3	+6.0
4	-6.0
5	-15

5.11.2.1 MODULATION GENERATOR

Set the front panel MODULATION switch to INT AM, INT FM, or INT PULSE. Check that the voltage at Pin 11 of A3B1 varies from about +5.6 volts to about +1.6 volts as the front panel FREQ/PRF control is varied from its counterclockwise to clockwise position. The voltage at Pins 1, 2 and 3 of U1 should equal the voltage at Pin 11. Center the front panel FREQ/PRF control and check the following voltages.

	4	5	6	7	8
U1	-15	0	0	0	+15

	1	2	3	4	5	6	7
U2	+9.0	+7.5	+7.5	+13	+13	+15	+12

	8	9	10	11	12	13	14
U2	+13	+1.8	+7.5	GND	+6.2	0	0

Using a scope, check Pin 9 of U2 for a squarewave having a peak-to-peak amplitude of about 3.5 volts. On Pin 2 of U2, and Pins 5 and 6 of U1, there should be a sine wave having a peak-to-peak amplitude of about 3.0 volts. On Pin 7 of U1, the sine wave should have an amplitude of twice that on Pins 5 and 6.

Check the voltage at Pin 7 of A3B1. With the front panel FREQ/PRF control pushed in, it should be about +5.4 volts; with the control pulled out, it should be zero.

5.11.2.2 LEVEL CONTROL

Set the MODE switch to CW, the BAND switch to 2-4, and the MODULATION switch to OFF. Vary the front panel RF LEVEL control from its full counterclockwise to full clockwise position, and check the following voltage swings.

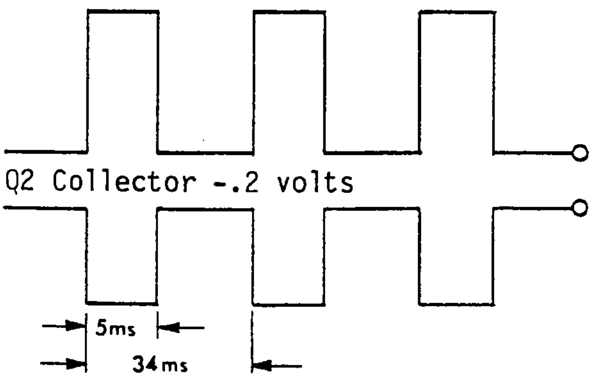
A3B1	Pin R	0 to +4.5
U7	Pins 5, 6 and 7	0 to +4.5
U6	Pin 7	0 to -4.5
U6	Pin 1	0 to +4.5
U5	Pins 4, 5 and 8	0 to +4.5
A3B1	J3	0 to +4.5

If the level control signal is not present at J3, check the following DC voltages.

	1	2	3	4	5	6	7	8
U5	+15	+15	0	—	—	-15	-15	—
U6	—	0	0	-15	0	0	0	+15
U7	—	—	—	-15	—	—	—	+15

Set the MODE switch to BAND, the BAND switch to 2-4, all SWEEP TIME controls fully clockwise, and the rear panel RF BLANKING switch to its on position. Check the following waveforms.

A3B1 Pin L +3.5 volts
Q2 Base +.7



Check the DC voltages at Q3.

	E	B	C
Q3	0	-.7	-.01

Set the MODE switch to CW and the MODULATION switch to INT AM. Check for the presence of a squarewave at the base of Q2 having a peak amplitude of about -.7 volts and a frequency controlled by the front panel FREQ/PRF control.

5.11.2.3 ATTENUATOR

The attenuator circuits on this board control the output over a 10 dB range in one dB steps when the SG-811 is connected to an external digital controller. They are operable for CW, AM Modulation and FM Modulation but not with Pulse Modulation. The controller is connected to the rear panel REMOTE CONTROL INPUT connector. The rear panel LOCAL-REMOTE switch must be in its REMOTE position, and the remote attenuator enable line must be grounded at Pin 18 of A3B1. Check the voltages on U8 with and without the enable line grounded.

	E	B	C	
Q2	+6.0	+6.0	0	A3B1 Pin 18 open
	+3.4	+2.7	+3.3	A3B1 Pin 18 grounded

	2	3	4	5	
U8	0	0	-15	0	A3B1 Pin 18 open
	0	0	-15	+1.0	A3B1 Pin 18 grounded

	6	7	8	
U8	0	0	+15	A3B1 Pin 18 open
	+1.0	+1.0	+15	A3B1 Pin 18 grounded

The following table indicates the status of the digital control inputs at both the rear panel REMOTE CONTROL INPUT connector and the pins of A3B1, as well as pertinent voltage readings, for each attenuator step. For the digital inputs "H" is a high or open contact, "L" is a low or grounded contact.

REMOTE CONTROL INPUT PINS					A3B1 PIN					U9 PIN			U8 PIN
DB	7	8	9	10	14	17	16	15	10	9	3	2	1
0	L	L	L	L	L	L	L	L	0	0	0	0	0
1	H	L	L	L	H	L	L	L	1.0	0	0	0	0.1
2	L	H	L	L	L	H	L	L	0	1.0	0	0	0.2
3	H	H	L	L	H	H	L	L	1.0	1.0	0	0	0.3
4	L	L	H	L	L	L	H	L	0	0	1.0	0	0.4
5	H	L	H	L	H	L	H	L	1.0	0	1.0	0	0.5
6	L	H	H	L	L	H	H	L	0	1.0	1.0	0	0.6
7	H	H	H	L	H	H	H	L	1.0	1.0	1.0	0	0.7
8	L	L	L	H	L	L	L	H	0	0	0	1.0	0.8
9	H	L	L	H	H	L	L	H	1.0	0	0	1.0	0.9

5.11.2.4 LEVEL COMPENSATION

The voltages at Pins 1, 5, 12, 14 and 15 of U3 will each vary as the SG-811 is tuned in the CW mode over each band. The variation may be zero or as great as ±1 volt, depending on the position of the associated trimmers. U9 switches the correct one of these inputs to its output at Pin 3. Identical voltages are at Pin 3 of U3 and Pins 1, 2 and 3 of U4. The table below lists the input pins of U3 for each band.

BAND	.01-2	2-4	4-8	8-12	12-18
U3 PIN	14	15	12	1	5

5.11.2.5 METER AMPLIFIER

Adjust the front panel RF LEVEL control for +2.0 volts at Pin 13 of A3B1. Check the following voltages.

	4	5	6	7	8
U4	-15	+.7	+.7	+.9	+15

The voltage at Pins 5, 6 and 7 of U4 will vary as the RF LEVEL control is rotated. Note that the front panel DBM meter also varies with the RF LEVEL control.

5.11.2.6 RELAY SWITCHING

Check that the following relays operate for the corresponding settings of the MODULATION switch. The Pins listed for A3B1 are grounded by the switch to operate the relay.

MODULATION	RELAY	A3B1 PIN
EXT AM	K1A	H
EXT FM	K1B	J
EXT PULSE	K1A & K1B	H & J
INT AM	K2B	K
INT FM	K2A	9
INT PULSE	K2A & K2B	K & 9

5.12 RF UNIT (A4)

A fault in the RF UNIT is usually indicated by (1) reduced power or no power in a single band and (2) improper leveling. Any failure in Options 1, 2, 3, 4 or 5 may also be located in the RF UNIT.

Before removing the RF UNIT from the mainframe, remove the connector P9 going to the RF UNIT and check the following voltages.

P9 PIN	VOLTS	P9 PIN	VOLTS
A	+24	F	-5
B	+18	G	-15
C	+18	H	GND
D	+15	J	GND
E	+6	K	GND

Check the BCD band information going to the RF Unit by measuring the following voltages at P9 for each position of the front panel BAND switch. The rear panel LOCAL-REMOTE switch must be in its LOCAL position if the SG-811 is connected to a remote controller.

BAND	P9		
	Pin d	Pin e	Pin f
.01-2	+5.5	0	0
2-4	0	+5.5	0
4-8	+5.5	+5.5	0
8-12	0	0	+5.5
12-18	+5.5	0	+5.5

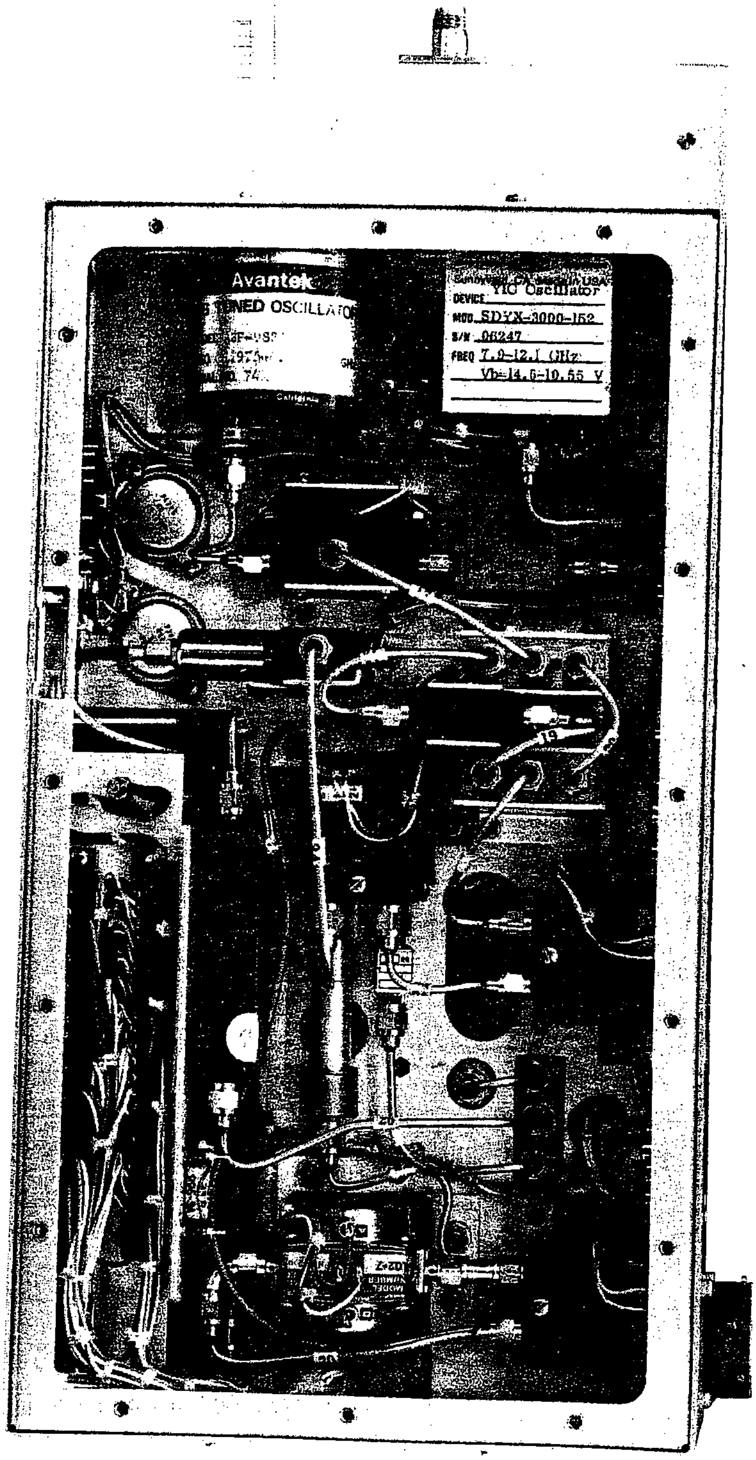
If it is necessary to remove the RF Unit from the mainframe, follow the procedures listed in Section 2.2

5.12.1 OSCILLATOR ASSEMBLY (A4B1)

Four YIG oscillators cover the 2 to 18 GHz frequency range. Refer to Figure 7.13. All except the 2-4 GHz oscillator connect directly to an isolator. The four oscillators are switched to the common output line by PIN switch Z9. Z9 also levels the output. The power output of each oscillator into Z9 is about 25 milliwatts for the SG-811A and 50 milliwatts for the SG-811B. With the front panel LEVELED-UNLEVELED switch in its UNLEVELED position and the RF LEVEL control fully clockwise, the loss through Z9 should be less than 3 dB.

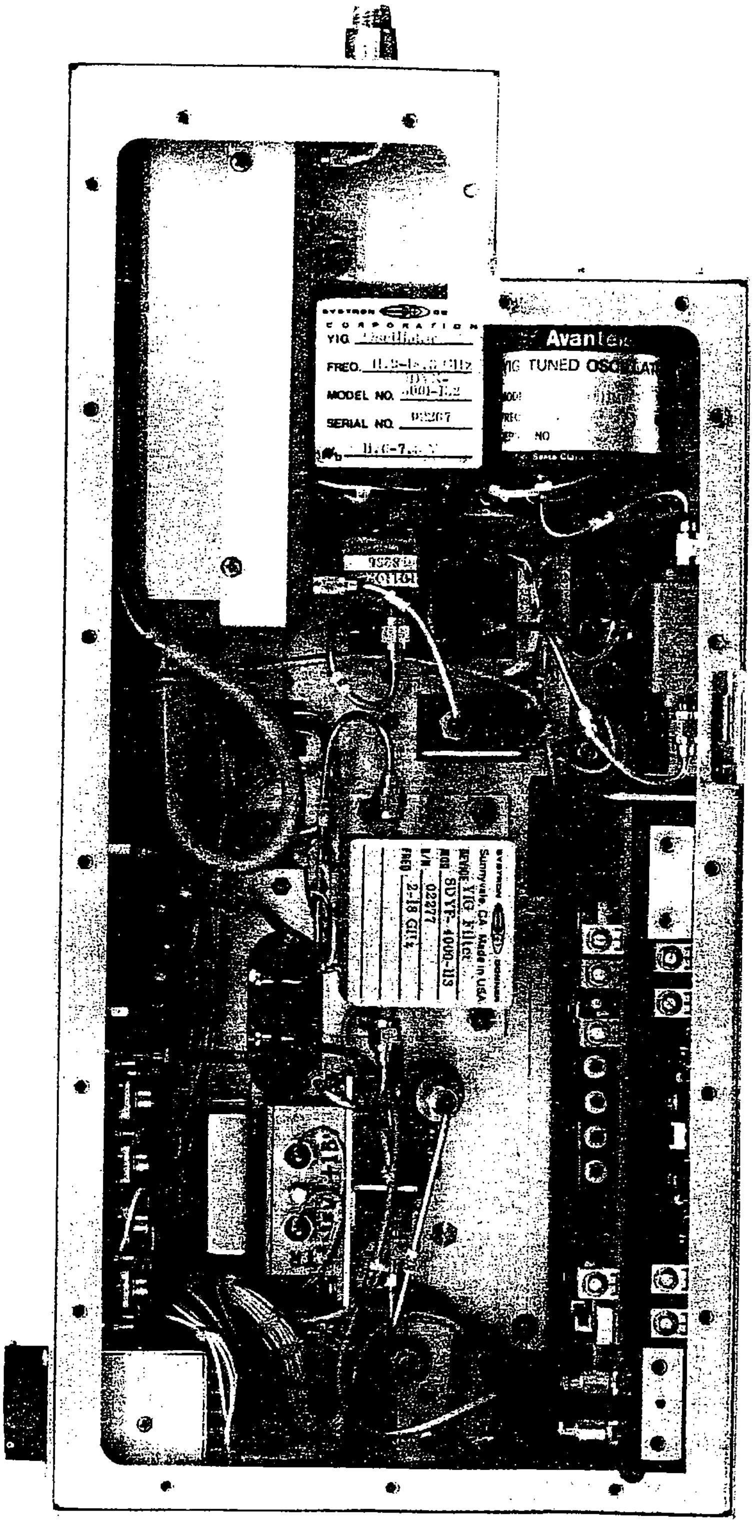
5.12.2 OSCILLATOR CONTROL BOARD (A4B2)

The circuits on this board (1) switch the YIG tuning line to the correct oscillator, and (2) program the oscillator supply voltages. For the 2-4 GHz and 4-8 GHz oscillators the supply voltage is



RF Unit, Top View (A4)

Figure 5.19



RF Unit, Bottom View (A4)

Figure 5.20

programmed with tuning to minimize the oscillator harmonic output. For the 8-12 GHz and 12-18 GHz oscillators, the supply voltage is programmed with tuning to maximimze power output across the band.

5.12.2.1 ALIGNMENT

Check the data sheet inserted at the back of this manual for the voltage values of the oscillators installed in this unit.

Set the BAND switch to 2-4. Tune to 4 GHz and adjust R59 for the correct voltage at Pin 22 of A4B2. Next tune to 2 GHz and adjust R63 for the correct voltage at Pin 22. Repeat until both values are correct.

Set the BAND switch to 4-8 GHz. Tune to 8 GHz and adjust R40 for the correct voltage at Pin Z of A4B2. Next tune to 4 GHz and adjust R44 for the correct voltage at Pin Z. Repeat until both values are correct.

If the oscillator data sheet is not available, the above adjustments can be made by checking the harmonic output across each band. The trimmers should be adjusted for maximum power output across each band with the second harmonic not exceeding 20 dB. IN NO CASE SHOULD THE VOLTAGE AT PIN R (2-4 GHz) OR PIN Z (4-8 GHz) EXCEED +15 VOLTS.

Set the BAND switch to 8-12 GHz. Tune to 8 GHz and adjust R23 for the correct voltage at Pin E of A4B2. Next tune to 12 GHz and adjust R27 for the correct voltage at Pin E. Repeat until both values are correct.

Set the BAND switch to 12-18 GHz. Tune to 12 GHz and adjust R6 for the correct voltage at Pin 2 of A3B2. Next tune to 18 GHz and adjust R10 for the correct voltage at Pin 2. Repeat until both values are correct.

If the oscillator data sheet is not available, the adjustments for the 8-12 GHz and 12-18 GHz bands can be made by adjusting the trimmers for best power output across each band. IN NO CASE SHOULD THE VOLTAGE AT PIN E (8-12 GHz) OR PIN 2 (12-18 GHz) EXCEED +15 VOLTS.

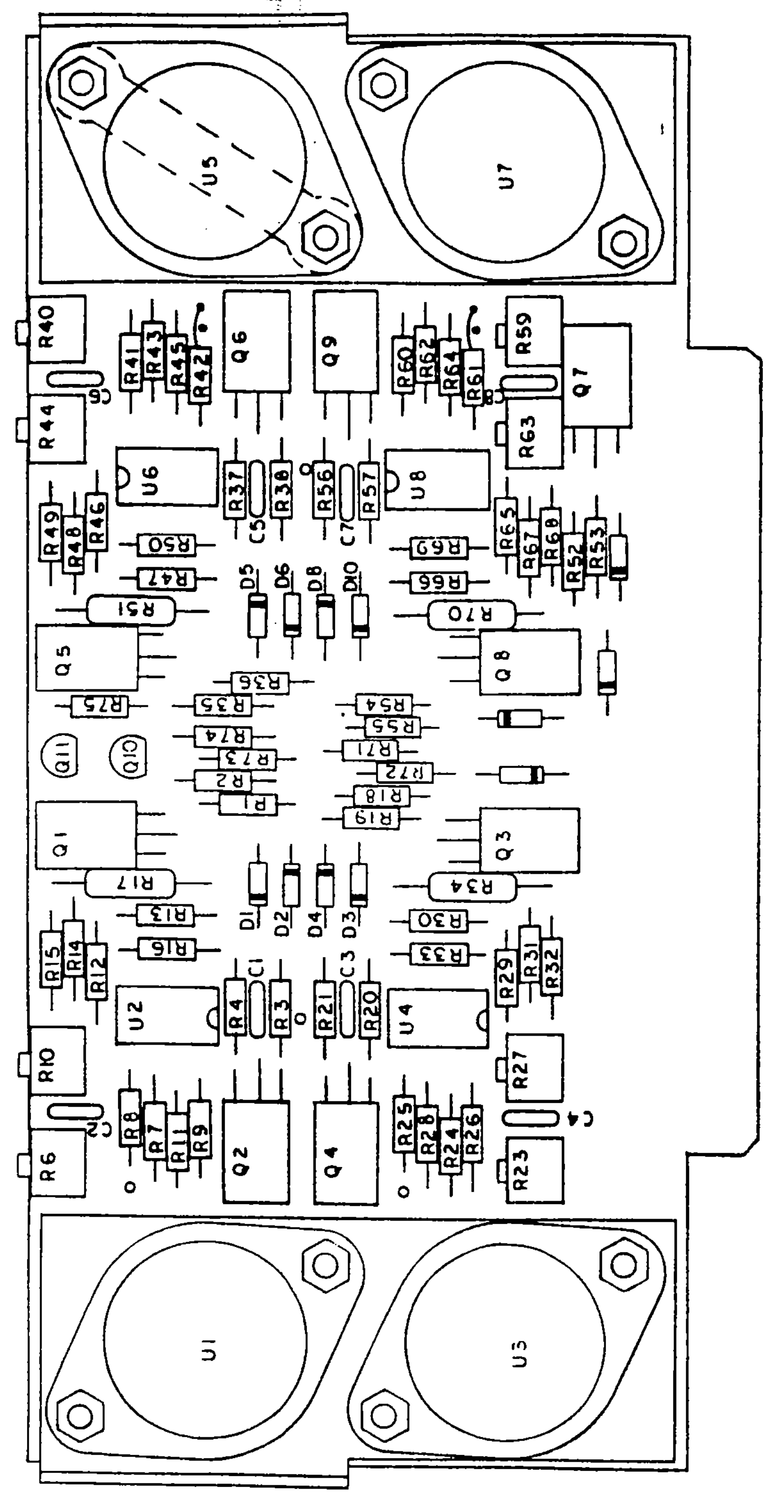
5.12.2.2 REPAIR

First check the following voltages to the A4B2 board.

A4B2 PIN	VOLTS	A4B2 PIN	VOLTS
A	GND	1	GND
D	+15	4	+15
~~C~~ F	-15	~~3~~ 6	-15
X	+15	R	+6

Check the bandswitch commands to A4B2. When the front panel BAND switch is set to .01-2 (Option 1) Pin V should be held near zero. For the 2-4 band, Pin U should be held near zero. For the 4-8 band, Pin 16 should be held near zero. For the 8-12 band, Pin J should be held near zero. Check that Pin 14 drops near zero for the .01-2 GHz and 2-4 GHz bands.

Switch the front panel BAND switch to the positions listed in the following table and note the typical voltage readings on the listed pins of A4B2 as the generator is tuned across each band. Actual voltage values may differ considerably because they depend on the characteristics of the oscillators used in a particular unit. It is important to note that the voltages appear only on the designated band.



Component Location, Oscillator Control Board

79-B-42-077 (A4B2)

Figure 5.21

BAND	PIN	VOLTAGE
.01-2 and 2-4	18	+2.0 to +4.4
	19	+2.1 to +4.6
	22	+3.0 to +6.8
	20	+15
	T	+10 to +15
4-8	15	+4.0 to +9.0
	17	+2.1 to +4.5
	W	+1.9 to +4.3
	Z	+8.9 to +15
8-12	7	+2.1 to +3.3
	E	+13 to +11
	H	+2.4 to +3.8
	L	+5.4 to +8.4
12-18	2	+11 to +6.7
	9 & K	+2.3 to +3.6
	12 & N	+2.8 to +4.3
	13 & P	+7.3 to +11

5.12.3 LEVEL BOARD (A4B7)

In addition to the leveling circuits, this board contains the FM driver and the BCD band decoding circuit for the RF Unit. Only the level circuits require alignment.

5.12.3.1 ALIGNMENT

Set the front panel LEVELED-UNLEVELED switch to its UNLEVELED position. Set the BAND switch to the 2-4 GHz band. Connect an RF power meter to the RF OUTPUT connector, and connect a digital voltmeter to A4B7J3 pin D. Adjust the front panel RF LEVEL control for +10 dBm and adjust R11 on A4B7A1 (2-18 GHz Det. Pre Amp) for +2.20 VDC. Connect a digital voltmeter to A4B7-D10 anode, and adjust the front panel RF LEVEL control for the power outputs listed below, and for each output, adjust the listed trimmer on A4B7 for the designated reading on the digital voltmeter.

POWER OUTPUT	ADJUST	VOLTS
+10 dBm	R27	+3.00
-10 dBm	R11	+1.00
0 dBm	R32	+2.00

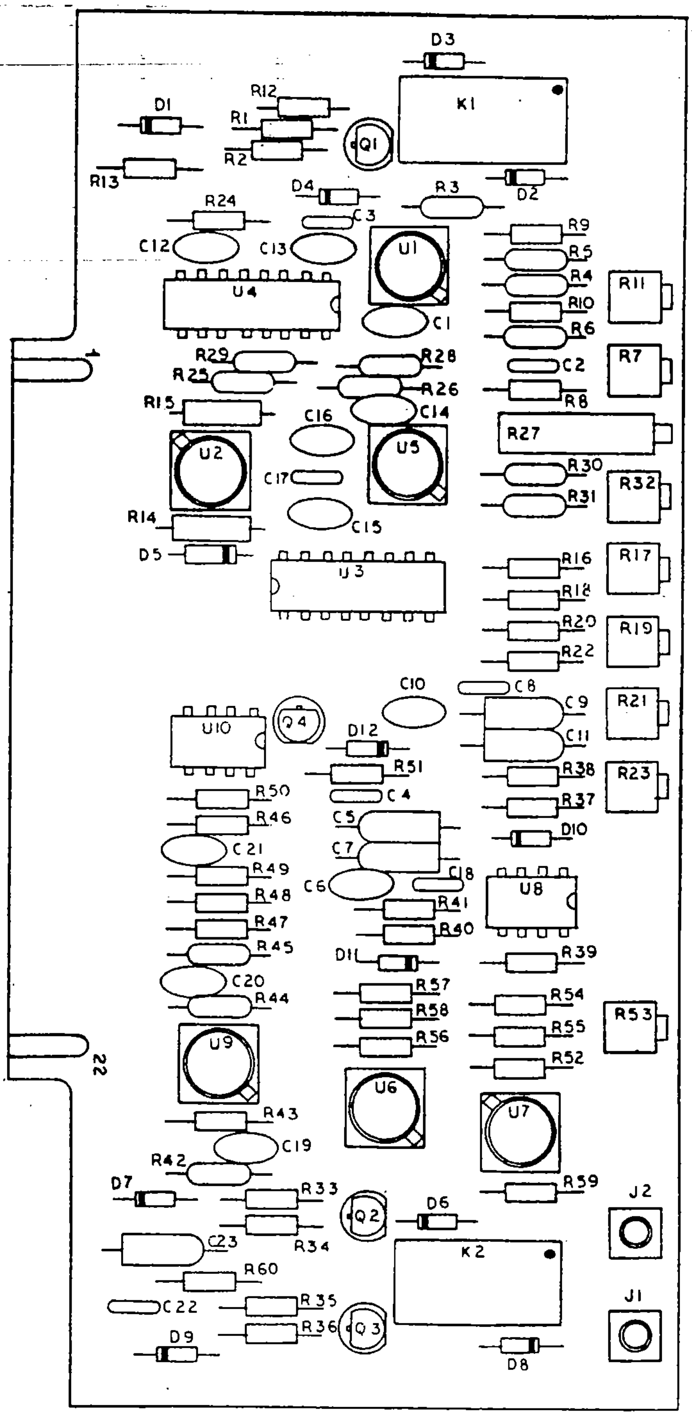
Repeat in the order listed until all readings are achieved. Monitor the output power with the RF power meter, not the front panel DBM meter. The meter calibration procedure is detailed in section 5.11.1.4.

Connect a crystal detector to the RF OUTPUT jack, and its output to a scope. Set the front panel MODULATION switch to INT AM and adjust the FREQ/PRF control for a 1000 Hz squarewave. Adjust A4B7-R53 for minimum overshoot of the square wave.

5.12.3.2 REPAIR

Check the power supply voltages to the board.

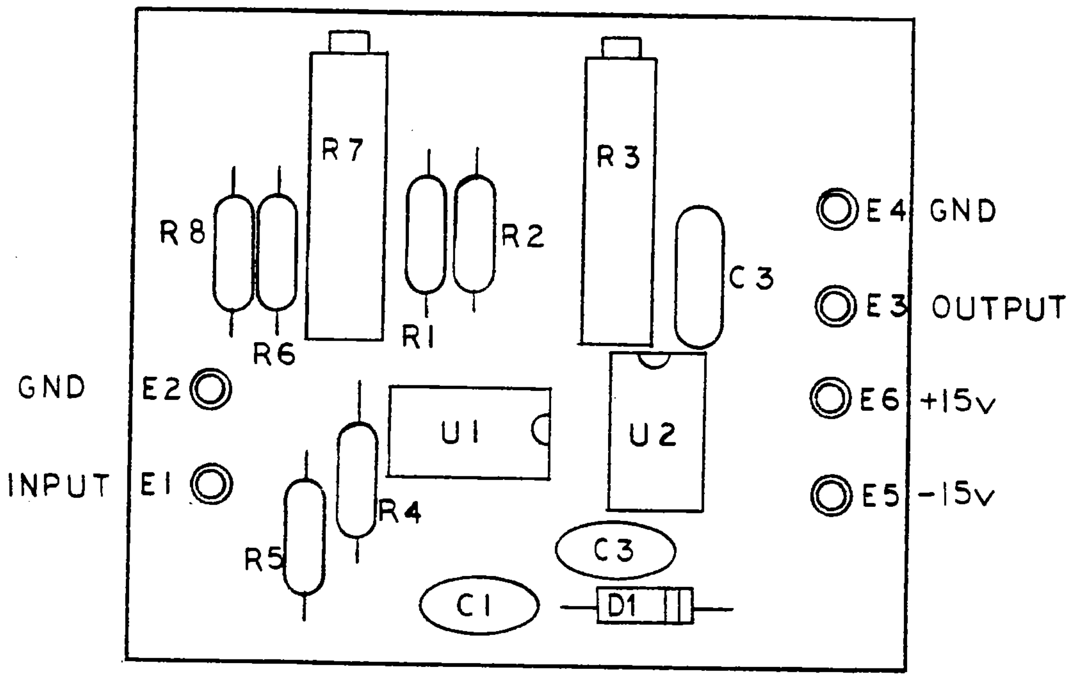
A4B7 PIN	VOLTS	A4B7 PIN	VOLTS
S	-15	15	-15
21,22	GND	4	GND
2	-6	17	+15
U	+15	19	+6.0
W	+6.0		



Component Location, Level Board

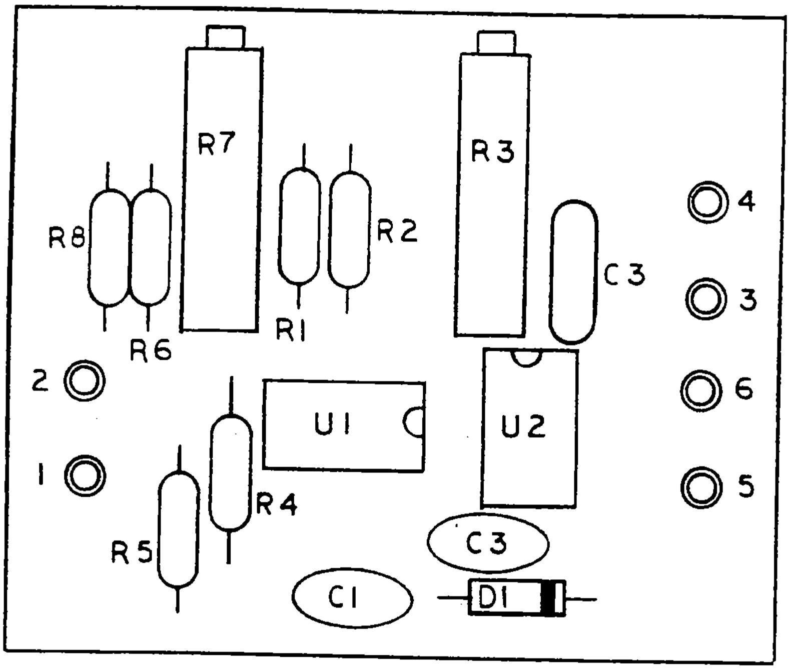
79-B-47-295 (A4B7)

FIGURE 5.22



Component Location, 2-18 GHz Det. Pre-Amp.
79A471-2 (A4B7A1)

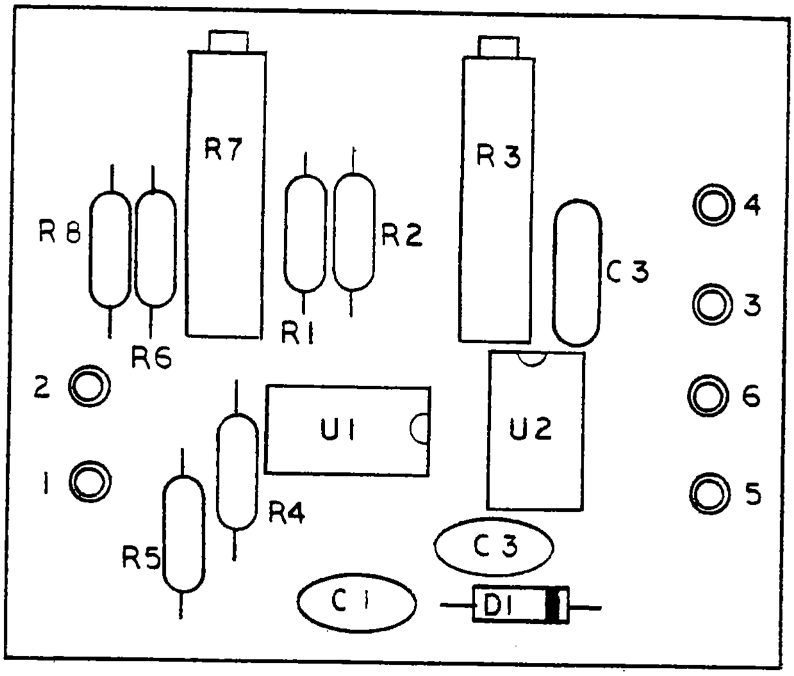
Figure 5.22-1



Component Location, Ext. Det. Pre-Amp.

79A472-2 (A4B7A2)

Figure 5.22-2



Component Location, .01-2 GHz Det. Pre-Amp.

79A473-2 (A4B7A3)

Figure 5.22-3

5.12.3.2.1 **BAND DECODER**

Rotate the front panel BAND switch to the positions listed below and verify the BCD band input command to U3 and its decoded output.

BAND	BAND DECODER			DECODER OUTPUT				
	Pin F	Pin H	Pin J	Pin 10	Pin 11	Pin 12	Pin L	Pin K
.01-2	+5.5	0	0	0	+18	+18	+18	+18
2-4	0	+5.5	0	+18	0	+18	+18	+18
4-8	+5.5	+5.5	0	+18	+18	0	+18	+18
8-12	0	0	+5.5	+18	+18	+18	0	+18
12-18	+5.5	0	+5.5	+18	+18	+18	+18	0

5.12.3.2.2 **FM DRIVER**

Check that relay K1A is energized when the front panel MODULATION switch is set to its INT FM position. Check the following voltages at U2.

	1	2	4	6	7	8
U16	+15	+14	0	-14	-15	0

Connect a scope to the junction of R90, R91, R92, R93 and Pin 4 of U16, and verify the presence of a sine wave having an amplitude of 2 volts peak-to-peak. The frequency should vary with the front panel FREQ/PRF control. If the internal FM operates in some bands and not others, trace the wires from the particular YIG oscillator FM coil terminals to the corresponding pins of A4B7.

5.12.3.2.3 **ALIGNMENT**

Set the front panel MODULATION switch to INT FM and FREQ/PRF control for 1 kHz. Connect the RF OUTPUT to spectrum analyzer and measure internal FM deviation with FM deviation control set for ±5 MHz. Using the chart below adjust the corresponding adjustment on A4B7 for correct deviation.

BAND	A4B7 ADJUSTMENT	DEVIATION
.01-2 & 2-4	R17	±5 MHz
4-8	R19	±5 MHz
8-12	R21	±5 MHz
12-18	R23	±5 MHz

5.12.3.2.4 LEVELER

Set the rear panel ALC switch to INT and the front panel BAND switch to 2-4. Check for continuity between Pin D and U4 Pin 4 of A4B7. Pins A and Y should be at +6 volts.

	E	B	C
Q1	+6	+6	0
Q3	+6	+6	0

Set the BAND switch to .01-2 GHz, if Option 1 is installed, and check for continuity between Pin E and U4 Pin 4. Pin A should be near zero volts.

	E	B	C
Q1	+6	+0.7	+5.5
Q3	+6	+6	0

Set the rear panel ALC switch to EXT, and check for continuity between Pin Z and K2A Pin 15. Pin Y should be near zero volts.

	E	B	C
Q1	+6	+0.7	+5.5
Q3	+6	+0.7	+5.5

Set the rear panel ALC switch to INT.

Tune the generator to 3.0 GHz CW in the 2-4 GHz band. Set the output power to 0 dBm in the LEVELED position. If the fault prevents setting the power, adjust the RF LEVEL control for +2.0 volts at pin 6 of U5.

	1	2	3	4
U1	+3.5	-0.2	-0.2	-5.2
U5	--	+2.4	+2.4	-15
U7	+15	+15	--	+0.3
U8	+2.0	+2.0	+2.0	-15
U9	--	+2.0	+2.0	-15
U10	+0.7	+0.7	+0.7	-15

	5	6	7	8
U1	+3.3	-4.5	+6.0	--
U5	+12	+2.0	+15	--
U7	--	-15	-15	+0.3
U8	+1.6	+1.6	+1.6	+15
U9	--	+1.8	+15	--
U10	+1.8	+1.8	-12.8	+15

	2	4	5	6	7
U4	-6.0	-0.2	+5.2	+5.5	0

	8	9	10	11	12
U4	+6.0	-3.4	+5.5	+5.2	GND

	E	B	C
Q2	+6	+6	0
Q4	0	-0.6	+6

Switch to UNLEVELED and check the voltages listed below. The UNLEVELED lamp should come on.

	E	B	C
Q2	+6	+5.1	+5.7
Q4	0	+0.8	+0.3

5.12.4 PIN DRIVER (A4B14)

The circuits on this board switch the output of the Level Board (A4B7) to one of the four arms of PIN switch Z9. This selects the correct oscillator for the selected band, and adjusts the power output as required by the leveling circuits.

5.12.4.1 ALIGNMENT

Connect a digital voltmeter to Pin 10 of A4B14 and adjust R25 for approximately +1.0 volt. In some units, further adjustment of this trimmer may be required to provide correct operation in Pulse mode.

5.12.4.2 REPAIR

Check the following voltages to the board.

A4B14 PIN	VOLTS	A4B14 PIN	VOLTS
1	+15	4	-5.0
2	+6.0	5	GND
3	-15	10	+1.0

Set the MODE switch to CW and the LEVELED/UNLEVELED switch to UNLEVELED. Check that the rear panel ALC switch is as its INT position. Adjust the front panel RF LEVEL control for exactly -1.0 volt at J1 of A5B14.

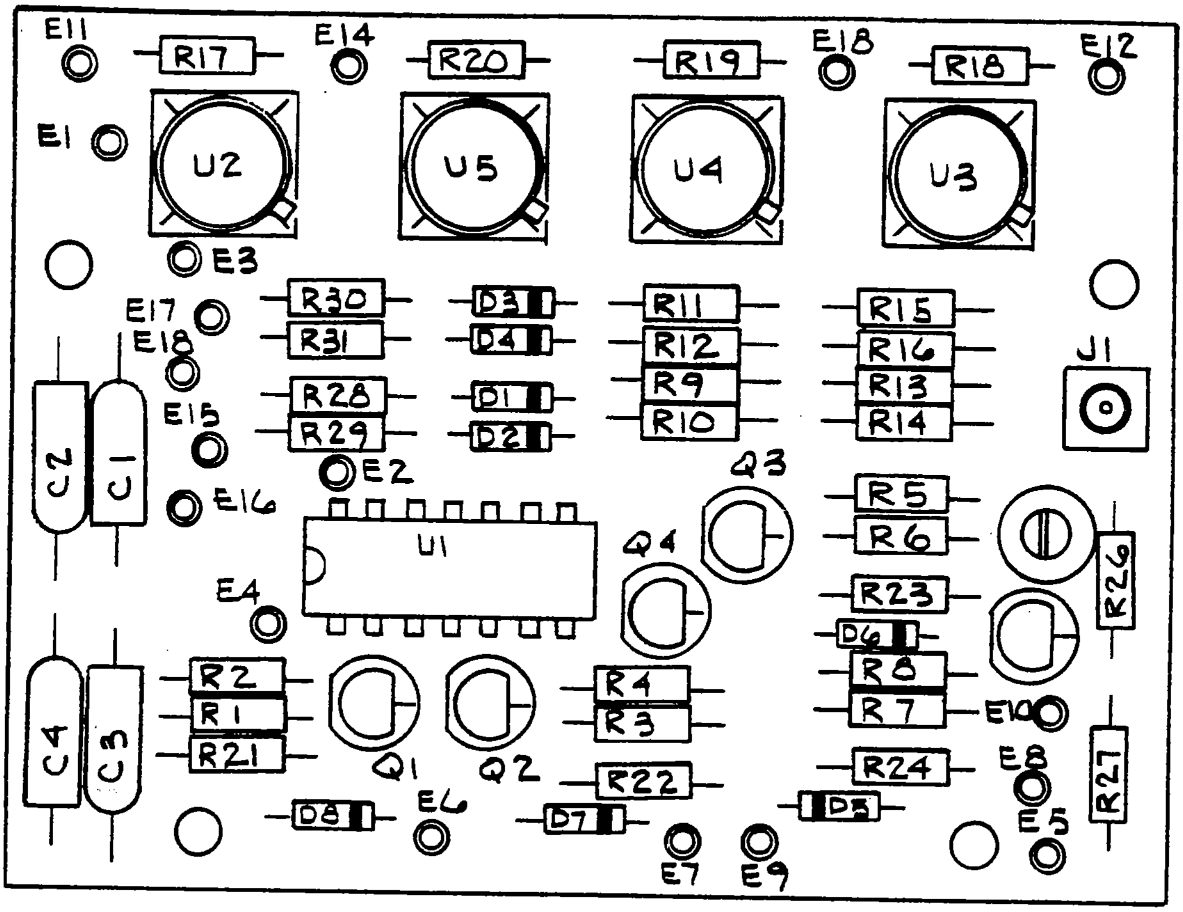
Check the voltages at Pins 6, 7, 8 and 9 of A4B14 for each position of the BAND switch.

BAND	PIN 6	PIN 7	PIN 8	PIN 9
.01-2	+1	+18	+18	+18
2-4	+1	+18	+18	+18
4-8	+18	+.3	+18	+18
8-12	+18	+18	+.3	+18
12-18	+18	+18	+18	+.3

Check the voltages at Q1, Q2, Q3 and Q4 for each position of the BAND switch.

	Q1			Q2		
BAND	E	B	C	E	B	C
.01-2	0	+.3	+1.6	0	+.7	+.1
2-4	0	+.3	+1.6	0	+.7	+.1
4-8	0	+.7	+.1	0	+.1	+1.6
8-12	0	+.7	+.1	0	+.7	+.1
12-18	0	+.7	+.1	0	+.7	+.1

	Q3			Q4		
BAND	E	B	C	E	B	C
.01-2	0	+.7	+.1	0	+.7	+.1
2-4	0	+.7	+.1	0	+.7	+.1
4-8	0	+.7	+.1	0	+.7	+.1
8-12	0	+.1	+1.6	0	+.7	+.1
12-18	0	+.7	+.1	0	+.1	+1.6



Component Location, PIN Driver

79-B-414-119 (A4B14)

Figure 5.23

Check the voltages on U1 for each position of the BAND switch. Pin 1 is at +5.0 volts, Pin 14 is at +6.0 volts, and Pin 7 is ground.

BAND	2	3	4 & 5	6
.01-2	+1.6	-3.7	+.1	+5.2
2-4	+1.6	-3.7	+.1	+5.2
4-8	+.1	+5.2	+1.6	-3.8
8-12	+.1	+5.2	+.1	+5.2
12-18	+.1	+5.2	+.1	+5.2

BAND	8	9 & 10	11	12 & 13
.01-2	+5.2	+.1	+5.2	+.1
2-4	+5.2	+.1	+5.2	+.1
4-8	+5.2	+.1	+5.2	+.1
8-12	-3.8	+1.6	+5.2	+.1
12-18	+5.2	+.1	-3.8	+1.6

Check the voltages on U2, U3, U4 and U5 for each position of the BAND switch. Pins 1 and 2 are at +15 volts. Pins 6 and 7 are at -15 volts.

	U2		U3	
BAND	8	4	8	4
.01-2	-1	-1	+3	+3
2-4	-1	-1	+3	+3
4-8	+3	+3	-1	-1
8-12	+3	+3	+3	+3
12-18	+3	+3	+3	+3

	U4		U5	
BAND	8	4	8	4
.01-2	+3	+3	+3	+3
2-4	+3	+3	+3	+3
4-8	+3	+3	+3	+3
8-12	-1	-1	+3	+3
12-18	+3	+3	-1	-1

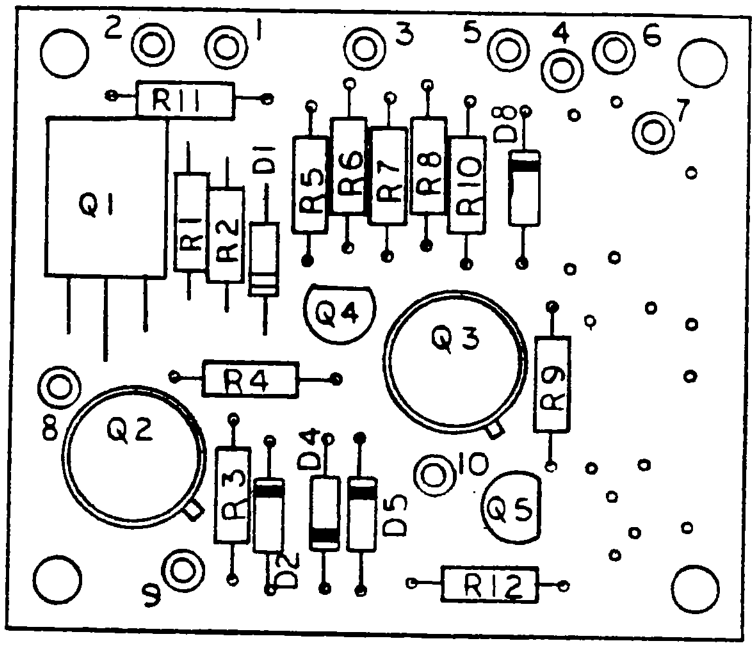
Check the voltages at 11, 12, 13 and 14 for each position of the BAND switch.

BAND	11	12	13	14
.01-2	-.3	+1.2	+1.2	+1.2
2-4	-.3	+1.2	+1.2	+1.2
4-8	+1.2	-.3	+1.2	+1.2
8-12	+1.2	+1.2	-.3	+1.2
12-18	+1.2	+1.2	+1.2	-.3

5.13 10 MHz TO 2 GHz - OPTION 1

The output of YIG oscillator Z1 is tracked to cover 2.310 to 4.300 GHz for this band, and its output is converted by a fixed-tuned 2.300 GHz oscillator to the frequency range of 10 MHz to 2 GHz. The only alignment required is that of the YIG oscillator tracking, which is covered in 5.9.1.

The only components added for this option are located in the RF Unit. Refer to Figure 7.13. Except for Relay Driver A4B8, all items are replaced as components, and have the following nominal specifications.



Component Location, Relay Driver

79-A-48-173 (A4B8)

Figure 5.24

Mixer Z16	10 dB conversion loss
Oscillator Z17	+10 dBm power output
Amplifier Z18	34 dB gain
Filter Z19	2 dB insertion loss

Set the front panel BAND switch to .01-2 and note that pin 5 of A4B8 is at less than +0.5 volts, pin 2 of K3 is less than +0.5 volts, and +24 volts is applied to pin 1 of K3. If not, check the following voltages on A4B8.

	E	B	C
Q2	+24	+23	+24
Q3	+24	+24	0
Q4	+2	+3	+2
Q5	—	+0.2	+24

For the 2-4, 4-8, 8-12 and 12-18 positions of the BAND switch, pin 1 of A4B8 should be at approximately +10 volts, pin 1 of relay K3 at less than +0.5 volts, and pin 2 of relay K3 at +24 volts. If not, check the following voltages on A4B8.

	E	B	C
Q2	+24	+24	0
Q3	+24	+23	+24
Q4	—	+0.3	+24
Q5	—	+0.7	+0.2

5.14 STEP ATTENUATOR - OPTIONS 2 AND 2A

These options add a step attenuator in the RF Unit. The attenuator for Option 2 has three sections of 10, 20 and 40 dB for a range of 70 dB in 10 dB steps. The attenuator for Option 2A has four sections of 10, 20, 40 and 40 dB for a range of 110 dB in 10 dB steps. The attenuator driver board (A4B12) is also in the RF Unit. The only additions to the mainframe are a front panel attenuator switch and the attenuator control board (A6). The latter switches control of the attenuator to either the front panel switch or the rear panel REMOTE CONTROL INPUT connector. No alignment is reuired for this option.

5.14.1 ATTENUATOR CONTROL BOARD (A6)

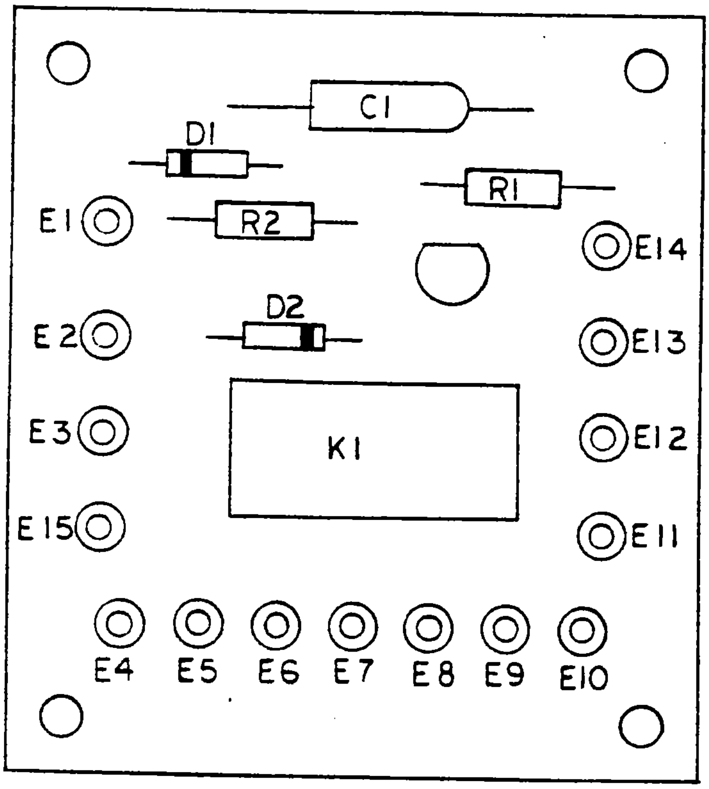
Relay K1 is operated when the remote attenuator enable line (Pin 15 of the rear panel REMOTE CONTROL INPUT connector) is grounded. This connects directly to terminal 1 of A6, and switches the collector of Q1 from 0 to +5.8 volts to energize K1.

With K1 de-engergized, the BCD signal to the attenuator driver board (A4B12) in the RF Unit is taken from the front panel DB switch. With K1 energized, the BCD signal is taken from the rear panel REMOTE CONTROL INPUT connector. Refer to Figure 2.1.

5.14.2 ATTENUATOR DRIVER BOARD (A4B12)

First check that +6.0 volts is on terminal E5 and that +24 volts is on terminal E15. Next check that the BCD signal to this board is correct.

DB	E1	E2	E3	E4
0	0	0	0	0
10	+5.9	0	0	0
20	0	+5.9	0	0
30	+5.9	+5.9	0	0
40	0	0	+1.9	0



Component Location, Attenuator Control

79-A-60-95 (A6)

Figure 5.25

DB	E1	E2	E3	E4
50	+5.9	0	+1.9	0
60	0	+5.9	+1.9	0
70	+5.9	+5.9	+1.9	0
80	0	0	0	+5.9
90	+5.9	0	0	+5.9
100	0	+5.9	0	+5.9
110	+5.9	+5.9	0	+5.9

Set the attenuator control to 0 dB and check the following voltages.

	1	2	3	4	5	6	7
U1	0	+5.9	0	+5.9	0	+5.9	GND

	8	9	10	11	12	13	14
U1	+5.9	0	0	+5.9	+5.9	0	+6.

	1	2	3	4	5	6	7	8
U2	+6	0	0	0	+24	+5.9	+6	+6
U3	+6	0	0	0	+24	+5.9	+6	+6
U4	+6	0	0	0	+24	+5.9	+6	+6
U5	+6	0	0	0	+24	+5.9	+6	+6

E6	E7	E8	E9	E10	E11	E12	E13
0	+24	0	+24	0	+24	0	+24

Set the attenuator control to 10 dB and check the following voltages

	1	2	3	4	5	6	7	8
U1	+5.9	0	--	--	--	--	--	--

	1	2	3	4	5	6	7	8
U2	+6	+5.9	+24	0	0	0	+6	+6

E6	E7
+24	0

Set the attenuator control to 20 dB and check the following voltages.

	1	2	3	4	5	6	7	8
U1	--	--	+5.9	0	--	--	--	--
U3	+6	+5.9	+24	0	0	0	+6	+6

E8	E9
+24	0

Set the attenuator control to 40 dB and check the following voltages.

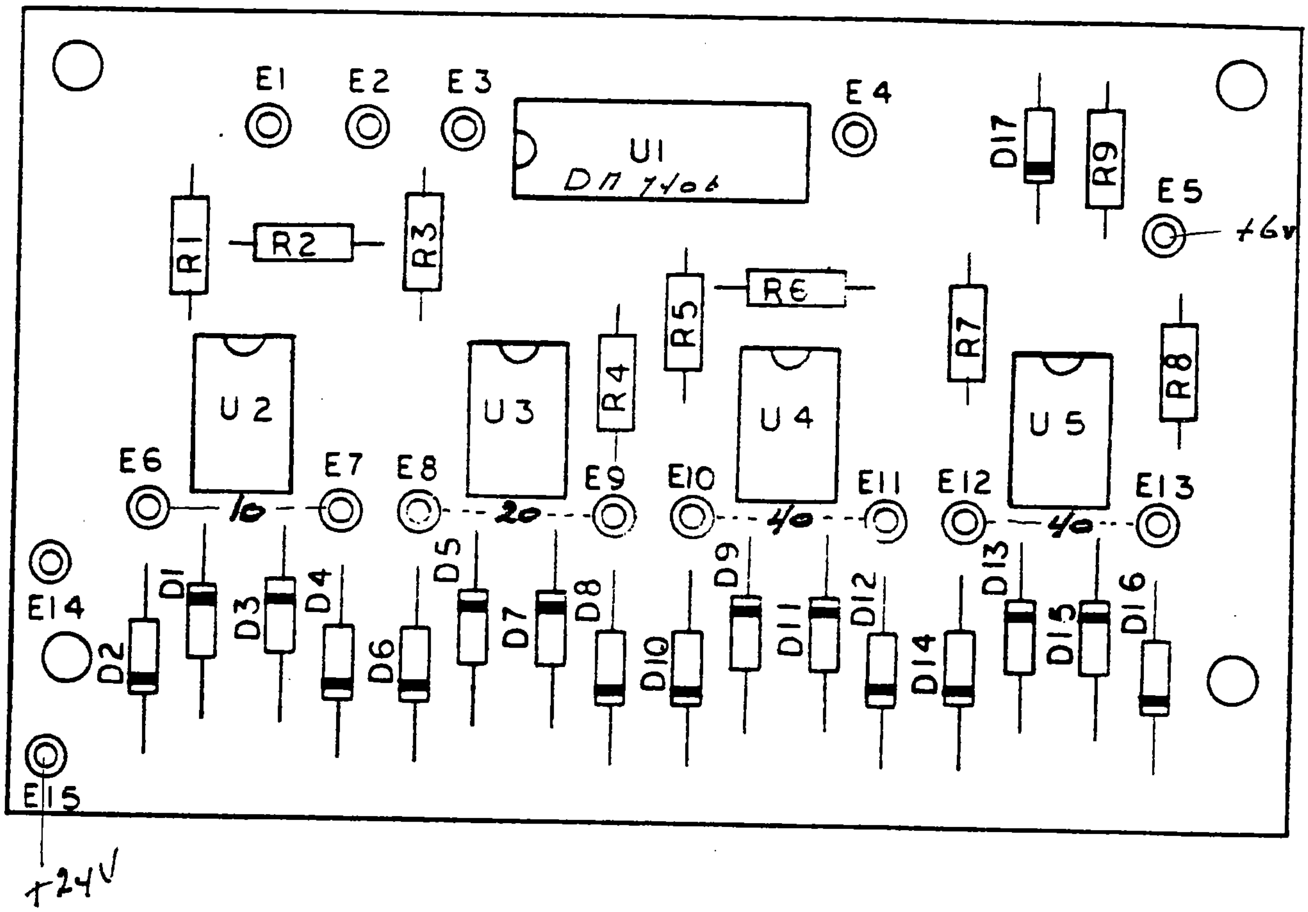
	5	6	8	9	10	11	12	13
U1	+5.9	0	+5.9	0	+5.9	0	0	+1.0

	1	2	3	4	5	6	7	8
U4	+6	+5.9	+24	0	0	0	+6	+6

E10	E11
+24	0

Set the attenuator control to 80 dB (Option 2A only) and check the following voltages.

	5	6	8	9	10	11	12	13
U1	+5.9	0	0	+5.9	+5.9	0	0	0



Component Location, Attenuator Driver

79-A-412-168 (A4B12)

Figure 5.26

	1	2	3	4	5	6	7	8
U4	+6	+5.9	+24	0	0	0	+6	+6
U5	+6	+5.9	+24	0	0	0	+6	+6

E10	E11	E12	E13
+24	0	+24	0

5.15 OUTPUT FILTER - OPTIONS 3 AND 3A

Option 3 adds a tracked YIG filter in the 2 to 18 GHz output line. Option 3A includes the components and circuits of Option 3, and also adds a filter in the .01 to 2 GHz (Option 1) output, but the filter tunes only .40 to 2 GHz. Option 3A can be included only if the SG-811 has Option 1.

The circuits which generate the YIG tuning currents for both filters are on printed circuit board A3B9 in the mainframe. Each filter is located in the RF Unit with its relay and relay driver.

5.15.1 ALIGNMENT

The adjustments on A3B9 compensate for the manufacturing tolerances of the YIG filters. Set the front panel FILTER PEAK control at its midpoint, the FILTER switch to its on position, and the MODE switch to CW. Connect an RF power meter to the generator. The front panel DBM meter can be used if the filters are not too far out of alignment.

Set the BAND switch and tuning controls for the following frequencies, and adjust the designated trimmers on A3B9 for maximum power output.

BAND	FREQUENCY	ADJUST
.01-2	.40	1 LO
.01-2	2.00	1 HI
2-4	2.00	2 LO
2-4	4.00	2 HI
4-8	4.00	3 LO
4-8	8.00	3 HI
8-12	8.00	4 LO
8-12	12.00	4 HI
12-18	12.00	5 LO
12-18	18.00	5 HI

5.15.2 REPAIR

First check that the transfer relays (K2 for 2-18 GHz and K4 for .40-2 GHz) in the RF Unit are operating.

For bands 2-4, 4-8, 8-12 and 12-18, pin 1 of K2 should be at 0 volts, and pin 2 at +24 volts when the front panel FILTER switch is on. When it is in its OFF position, pin 1 of K2 should be at +24 volts, and pin 2 at 0 volts.

For the .01-2 band (Option 3A only), pin 1 of K4 should be at +24 volts, and pin 2 at 0 volts when the front panel FILTER switch is on. When it is in its OFF position, pin 1 of K4 should be at 0 volts, and pin 2 at +24 volts.

If the relay switching is incorrect, check the relay driver boards.

5.15.2.1 RELAY DRIVER (A4B5)

Set the front panel FILTER switch to its on position,, and tune the generator to 3.00 GHz in the CW mode, Check the following voltages on A4B5.

E1	E2	E3	E4	E5
+1.9	0	+24	+24	0

E6	E7	E8	E9	E10
0	+0.6	+1.2	+24	0

	E	B	C
Q1	+1.9	+1.2	+1.2
Q2	+24	+23	+24
Q3	+24	+24	0
Q4	0	+.7	+.2
Q5	0	+.2	+24

Next set the FILTER switch to OFF, and check the following voltages on A4B5.

E1	E2	E3	E4	E5
+17	0	+24	+8.2	+8.1

E6	E7	E8	E9	E10
0	0	0	0	+24

Q1	+17	+17	0
Q2	+24	+24	0
Q3	+24	+23	+24
Q4	0	+.2	+24
Q5	0	+.7	+.1

5.15.2.2 RELAY DRIVER (A4B10) (OPTION 3A ONLY)

Set the front panel FILTER switch to its on position, and tune the generator to 1.50 GHz in the CW mode, Check the following voltages on A4B10.

E1	E2	E3	E4	E5
+5.7	0	+24	+24	0

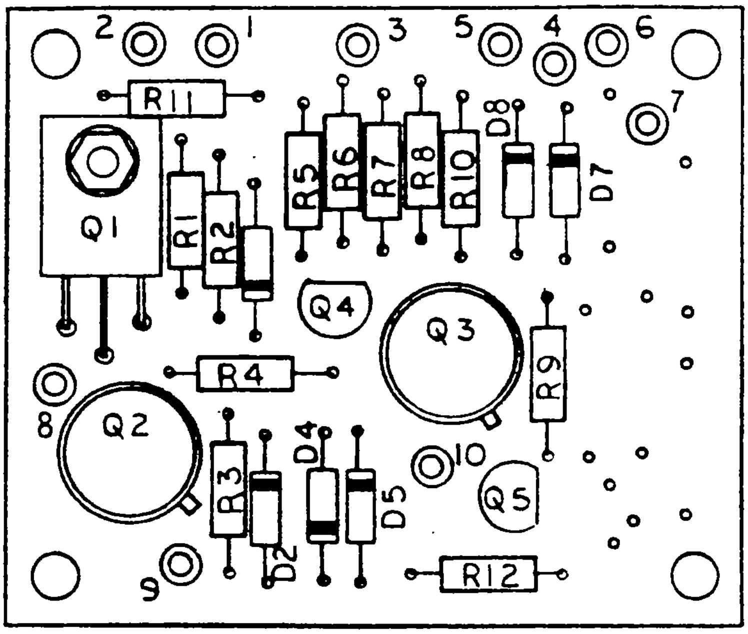
E6	E7	E8	E9	E10
+.1	+.6	+5.6	+24	0

	E	B	C
Q1	+5.7	+5.0	+5.6
Q2	+23	+5.0	+5.6
Q3	+24	+24	0
Q4	0	+.7	+.8
Q5	0	+.2	+24

Next set the FILTER switch to OFF, and check the following voltages on A4B10.

E1	E2	E3	E4	E5
+17	0	+24	0	+8.1

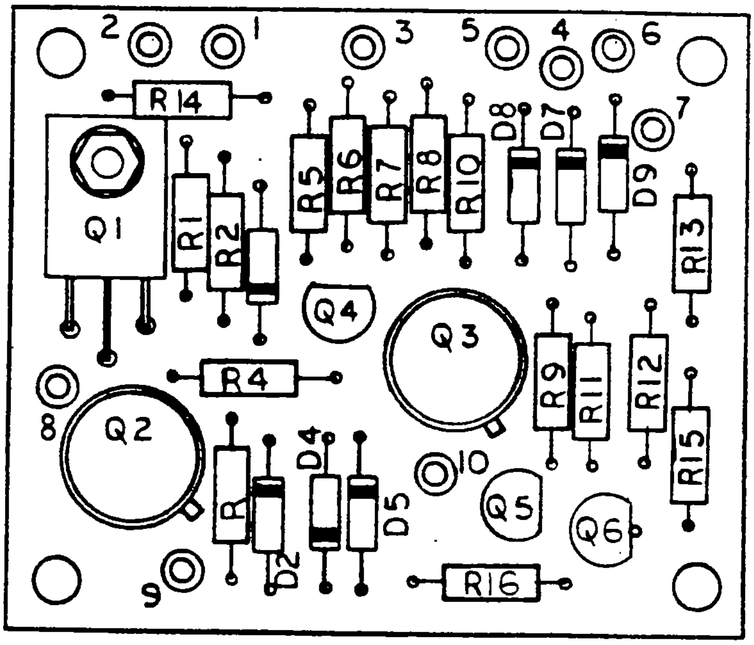
E6	E7	E8	E9	E10
+.1	0	0	0	+24



Component Location, Relay Driver

79-A-45-172 (A4B5)

Figure 5.27



Component Location, Relay Driver

79-A-410-174 (A4B10)

Figure 5.28

	E	B	C
Q1	+17	+17	0
Q2	+24	+24	0
Q3	+24	+23	+24
Q4	0	+.2	+24
Q5	0	+.7	+.1

5.15.2.3 FILTER TRACKING/DRIVER (A3B9)

Check the following voltages at the connector pins of the board.

A3B9 PIN	VOLTS	A3B9 PIN	VOLTS
A	GND	K	GND
B	+15	1	GND
C	+15	2	+15
D	+6	3	+15
E	-6	4	+6
F	-15	5	-6
H	+11.0	6	-15

Check that the BCD band command is present at the connector pins and at the integrated circuit switches.

BAND	Pin 10 A3B9 Pin 11 U2, U3, U9
.01-2	+6
2-4	+0.1
4-8	+6
8-12	+0.1
12-18	+6

BAND	Pin 11 A3B9 Pin 10 U2, U3, U9
.01-2	+0.1
2-4	+6
4-8	+6
8-12	+0.1
12-18	+0.1

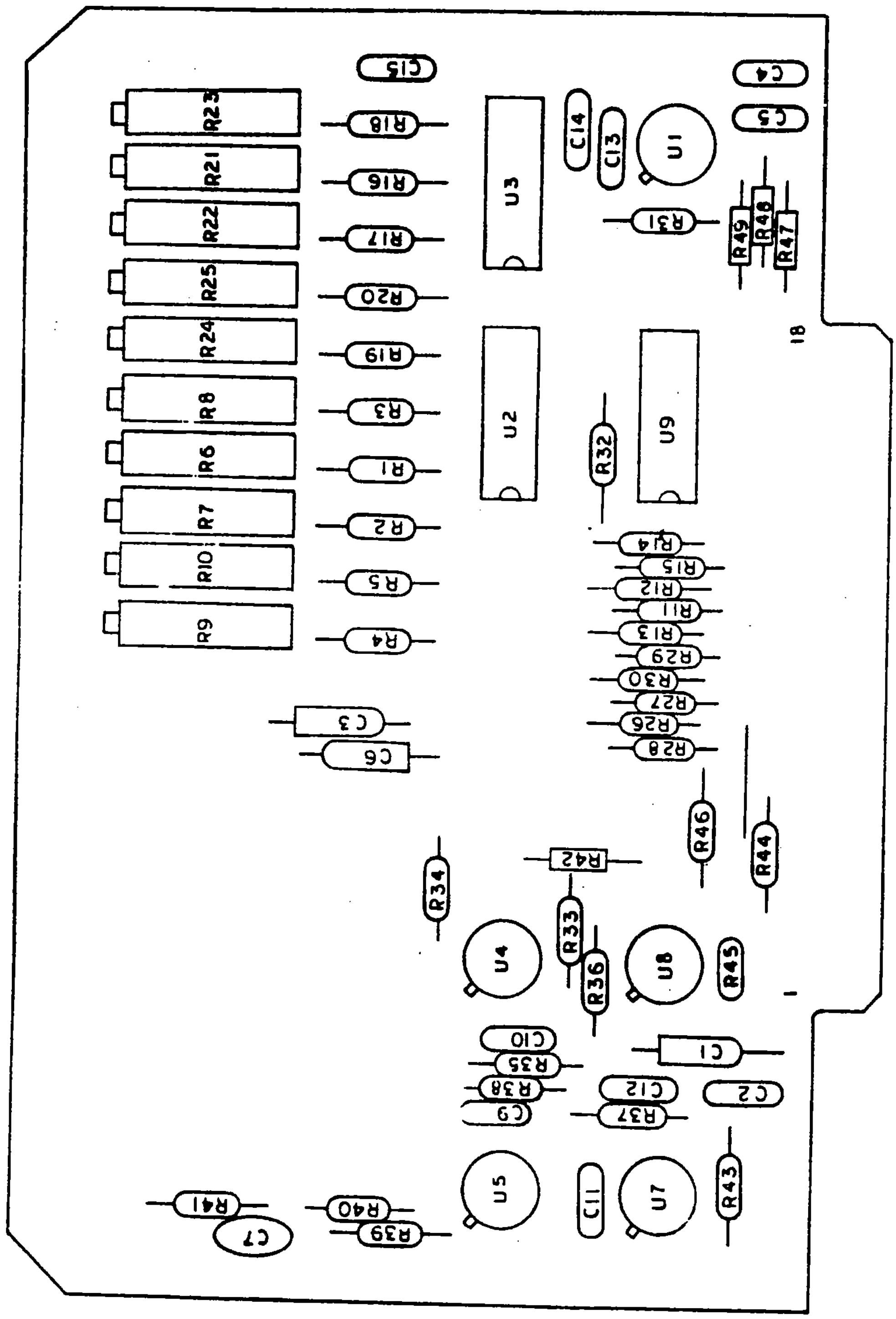
BAND	Pin 12 A3B9 Pin 9 U2, U3, U4
.01-2	+0.1
2-4	+0.1
4-8	+0.1
8-12	+6
12-18	+6

With the MODE switch at CW and the BAND switch at 2-4, select the M_3 tuning control. Check that the voltage at pin 18 of A3B9 varies from 0 to +9 volts as the M_3 control is rotated thru its full range. Then adjust it for +6.0 volts at pin 18 and check the following voltages.

A3B9 PIN	VOLTS
P	+2.8
R	+2.0
S	+.7
T	+.7

A3B9 PIN	VOLTS
14	+2.0
15	0
16	+.7

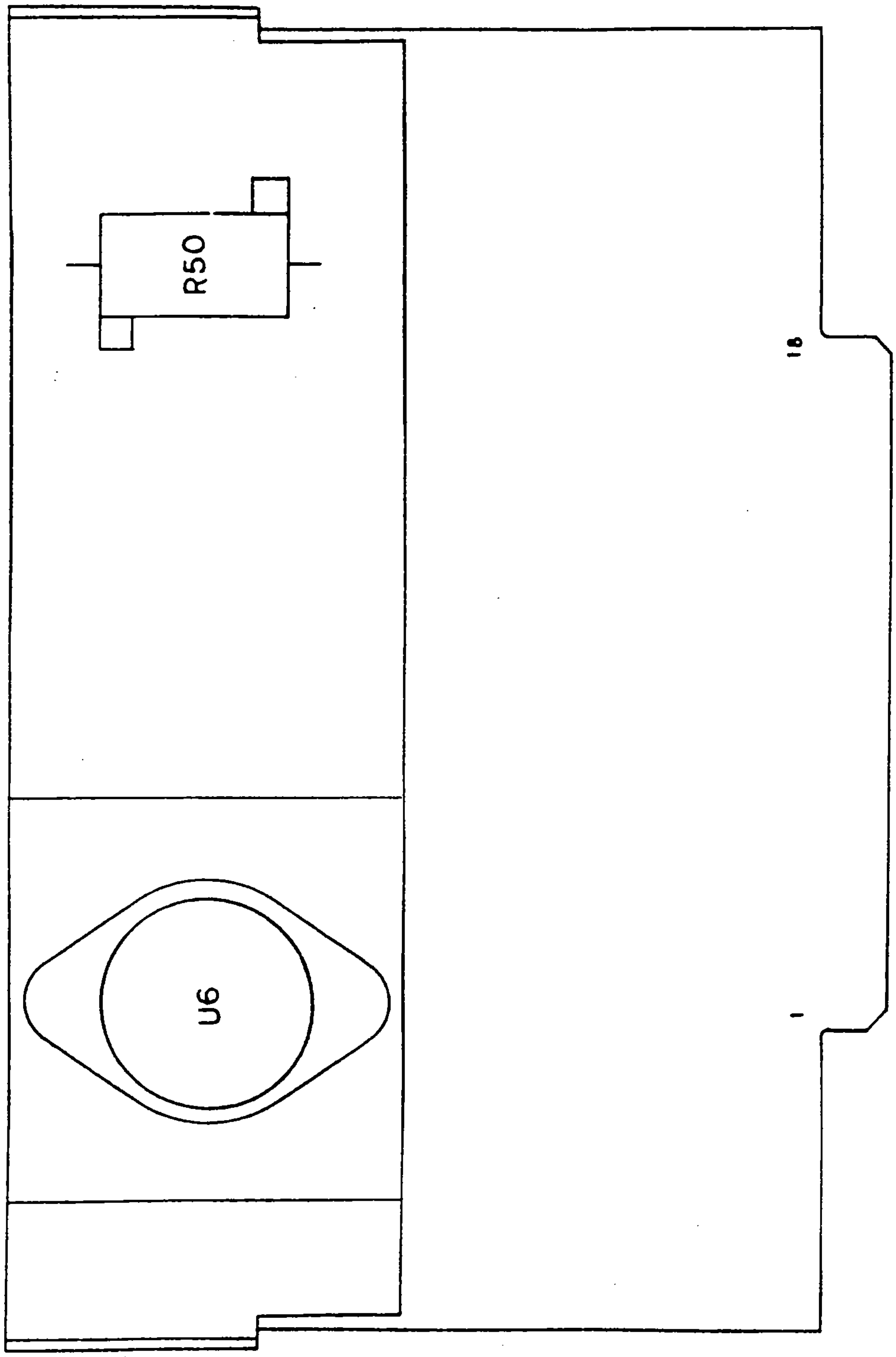
	2	3	4	6	7
U1	+6	+6	-15	+6	+15



Component Location, Filter Tracking/Driver

79-B-39-047 (Sheet 1 of 2) (A3B9)

Figure 5.29



Component Location, Filter Tracking/Driver

79-B-39-047 (Sheet 2 of 2) (A3B9)

Figure 5.29

	1	5	12	14	15
U2	+3.0	+4.7	+1.5	+.1	+.7
U3	+1.1	+1.7	+1.1	+1.4	+.6

Pins 2, 4, 6, 8 and 13 of U2, U3 and U9 are ground. The voltage at pin 3 depends on the postion of the BAND switch. These circuits are switches. Typical voltages and switching logic are shown below.

BAND	Pin 3 TO	Pin 3, U2
.01-2	Pin 14	+.1
2-4	Pin 15	+.7
4-8	Pin 12	+1.5
8-12	Pin 1	+3.1
12-18	Pin 5	+4.7

BAND	Pin 3 TO	Pin 3, U3
.01-2	Pin 14	+1.5
2-4	Pin 15	+.6
4-8	Pin 12	+1.1
8-12	Pin 1	+1.1
12-18	Pin 5	+1.7

BAND	Pin 3 TO	Pin 3, U9
.01-2	Pin 14	+.7
2-4	Pin 15	+.6
4-8	Pin 12	+1.3
8-12	Pin 1	+2.1
12-18	Pin 5	+3.2

Set the BAND Switch to 2-4 and check the following voltages.

	2	3	4	6	7
U4	+.7	+.7	-15	+.7	+15
U5	+.7	+.7	-15	+1.9	+18
U6	+18	0	+1.0	+1.9	-15
U7	+.7	+.7	-15	+.7	+15
U8	+.6	+.6	-15	+.6	+15

5.16 RF SAMPLE - OPTION 4

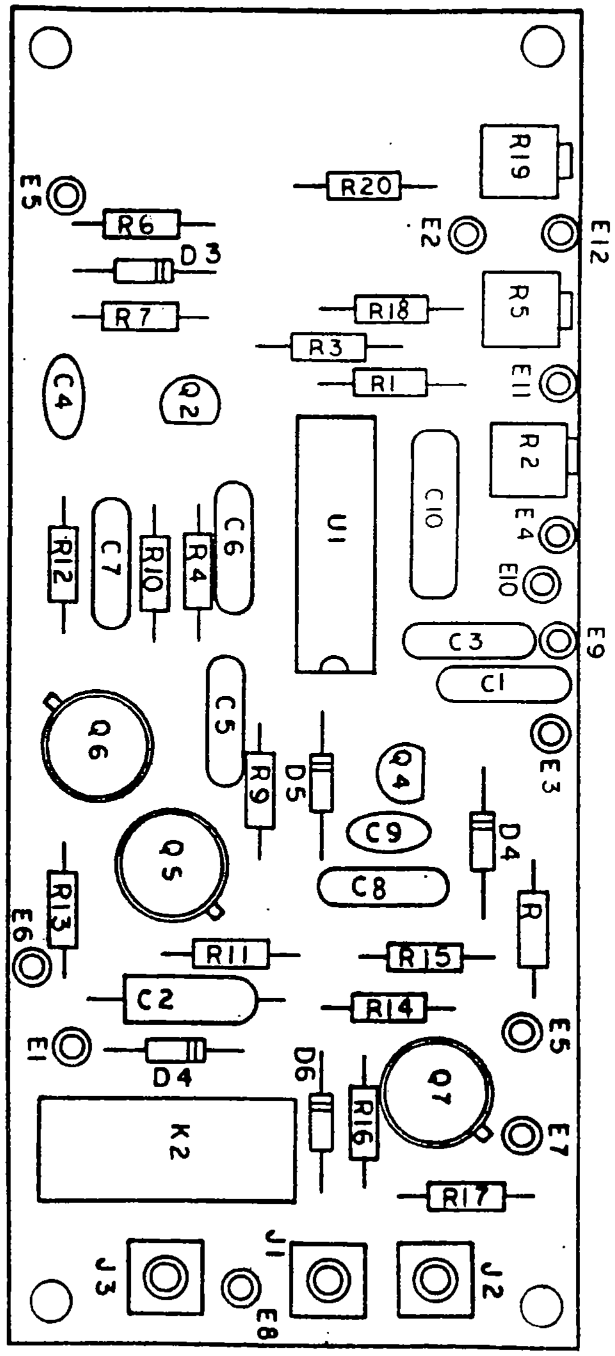
Refer to Figure 7.13. This option adds a directional coupler to each of the four YIG oscillator outputs, and switch Z9A to connect the coupler outputs to the single RF SAMPLE output connector. The switch Z9A is identical to switch Z9. Both are controlled by the same driver circuits located on A4B14. Refer to 5.12.4.2.

5.17 INTERNAL PULSE GENERATOR OPTION 5

Pin pulser Z12 is added in the RF Unit. It is switched in series with the YIG oscillator output (2-18 GHz) by relay K1. Refer to Figure 7.13. The PIN pulser is driven by the Pulse Generator (A7) in the mainframe.

5.17.1 ALIGNMENT

Set the front panel PULSE WIDTH control to 1, multiiplier switch to X.1 position and MODULATION switch to INT PULSE. Connect a scope with 50 ohm termination to A4P8, adjust the corresponding resistor on A7 per the following table. NOTE: The pulse may also be observed at the RF OUTPUT using and RF detector and scope.



Component Location, Pulse Generator

79-B-70-149 (A7)

FIGURE 5.30

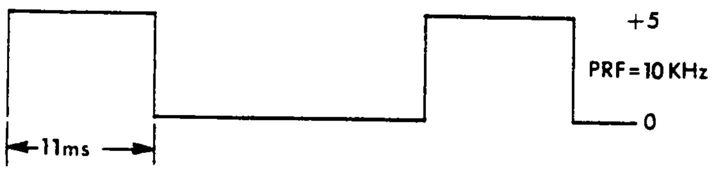
MULTIPLIER SWITCH	PULSE WIDTH CONTROL	PULSE WIDTH	ADJUST (A7)
X.1	CCW	.09 us	R2
X1	CCW	1 us	R5
X10	CCW	10 us	R19

5.17.2 REPAIR

PIN switch Z12 is a replaceable component. First check the pulse output from J1 of A7 to determine whether the fault is in the mainframe or RF Unit. If in the RF Unit, check for proper operation of relay K1A and K1B.

5.17.2.1 PULSE GENERATOR (A7)

Set the front panel MODULATION switch to INT PULSE, the PULSE WIDTH control fully clockwise, multiplier switch to the X1 position, and the FREQ/PRF control fully clockwise in its X10 position. Connect a scope with 50 ohm termination to J8 on the rear panel. Check the following waveform.



5.17.2.2 RELAY DRIVER (A4B4)

Switch the front panel MODULATION switch to INT PULSE and check the following voltages.

E1	E2	E3	E4	E5
+15	0	+24	0	+.7

E6	E7	E8	E9	E10
0	-15	+15	+24	0

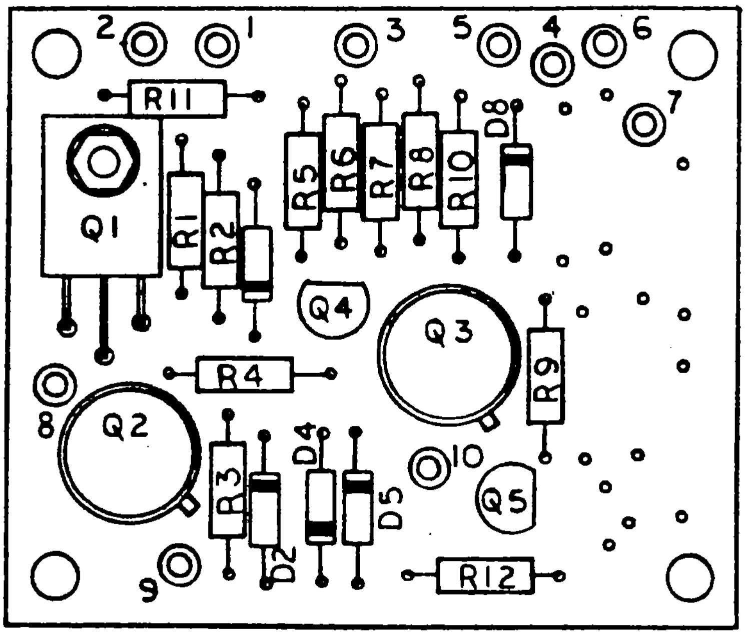
	E	B	C
Q1	+15	+14	+15
Q2	+24	+23	+24
Q3	+24	+24	0
Q4	0	+.7	+.1
Q5	0	+.4	+24

Switch the MODULATION switch to OFF and check the following voltages.

E1	E2	E3	E4	E5
+15	0	+24	0	+5.8

E6	E7	E8	E9	E10
0	-15	0	0	+24

	E	B	C
Q1	+15	+15	0
Q2	+24	+24	0
Q3	+24	+23	+24
Q4	0	+.2	+24
Q5	0	+.7	0



Component Location, Relay Driver

79-A-44-171 (A4B4)

Figure 5.31

5.18 DIGITAL FREQUENCY CONTROL OPTION 6

This option generates an analog tuning signal from a digital input. All pin numbers in parenthesis refer to the rear panel REMOTE CONTROL INPUT connector.

5.18.1 ALIGNMENT

Enable the external digital frequency control by grounding Pin 17 (42). With 0000 to DAC-1 (all inputs low), adjust R5 for exactly zero volts output at Pin 18 of A8. Next set the digital input to 9999 and adjust R3 for +10.000 volts at Pin 18.

5.18.2 REPAIR

Check the following supply voltages to A8.

A8 PIN	VOLTS
1	GND
2	+15
3	+6
5	-15

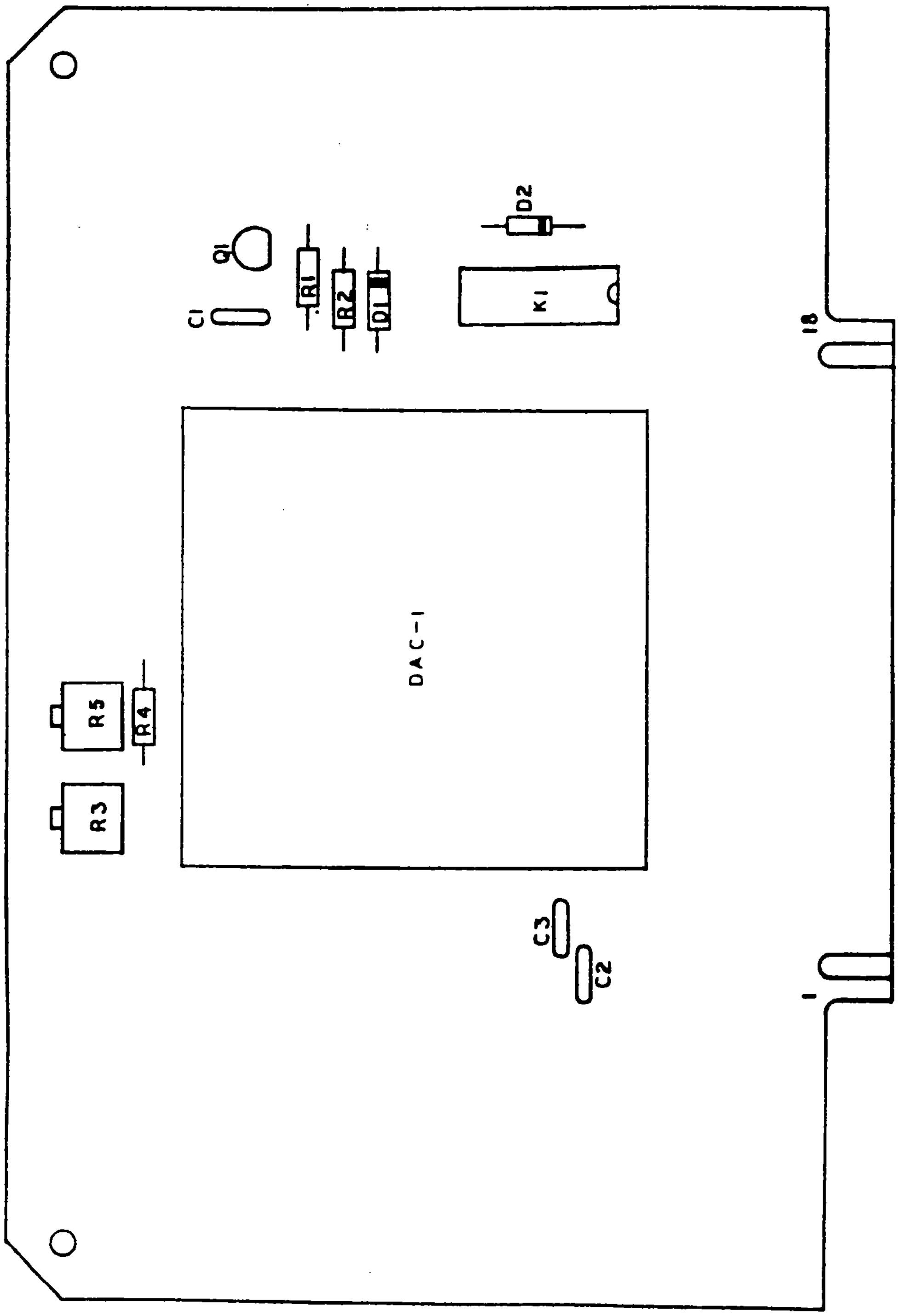
A8 PIN	VOLTS
A	GND
B	+15
C	+6
E	-15

Check for continuity between Pins V and 18 of A8. Then ground Pin 17 and check for continuity between Pin 18 of A8 and Pin 20 of DAC-1.

Set a digital number into the rear panel REMOTE CONTROL INPUT connector; logic is TTL positive true. The output at PIN 20 of DAC-1 should be 10N/9999 volts when N is the digital number. Other voltages of DAC-1 are listed as follows.

	17	18	19	22
DAC-1	+15	-15	GND	0

	23	24	26	27
DAC-1	GND	0	-6.4	-6.2



Component Location, Digital Frequency Control

79-B-80-175 (A8)

Figure 5.32

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A1B1, FRONT PANEL ASSEMBLY			
D1,2,3,4	DIODE, Silicon		1N4148
DS1,2	LAMP	Alco	BFK-5 #680 (Whit
E1,4	TERMINAL	Cambion	2380-1-05
E2,3	TERMINAL	Cambion	4838-01-0516
M1	METER, Edge	G-E	50-185111FAFA
R1	RESISTOR, Variable, 50K	Bourns	3511S-1-503
R3,7	RESISTOR, Variable, 10/10K	Beckman	8106R10KL.25/
R4,6	RESISTOR, Variable, 10K	Beckman	8106R10KL.25
R5	RESISTOR, Variable, 10K	Beckman	8103R10KL.25
R9	RESISTOR, W/Switch, 50K	A-B	16M638
R10,11	RESISTOR, Variable, 25K	A-B	70A1N048R253U
R12	RESISTOR, Variable, 1 Meg	A-B	70A1G020L105U
S1,5,9	SWITCH, DPDT	C-H	SF22SCW-191
S6	SWITCH, Rotary	Grayhill	71AD30-03-2-AJN
S7	SWITCH, Push 5 Station	Cen-Lab	79SC-11-054
S8,10	SWITCH, Rotary	Grayhill	71AD30-04-1-AJN
S11	SWITCH, Rotary	Grayhill	54D30-01-1-AJN
S12	SWITCH, Push	Grayhill	30-3
S13	SWITCH, Rotary	Grayhill	71AD30-02-2-AJN

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A1B2, REAR PANEL ASSEMBLY			
E1	TERMINAL	Cambion	2381-1-05
J7,10	CONNECTOR, BNC/SMA	OSM	21172
J9	CONNECTOR, 41 Pin Bulkhead	Bendix	PTB-20-41PS
S15,16	SWITCH, DPDT	C-H	SF22SCW-191
S17	SWITCH, 4PDT	Alco	MST-405N
W1	CABLE	MTC	MT-A-332-04-04.0-(
A1B5, WIRING HARNESS ASSEMBLY			
A1B1-J1,2,3,4	CONNECTOR, BNC	AMPH	86350-1050
A1B2-J11,12,13,14	CONNECTOR, 50 Pin	AMPH	57-40500
A2-P2	CONNECTOR, 25 Pin	Cinch	DBM-25P
A3B1-J1A,2,3	CONNECTOR, SMC	AEP	10-1120-188
A4-P7,8	CONNECTOR, CMA	OSM	521-3
A4-P9	CONNECTOR, 41 Pin	Bendix	PT06A-20-41S (SR)
A5-P1	CONNECTOR, 9 Pin	Cinch	DEM-9-S

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A2, POWER SUPPLY			
A2B1	INPUT RECTIFIER	MTC	SG-811 BM-21
A2B2	CONTROL CIRCUITS	MTC	SG-811 BM-22
A2B3	SWITCHING CIRCUITS	MTC	SG-811 BM-23
A2B4	RECTIFIERS/FILTERS	MTC	SG-811 BM-24
A2B5A1	REGULATOR	MTC	SG-811 BM-25-1
2B5A2	REGULATOR	MTC	SG-811 BM-25-2
F1	FUSE	Littelfuse	1 A
FL1	LINE FILTER, AC	Corcum	3EF2
J2	CONNECTOR, 25 Pin	Cinch	DBM-25S
L1	INDUCTOR	MTC	79A20-163
L2	INDUCTOR	MTC	79A20-163
L4	INDUCTOR	MTC	79A20-163
S1	SWITCH, 3PDT Slide	Switchcraft	50209L
T3	TRANSFORMER, Power	MTC	79B20-157
XF1	FUSEHOLDER	Littelfuse	9532B-A-0440
A2B1, INPUT RECTIFIER			
C1,2	CAPACITOR, Electrolytic, 210uf, -10/50, 200 VDC	Mallory	TCG211T200N2C3P
C3	CAPACITOR, Film, 1.5uf, 5%, 200 VDC	APC	ACF-200-967
D3	DIODE, Silicon		1N4148
DA1	DIODE BRIDGE, Full-Wave, 1.5 Amp, 400 V	MOT	MDA-942A-5

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
K1	RELAY, DPDT 12 VDC	Guardi	1334P-2C-12D
R3,4	THERMISTOR, 20 ohm	Rodan	2DA200
R5,6	RESISTOR, Composition, 100K, 5%, 1/2W		RC10GF104J

A2B2, CONTROL CIRCUITS

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
AT1	ISOLATOR, Optical	Fairchild	TIL-115
C4	CAPACITOR, Electrolytic, 300uf, -10/75, 25 VDC	Mallory	TT25X300
C5	CAPACITOR, Ceramic, .33uf, -20/80, 50 VDC	Sprague	2CZ5U334D85000C4
C6,8	CAPACITOR, Tantalum, 15uf, 10%, 20 VDC	Kemet	T310B156K010AS
C7,14,15,16,17	CAPACITOR, Ceramic, .1uf, 20%, 100 VDC	Erie	8131-100-651-104M
C11	CAPACITOR, Mica 2200pf, 1%, 500 VDC		CM06FD2222F03
C12	CAPACITOR, Film, 2200pf, 10%, 80 VDC	Sprague	192P22229R8
C13	CAPACITOR, Mica, 100pf, 5%, 100 VDC		CM04FD101J03
D5,6,7	DIODE, Silicon		1N4148
DA1	DIODE BRIDGE, Full-Wave, 1.5 Amp	Motorola	MDA-100
Q1,2,3,4	TRANSISTOR, PNP		2N2905A
R1,2	RESISTOR, Varistor, 130 V	G-E	V130LA10A

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R7	RESISTOR, Composition, 3.9K, 5%, 1/4W		RC07GF392J
R8	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
R9	RESISTOR, Composition, 4.7K, 5%, 1/4W		RC07GF472J
R10,18,19	RESISTOR, Composition, 1.8K, 5%, 1/4W		RC07GF182J
R11	RESISTOR, Metal, 11.5K, 1%, 1/4W		RN55D1152F
R12	RESISTOR, Composition, 2K, 5%, 1/4W		RC07GF202J
R13,14	RESISTOR, Composition, 1K, 5%, 1/4W		RC07GF102J
R15,16	RESISTOR, Composition, 750 ohm, 5%, 1/4W		RC07GF751J
R17	RESISTOR, Composition, 3.3K, 5%, 1/4W		RC07GF332J
R26	RESISTOR, Composition, Selected Value, 5%, 1/4W		RC07GFXXXJ
T1	TRANSFORMER, Power, 24 VCT, 290 ma	Promenco	7-24
T2	TRANSFORMER, Driver	MTC	79A22-139
U1	INTEGRATED CIRCUIT, Regulator	Fairchild	uA78GU1C
U2	INTEGRATED CIRCUIT, Timer	Sig	NE556A
U3	INTEGRATED CIRCUIT Divider	Motorola	MC14013CP
U4	INTEGRATED CIRCUIT, Nand Gate	Motorola	MC14011CP

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
U5	INTEGRATED CIRCUIT, Op Ampl	NSC	LM1458
XQ1,2,4	PAD	Rob	TO-5075-5A

A2B3, SWITCHING CIRCUITS

C18,19	CAPACITOR, Tantalum, 2.2uf, 10%, 20 VDC	Kemet	T310A225K020AS
D2,10,12	DIODE, Silicon		1N4148
D9,11	DIODE, Silicon		1N4936
Q5,7	TRANSISTOR, NPN	Delco	DTS-723
Q6,8	TRANSISTOR, NPN		2N2222
R20,22	RESISTOR, Composition, 27 ohm, 5%, 1/4W		RC07GF270J
R21,23	RESISTOR, Composition, 56 ohm, 5%, 1/4W		RC07GF560J
XQ5,7	INSULATOR, TO-3	Rob	RC-T03062-1
XQ6,8	SPREADER, TO-18	Therm	7717-149

A2B4, RECTIFIER/FILTERS

21	CAPACITOR, Ceramic, .luf, 20%, 100 VDC	Erie	8131-100-651-104M
8	DIODE, Silicon		1N4148
13	DIODE, Zener, 6.0 V		1N5233
A3	DIODE BRIDGE, Full-Wave, 1 Amp, 50 V	Varo	VE08X

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
DA4,5	DIODE BRIDGE, Full-Wave, 5 Amp, 100 V	Varo	VH148X
L3	INDUCTOR	MTC	79A20-163
L5	INDUCTOR	MTC	79A20-163
Q11	TRANSISTOR, NPN		2N3904
R27,28,30,32,32	RESISTOR, Composition, 4.7K, 5%, 1/4W		RC07GF472J
R29	RESISTOR, Composition, 47K, 5%, 1/4W		RC07GF473J
R33	RESISTOR, Composition, 470 ohm, 5%, 1/4W		RC07GF471J
R34	RESISTOR, Metal Film 5.49K, 1%, 1/4W		RN55D5491F
R35	RESISTOR, Variable, 1K, 10%, 1/2W	Beckman	61PAR-1K
R36	RESISTOR, Metal Film, 2.49K, 1%, 1/4W		RN55D2491F
U6	INTEGRATED CIRCUIT, Op Ampl	NSC	LM1458
XQ11	SPREADER	Therm	7717-147

A2B5A1, REGULATOR

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
C24,30,34	CAPACITOR, Electrolytic, 100uf, -10/15, 25 VDC	CDE	WBR100-25
C25,31	CAPACITOR, Ceramic, .33uf, -20/80, 50 VDC	Sprague	2CZ5U334D8500C4
C26,32	CAPACITOR, Ceramic, .1uf, 20%, 100 VDC	Erie	8131-100-651-104M

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
C27,29	CAPACITOR, Tantalum, 10uf, 10%, 35 VDC	Kemet	T310C106K035AS
C28	CAPACITOR, Tantalum, 4.7uf, 10%, 35 VDC	Kemet	T310B475K035AS
C33,35	CAPACITOR, Tantalum, 15uf, 10%, 20 VDC	Kemet	T310B156K020AS
R37	RESISTOR, Composition, 9.1K, 5%, 1/4W		RC07GF912J
R38,41	RESISTOR, Variable, 2K, 10%, 1/2W	Beckman	62PAR-2K
R39,45	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
R40	RESISTOR, Composition, 12K, 5%, 1/4W		RC07GF123J
R42,48	RESISTOR, Composition, 2.2 K, 5%, 1/4W		RC07GF222J
R43	RESISTOR, Composition, 820 ohm, 5%, 1/4W		RC07GF821J
R44	RESISTOR, Variable 500 ohm, 10%, 1/2W		
R46	RESISTOR, Composition, 3.3K, 5%, 1/4W		RC07GF332J
R47	RESISTOR, Variable, 1K, 10%, 1/2W	Beckman	62PAR-1K
P2,3,4,5,6,7	TEST POINT	HHS	63-3005-101
7,9	INTEGRATED CIRCUIT, Regulator	Fairchild	uA78GKC
8,10	INTEGRATED CIRCUIT, Regulator	Fairchild	uA79GKC
U7,8,9,10	INSULATOR	Rob	RC-T03062-1
U8,10	WASHER, Mica		MM03-11-101G37250-5

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A2B5A2, REGULATOR			
C22	CAPACITOR, Ceramic, .luf, 20%, 100 VDC	Erie	8131-100-651-104
C23	CAPACITOR, Tantalum, 4.7uf, 10%, 50 VDC	Kemet	T310B475K050AS
C36	CAPACITOR, Tantalum, 15uf, 10%, 20 VDC	Kemet	T310B156K020AS
E1-9	TERMINAL, Swage-on	Cambion	1457-2
R49,51	RESISTOR, Composition, 2.2K, 5%, 1/4W		RC07GF222J
R50	RESISTOR, Variable, 1K, 10%, 1/2W	Beckman	62PAR-1K
R52	RESISTOR, Composition, 3.3K, 5%, 1/2W		RC07GF332J
TP1,8,9	TEST POINT	HHS	63-3005-101
U11	INTEGRATED CIRCUIT, Regulator	Fairchild	uA79GKC
XU1	INSULATOR	Rob	RCT03062-1

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A3, BUCKET ASSEMBLY			
A3E1,6	TERMINAL	Cambion	2380-1-05
A3E2,3,4,5	TERMINAL	Cambion	4838-01-0516
A3A1	CONTROL BOARD	MTC	SG-811 BM-31A
A3A1J1	CONNECTOR	Viking	2VH18/1AN5
A3A2	EXTENDER BOARD	MTC	79C10-137
A3A2J1	CONNECTOR	VIking	2VH18/1AN5
A3A2J2	CONNECTOR	Viking	2VH18/1AN5
A3B1	MOD GEN/LEVEL CONTROL BOARD	MTC	SG-811 BM-31
.3B1J1	CONNECTOR	Viking	2VH18/1AN5
.3B2	SAWTOOTH GEN BOARD	MTC	SG-811 BM-32
.3B2J1	CONNECTOR	Viking	2VH18/1AN5
.3B3	MARKER/SWEEP GEN BOARD	MTC	SG-811 BM-33
3B3J1	CONNECTOR	Viking	2VH18/1AN5
3B4	CROSSBAND LOGIC BOARD	MTC	SG-811 BM-34
3B4J1	CONNECTOR	Viking	2VH18/1AN5
3B5	METER/ANALOG TRACKING BOARD	MTC	SG-811 BM-35
3B5J1	CONNECTOR	Viking	2VH18/1AN5
33B6	CROSSBAND TUNING GEN BOARD	MTC	SG-811 BM-36
3B6J1	CONNECTOR	Viking	2VH18/1AN5

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A3B7	TUNING GEN BOARD	MTC	SG-811 BM-37
A3B7J1	CONNECTOR	Viking	2VH18/1AN5
A3B8	OSCILLATOR TRACKING/ DRIVER BOARD	MTC	SG-811 BM-38
A3B8J1	CONNECTOR	Viking	2VH18/1AN5
A3B9J1	CONNECTOR	Viking	2VH18/1AN5

A3A1, CONTROL BOARD

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
C1	CAPACITOR, Ceramic, .luf, 20%, 100VDC	Erie	8131-100-651-104M
C2	CAPACITOR, Tantalum, luf, 10%, 35VDC	Kemet	T310A105K035AS
D1,2,3,4,5,7,8	DIODE, Silicon		1N4148
D6	DIODE, Silicon		1N4001
K1,2,3,4	RELAY, Dual DPDT, 50VDC	AMP	53451-1
R1,2,3,4,5,6,7,8 9,10,11,12,13,14	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
U1,2,3,4	INTEGRATED CIRCUIT, Quad Nand Gate		SN7438
U5	INTEGRATED CIRCUIT 8-Input Gate		SN7430
U6	INTEGRATED CIRCUIT Hex Inverter		SN7406
U7	INTEGRATED CIRCUIT, 3-Input Gate		SN7410

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A3B1, MOD GEN/LEVEL CONTROL BROAD			
C1	CAPACITOR,, Film, .033uf, 10%, 100VDC	Sprague	225P33391WD3
C2	CAPACITOR, Film, .0039uf, 10%, 100VDC	Sprague	2225P39291WD3
C3	CAPACITOR, Tantalum, 10uf, 10%, 20VDC	Sprague	196D106X0020JA1
C4,6,8,10	CAPACITOR, Ceramic, .1uf, 20%, 100VDC	Erie	8131-100-651-104M
C5,7,9,11	CAPACITOR, Tantalum, 1uf, 20%, 35VDC	Kemet	T310A105K020AS
C12	CAPACITOR, Ceramic, .001uf, 10%, 100VDC	Sprague	TG-S10
D1	DIODE, Silicon		1N4001
D2,3,4,5,7,9	DIODE, Silicon		1N4148
D6	DIODE, Zener		1N4739
D8	DIODE, Zener		1N4731
J1,2,3	CONNECTOR, Jack (SMC)	AEP	109
K1,2	RELAY, Dual DPDT, 5VDC	AMP	53451-1
Q1,2	TRANSISTOR, NPN		@N3904
Q2,3	TRANSISTOR, PNP		2N3906
R1	RESISTOR, Metal Film, 95.3K, 1%, 1/4W		RN55D9532F
R2,3,6,7,10,11, 12,13,15,16,23, 24,25,26,31,32, 33,34,35,37,38, 40,42,43,44,45, 47	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R4,27,49,51,52, 62,63	RESISTOR, Composition, 1K, 5%, 1/4W		RC07GF102J
R5,8,9	RESISTOR, Variable, 20K	Dale	8487-20K
R14,22,46	RESISTOR, Composition, 20K, 5%, 1/4W		RC07GF203J
R17,18,19,20,21, 66,67,68,69,70	RESISTOR, Variable, 10K	Dale	8487-10K
R28	RESISTOR, Composition, 240K, 5%, 1/4W		RC07GF244J
R29,50	RESISTOR, Variable, 1K	Dale	8487-1K
R30	RESISTOR, Composition, 100 ohm, 5%, 1/4W		RC07GF101J
R36,39	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
R41	RESISTOR, Composition, 15K, 5%, 1/4W		RC07GF153J
R48	RESISTOR, Composition, 750 ohm, 5%, 1/4W		RC07GF751J
R53,57	RESISTOR, Metal Film, 10K, 1%, 1/4W		RN55D1002F
R54	RESISTOR, Metal Film, 20K, 1%, 1/4W		RN55D2002F
R55	RESISTOR, Metal Film, 40.2K, 1%, 1/4W		RN55D4022F
R56	RESISTOR, Metal Film, 80.6K, 1%, 1/4W		RN55D8062F
R58	RESISTOR, Metal Film, 8.06K, 1%, 1/4W		RN55D8061F

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R59	RESISTOR, Variable, 20K	Beckman	62PR-20K
R60	RESISTOR, Variable, 5K	Beckman	62PR-5K
R64,71,72,73,74	RESISTOR, Composition, 100K, 5%, 1/4W		RCO7GF104J
R65	RESISTOR, Composition, 3.3K, 5%, 1/4W		RCO7GF332J
U1,4,6,7,8	INTEGRATED CIRCUIT, Op Ampl	NSC	LM1458
U2	INTEGRATED CIRCUIT, Waveform Gen	Intersil	ICL8038
U3	INTEGRATED CIRCUIT, CMOS	RCA	DC4051AE
U5	INTEGRATED CIRCUIT, Buffer	NSC	LH0002CH
U9	INTEGRATED CIRCUIT CMOS	RCA	CD4066AE
XQ1,2,3,4	SPREADER, TO-18	THERM	7717-247

A3B2, SAWTOOTH GENERATOR BOARD

C1	CAPACITOR, Mica, 300pf, 5%, 500VDC	Elmenco	DM15-301J
C2,20	CAPACITOR, Ceramic, .001uf, 20%, 1KV	Sprague	5GA-D10
C3,4,6	CAPACITOR, Ceramic, .01uf, 20%, 100VDC	Sprague	TG-S10

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
C5	CAPACITOR, Mica 470pf, 5%, 500VDC	Elmenco	DM15-471J
C7,8,9,11	CAPACITOR, Tantalum, 100uf, 10%, 15VDC	Kemet	K100C15K
C10,16,18	CAPACITOR, Ceramic, .1uf, 20%, 100VDC	Erie	8131-100-651-104M
C12	CAPACITOR, Film, 10uf, 10%, 100VDC	GE	BA19A106A
C13	CAPACITOR, Film, 1uf, 10%, 100VDC	GE	BA14A105A
C14	CAPACITOR, Film, .33uf, 10%, 100VDC	GE	BA13A334A
C15,17	CAPACITOR, Tantalum, 15uf, 20%, 20VDC	Kemet	T310B156K020AS
D1,2,3,4,6,7	DIODE, Silicon,		1N4148
Q1,12,16,21,22,23	TRANSISTOR, PNP		2N3906
Q2	TRANSISTOR, FET		2N4352
Q3,7	TRANSISTOR, FET		2N4351
Q4	TRANSISTOR, NPN		2N2222
Q6	TRANSISTOR, PNP		2N2907
Q8,9,11,13,14,17, 18,19,24,26,27 28	TRANSISTOR, NPN		2N3904
R1,33,46,48	RESISTOR, Composition, 30K, 5%, 1/4W		RC07GF303J
R2	RESISTOR, Composition, 18K, 5%, 1/4W		RC07GF183J
R3,79	RESISTOR, Composition, 47K, 5%, 1/4W		RC07GF473J

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R4,89	RESISTOR, Composition, 39K, 5%, 1/4W		RC07GF393J
R5	RESISTOR, Composition, 10Meg, 5%, 1/4W		RC07GF106J
R6,26	RESISTOR, Composition, 12K, 5%, 1/4W		RC07GFf123J
R7	RESISTOR, Composition, 330K, 5%, 1/4W		RC07GF334J
R8,37,42	RESISTOR, Composition, 62K, 5%, 1/4W		RC07GF623J
R9,11,31,38	RESISTOR, Composition, 3.9K, 5%, 1/4W		RC07GF392J
R12,13,15,16,17, 18,22,23,34,39, 43,44,51,52,56, 61,70,71,72,73 74	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R14,19,21,27,32, 41,45,53,58,59, 67,81,82	RESISTOR, Composition,		RC07GF104J
R24,76	RESISTOR, Composition, 180K, 5%,, 1/4W		RC07GF184J
R28,47,57,69,77, 80,85,90	RESISTOR, Composition, 56K, 5%, 1/4W		RC07GF563J
R29,83,84	RESISTOR, Composition, 51K, 5%, 1/4W		RC07GF513J
R36	RESISTOR, Composition, 43K, 5%, 1/4W		RC07GF433J
R49	RESISTOR, Composition, 470K, 5%, 1/4W		RC07GF474J

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R54	RESISTOR, Composition, 240K, 5%, 1/4W		RC07GF244J
R62	RESISTOR, Composition, 4.7K, 5%, 1/4W		RC07GF472J
R63	RESISTOR, Composition, 1.8K, 5%, 1/4W		RC07GF182J
R64,66	RESISTOR, Composition, 180 ohm, 5%, 1/4W		RC07GF181J
R68	RESISTOR, Composition, 200K, 5%, 1/4W		RC07GF204J
R75	RESISTOR, Composition, 150K, 5%, 1/4W		RC07GF154J
R78	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
R86	RESISTOR, Composition, 1K, 5%, 1/4W		RC07GF102J
R87	RESISTOR, Composition, 1.6 Meg, 5%, 1/4W		RC07GF165J
U1	INTEGRATED CIRCUIT, Op Ampl	NSC	LM308AH
U2	INTEGRATED CIRCUIT, Comparator	NSC	LM339AN
U3	INTEGRATED CIRCUIT, Timer	SIG	NE55V

A3B3, MARKER GENERATOR BOARD

C1	CAPACITOR, Mica, 500pf, 5%, 500VDC	Elmenco	DM15-501J
C2,3	CAPACITOR, Tantalum, 15uf, 20%, 20VDC	Kemet	T310B156K020AS

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
C4,6	CAPACITOR, Ceramic, .luf, 10%, 100VDC	Erie	8131-100-651-104M
D1	DIODE, Silicon		1N4148
R1,2,3,4,5,8,9,10, 21,42,43,44,46, 73,76,77	RESISTOR, Metal Film, 10.0K, 1%, 1/4W		RN55D1002F
R6,19,78	RESISTOR, Metal Film, 9.09K, 1%, 1/4W		RN55D9091F
R7,12,16,18,79	RESISTOR, Variable, 2K	Dale	8487-2K
R11,13,14,32,33, 36,37,38,41,58, 59,61,62,97,98, 101,102,103,106	RESISTOR, Composition, 30K, 5%, 1/4W		R/C07GF303J
R17	RESISTOR, Metal Film, 3.92K, 1%, 1/4W		RN55D3921F
R22,24,27,29,52, 54,87,89,92,94	RESISTOR, Composition, 18K, 5%, 1/4W		RC07GF183
R23,26,28,31,53, 56,88,91,93,96	RESISTOR, Composition, 47K, 5%, 1/4W		RC07GF473J
R34,39,99,104	RESISTOR, Composition, 1K, 5%, 1/4W		RC07GF102J
R47,49,82	RESISTOR, Composition, 15K, 5%, 1/4W		RC07GF153J
R57,63,64,66,67, 71	RESISTOR, Composition, 100K, 5%, 1/4W		RC07GF104J
R68,69	RESISTOR, Composition, 1 Meg, 5%, 1/4W		RC07GF105J
R72	RESISTOR, Composition, 4.7K, 5%, 1/4W		RC07GF472J

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R74	RESISTOR, Composition, 200 ohm, 5%, 1/4W		RC07GF201J
R81	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
R83	RESISTOR, Composition, 560K, 5%, 1/4W		RC07GF564J
R84	RESISTOR, Composition, 620K, 5%, 1/4W		RC07GF624J
R86	RESISTOR, Composition, 220K, 5%, 1/4W		RC07GF224J
U1,2,5,6,7,8,9, 11,12,13	INTEGRATED CIRCUIT, Op Ampl	NSC	LM1458
U3,4,14	INTEGRATED CIRCUIT, Comparator	NSC	LM339AN

A3B4, CROSSBAND LOGIC BOARD

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
C1,2,3,6,7	CAPACITOR, Ceramic, .1uf, 20%, 100VDC	Erie	8131-100-651-104M
C4,5	CAPACITOR, Ceramic, .01uf, 20%, 100VDC	Sprague	TG-S10
C8	CAPACITOR, Ceramic, .001uf, 20%, 1KVDC	Sprague	5GA-D10
D1,2	DIODE, Silicon		1N4148
Q1,2,3	TRANSISTOR, NPN		2N3904
R1,9,10,11,13,14, 15,38,39,40,41 42,43,44,45,47, 48,49,50,51,52	RESISTOR, Composition, 100K, 5%, 1/4W		RC07GF104J
R2	RESISTOR, Metal Film, 1K, 1%, 1/4W		RN55D1001F

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R4	RESISTOR, Composition, 1 Meg, 5%, 1/4W		RC07GF105J
R5	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
R6,12,26,27,28,29, 30,31,32,33,46	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R7,8	RESISTOR, Composition, 30K, 5%, 1/4W		RC07GF303J
R16	RESISTOR, Composition, 200K, 5%, 1/4W		RC07GF204J
R17	RESISTOR, Metal Film, 5.90K, 1%, 1/4W		RN55D5901F
R18,20,22,24	RESISTOR, Variable, 200 ohm	Dale	8487-200 ohm
R19,21	RESISTOR, Metal Film, 4.6K, 1%, 1/4W		RN55D4641F
R23	RESISTOR, Metal Film, 1.18K, 1%, 1/4W		RN55D1181F
R25	RESISTOR, Metal Film, 1.21K, 1%, 1/4W		RN55D1211F
R34,35,36,37	RESISTOR, Composition, 5.6 Meg, 5%, 1/4W		RC07GF565J
I1	INTEGRATED CIRCUIT, Opm Ampl	NSC	LM1458
I3	INTEGRATED CIRCUIT, CMOS	Motorola	MC14528CP
I4,	INTEGRATED CIRCUIT, Comparator	NSC	LM339AN
I5	INTEGRATED CIRCUIT CMOS	Motorola	MC14532CP

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
U6,7	INTEGRATED CIRCUIT, CMOS	Motorola	MC14529CP
U8	INTEGRATED CIRCUIT, CMOS	RCA	CD4009AE
U9	INTEGRATED CIRCUIT, Hex Buffer		SN7407
XQ1,2,3,	SPREADER, TO-18	THERM	7717-247

A3B5, METER/ANALOG TRACKING BOARD

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
C1,3,5,7	CAPACITOR, Ceramic, .luf, 20%, 100VDC	Erie	8131-100-651-104
C2,4,6,8	CAPACITOR, Tantalum, luf, 10%, 35VDC	Kemet	T310B105K035AS
D1,	DIODE, Silicon		1N4148
K1	RELAY, Reed	G-B	GB-835C-1
R1,7,46	RESISTOR, Metal Film, 17.4K, 1%, 1/4W		RN55D1742F
R2,5,8,11,14,17, 30,34,45,48,51, 54,57,60	RESISTOR, Variable, 1K	Dale	8487-1K
R3,9	RESISTOR, Metal Film, 1.50K, 1%, 1/4W		RN55D1501F
R4	RESISTOR, Metal Film, 294 ohm, 1%, 1/4W		RN55D2940F
R6	RESISTOR, Metal Film, 20K, 1%, 1/4W		RN55D2002F
R10	RESISTOR, Metal Film, 15.4K, 1%, 1/4W		RN55D1542

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R12	RESISTOR, Metal Film, 2.49K, 1%, 1/4W		RN55D2491F
R13,16,18,71	RESISTOR, Metal Film, 11.5K, 1%, 1/4W		RN55D1152DF
R15	RESISTOR, Metal Film, 5.90K, 1%, 1/4W		RN55D5901F
R19,20,22,26,27, 28,38,39,40,41, 42,43,62,63,64, 65,66,67,68,70, 72,73	RESISTOR, Metal Film, 10.0K, 1%, 1/4W		RN55D1002F
R21	RESISTOR, Metal Film, 9.53K, 1%, 1/4W		RN55D9531F
R23,24,31,36,37	RESISTOR, Metal Film, 1.00K, 1%, 1/4W		RN55D1001F
R25	RESISTOR, Metal Film, 100K, 1%, 1/4W		RN55D1003F
R29	RESISTOR, Metal Film, 6.19K, 1%, 1/4W		RN55D6191F
R32	RESISTOR, Metal Film, 2.00K, 1%, 1/4W		RN55D2001F
R33	RESISTOR, Metal Film, 7.15K, 1%, 1/4W		RN55D7151F
R44	RESISTOR, Metal Film, 100 ohm, 1%, 1/4W		RN55D1000F
R47,50	RESISTOR, Metal Film, 16.9K, 1%, 1/4W		RN55D1692F
R49,52	RESISTOR, Metal Film, 2.21K, 1%, 1/4W		RN55D2211F
R53,56,59	RESISTOR, Metal Film, 15.0K, 1%, 1/4W		RN55D1502F

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R55,58	RESISTOR, Metal Film, 3.92K, 1%, 1/4W		RN55D3921F
R61	RESISTOR, Metal Film, 7.50K, 1%, 1/4W		RN55D7501F
R69	RESISTOR, Metal Film, 4.99K, 1%, 1/4W		RN55D4991F
R74,75,76	RESISTOR, Composition, 100K, 5%, 1/4W		RC07GF104J
U1,2,3,6,7,8	INTEGRATED CIRCUIT, Op Ampl	NSC	LM1458
U4,5	INTEGRATED CIRCUIT, CMOS	RCA	CD4051AE
XU1,2,3,6,7,8	SPREADER	THERM	7717-246N

A3B6, CROSSBAND TUNING GENERATOR BOARD

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
C1,4,5,6,7	CAPACITOR, Ceramic, .luf, 20%, 100VDC	Erie	8131-100-651-104M
C2,3,8,9,10	CAPACITOR, Mica, 100pf, 5%, 500VDC	Elmenco	DM15-101J
D1,2	DIODE, Silicon		1N4148
K1	RELAY, Dual DPDT	AMP	53451-1
Q1	TRANSISTOR, PNP		2N3906
R1	RESISTOR, Metal Film, 649 ohm, 1%, 1/5W		RN55D6490F
R2,8	RESISTOR, Variable, 1K	Dale	8487-1K
R3	RESISTOR, Metal Film, 6.04K, 1%, 1/4W		RN55D6041F

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R4,20	RESISTOR, Metal Film, 1.00K, 1%, 1/4W		RN55D1001F
R5,23,24,25,26,44, 45,46,47,48	RESISTOR, Metal Film, 10.0K, 1%, 1/4W		RN55D1002F
R6	RESISTOR, Metal Film, 200K, 1%, 1/4W		RN55D2003F
R7	RESISTOR, Metal Film, 100K, 1%, 1/4W		RN55D1003F
R9	RESISTOR, Metal Film, 5.90K, 1%, 1/4W		RN55D5901F
R10,27	RESISTOR, Metal Film, 9.09K, 1%, 1/4W		RN55D9091F
R11	RESISTOR, Metal Film, 698 ohm, 1%, 1/4W		RN55D6980F
R12,14,16,18	RESISTOR, Variable, 200 ohm	Dale	8487-200 ohm
R13	RESISTOR, Metal Film, 2.80K, 1%, 1/4W		RN55D2801F
R15	RESISTOR, Metal Film, 2.15K, 1%, 1/4W		RN55D2151F
R17	RESISTOR, Metal Film, 1.62K, 1%, 1/4W		RN55D1621F
R19	RESISTOR, Metal Film, 499 ohm, 1%, 1/4W		RN55D4990F
R21,22	RESISTOR, Metal Film, 2.00K, 1%, 1/4W		RN55D2001F
R29,30	RESISTOR, Metal Film, 121K, 1%, 1/4W		RN55D1213F
R31,32	RESISTOR, Metal Film, 59.0K, 1%, 1/4W		RN55D5902F

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R33	RESISTOR, Metal Film, 33.2K, 1%, 1/4W		RN55D3322F
R34,35,36	RESISTOR, Composition, 100K, 5%, 1/4W		RC07GF104J
R37,38,40,41	RESISTOR, Variable, 10K	Dale	8487-10K
R39	RESISTOR, Variable, 5K	Dale	8487-5K
R42	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R43	RESISTOR, Composition, 2.7K, 5%, 1/4W		RC07GF272J
U1,2,3,4,5	INTEGRATED CIRCUIT, Op Ampl	NSC	LM308AH
U6,7	INTEGRATED CIRCUIT, CMOS	RCA	CD4051AE
XU1,2,3,4,5	SPREADER	THERM	7717-246N

A3B7, TUNING GENERATOR BOARD

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
C1,3,8,11	CAPACITOR, Tantalum, luf, 10%, 35VDC	Kemet	T310B105K035AS
C2,4	CAPACITOR, Ceramic, .luf, 20%, 100VDC	Erie	8131-100-651-104M
C5,6,7,9,10,12	CAPACITOR, Mica, 300pf, 5%, 100VDC	Elmenco	DM15-301J
D1,2	DIODE, Reference, 6.2V		
Q1	TRANSISTOR, NPN		2N3904
Q2	TRANSISTOR, PNP		2N3906

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R1,44	RESISTOR, Metal Film, 100K, 1%, 1/4W		RN55D1003F
R2,3,6,10,11,12, 20,21,27,28,34, 35,38	RESISTOR, Metal Film, 1.00K, 1%, 1/4W		RN55D1001F
R4,5,14,23,37,38, 39,42	RESISTOR, Metal Film, 10.0K, 1%, 1/4W		RN55D1002F
R7	RESISTOR, Metal Film, 2.00K, 1%, 1/4W		RN55D2001F
R8	RESISTOR, Metal Film, 9.09K, 1%, 1/4W		RN55D9091F
R9,17,18,26,32	RESISTOR, Variable, 1K	Dale	8487-1K
R13,22	RESISTOR, Metal Film, 1.21K, 1%, 1/4W		RN55D1211F
R15,24	RESISTOR, Metal Film, 4.99K, 1%, 1/4W		RN55D4991F
R16,25	RESISTOR, Metal Film, 7.15K, 1%, 1/4W		RN55D7151F
R19	RESISTOR, Metal Film, 20.0K, 1%, 1/4W		RN55D2002F
R29	RESISTOR, Composition, 1K, 5%, 1/4W		RC07GF102J
R30	RESISTOR, Variable, 10K	Dale	8487-10K
R31,33	RESISTOR, Metal Film, 10.5K, 1%, 1/4W		RN55D1052F
R36	RESISTOR, Metal Film, 30.1K, 1%, 1/4W		RN55D3012F
R40	RESISTOR, Variable, 500 ohm	Dale	8487-500 ohm

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R41	RESISTOR, Metal Film, 825 ohm, 1%, 1/4W		RN55D8250F
U1,2,3,5,6,7	INTEGRATED CIRCUIT, Op Ampl	NSC	LM308AH
U4	INTEGRATED CIRCUIT, Buffer Ampl	NSC	LH0002CH
U8,9	INTEGRATED CIRCUIT, Op Ampl	NSC	LM1458
XU1,2,3,5,6,7	SPREADER	THERM	7717-246N
XU4	SPREADER	ROB	RC-T05075-4A
XQ1,2	SPREADER	THERM	7717-247N

A3B8, OSCILLATOR TRACKING/DRIVER BOARD

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
C1,3,6	CAPACITOR, Tantalum, 1uf, 10%, 35VDC	Kemet	T310B105K035AS
C2,4,5,14,15	CAPACITOR, Ceramic, .1uf, 20%, 100VDC	Erie	8131-100-651-104M
C7	CAPACITOR, Ceramic, .001uf, 20%, 100VDC	Sprague	5GA-D10
C8	CAPACITOR, Tantalum, 22uf, 10%, 15VDC	Kemet	T310B226K015AS
C9,10,11,12,13	CAPACITOR, Mica, 300pf, 5%, 500VDC	Elmenco	DM15-301J
D1	DIODE, Silicon		1N4148
K1	RELAY, Reed	G-B	831A-4
R1,2,3,4,5,16,17, 18,19,20,33,34, 35,36,43,44,45,46	RESISTOR, Metal Film, 10.0K, 1%, 1/4W		RN55D1002F

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R6,7,8,9,10,21,22, 23,24,25	RESISTOR, Variable, 1K	Dale	8487-1K
R11	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R12	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R13	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R14	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R15	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R26	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R27	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R28	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R29	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R30	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R31,37,39,40	RESISTOR, Metal Film, 1.00K, 1%, 1/4W		RN55D1001F
R32	RESISTOR, Metal Film, 100K, 1%, 1/4W		RN55D1003F
R38	RESISTOR, Metal Film, 499K, 1%, 1/4W		RN55D4993F
R41	RESISTOR, Metal Film, 1.05K, 1%, 1/4W		RN55D1051F

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R47,48,49	RESISTOR, Composition, 100K, 5%, 1/4W		RC07GF104J
R50	RESISTOR, Wire-Wound, 5 ohm, 1%, 10W	Dale	RH10-5
R51	RESISTOR, Wire-Wound, 7 ohm, 1%, 10W	Dale	RH10-7
R52	RESISTOR, Wire-Wound, 10 ohm, 1%, 10W	Dale	RH10-10
R53	RESISTOR, Wire-Wound, 20 ohm, 1%, 10W	Dale	RH10-20
U1,4,5,7,8	INTEGRATED CIRCUIT, Op Ampl	NSC	LM308AH
U2,3,9	INTEGRATED CIRCUIT, CMOS	RCA	CD4051AE
U6	INTEGRATED CIRCUIT, Op Ampl (Pwr)	NSC	LH0021CK
XU1,4,5,7,8	SPREADER	THERM	7717-246N

A3B9, FILTER TRACKING/DRIVER BOARD

C1,3,6	CAPACITOR, Tantalum, luf, 10%, 35VDC	Kemet	T310B105K035AS
C2	CAPACITOR, Ceramic, .luf, 20%, 100VDC	Erie	8131-100-651-104M
C7	CAPACITOR, Ceramic, .001uf, 20%, 100VDC	Sprague	5GA-D10
C9,10,11,12,13	CAPACITOR, Mica, 300pf, 5%, 500VDC	Elmenco	DM15-301J
R1,2,3,4,5,16,17, 18,19,20,33,34, 35,36,43,44,45,46	RESISTOR, Metal Film, 10.0K, 1%, 1/4W		RN55D1002F

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R6,7,8,9,10,21,22, 23,24,25	RESISTOR, Variable, 1K	Dale	8487-1K
R11	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R12	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R13	RESISTOR, Metal Film,, Selected Value, 1%, 1/4W		RN55DXXXXF
R14	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R15	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R25	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R27	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R28	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R29	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R30	RESISTOR, Metal Film, Selected Value, 1%, 1/4W		RN55DXXXXF
R31,37,39,40	RESISTOR, Metal Film, 1.00K, 1%, 1/4W		RN55D1001F
R32	RESISTOR, Metal Film, 100K, 1%, 1/4W		RN55D1003F
R38	RESISTOR, Metal Film, 499K, 1%, 1/4W		RN55D4993F
R41	RESISTOR, Metal Film, 1.05K, 1%, 1/4W		RN55D1051F

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
R42	RESISTOR, Composition, 330K, 5%, 1/4W		RC07GF334J
R47,48,49	RESISTOR, Composition, 100K, 5%, 1/4W		RC07GF104J
R50	RESISTOR, Wire-Wound, 5 ohm, 1%, 10W		RH10-5
U1,4,5,7,8	INTEGRATED CIRCUIT, Op Ampl	NSC	LM308AH
U2,3,9	INTEGRATED CIRCUIT, CMOS	RCA	CD4051AE
U6	INTEGRATED CIRCUIT, Op Ampl (Pwr)	NSC	LH0021CK
XU1,4,5,7,8	SPREADER	THERM	7717-246N

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A4, RF UNIT			
A4B1-1	OSCILLATOR ASSEMBLY "A"	MTC	SG-811 BM41-1
A4B1-2	OSCILLATOR ASSEMBLY "B"	MTC	SG-811 BM-41-2
A4B2	OSCILLATOR CONTROL BOARD	MTC	SG-811 BM-42
A4B2J1	CONNECTOR, 22 Pin Dual	Viking	2VH22/1AN5
A4B7	LEVEL BOARD	MTC	SG-811 BM-47
A4B7J3	CONNECTOR, 22 Pin Dual	Viking	2VH22/1AN5
A4B7A1	2-18 GHz DET PRE-AMP BD	MTC	SG-811 BM-47-1
A4B7A2	EXT DET PRE-AMP BD	MTC	SG-811 BM-47-2
A4B13	RF CONTROL FILTER BOX	MTC	SG-811 BM-413
A4B14	PIN DRIVER BOARD	MTC	SG-811 BM-414
AT2	ATTENUATOR, SMA, 3 dB	EMC	4403
C1,2,3,4	CAPACITOR, Ceramic, .luf, 20%, 100VDC	Erie	8131-100-651-104M
D1,2,3	DIODE, Silicon		1N4148
D4,6,9,11	DIODE, Zener	Unitrode	UDZ860
D5,7,8,10	DIODE, Zener, Selected Value		Supplied By Manufacturer
E1,4,13,14	TERMINAL	Cambion	2381-1-05
E5,6,7,8,9,10,11, 12,15,16	TERMINAL	Cambion	4838-0-1-0516
E17,18,19	TERMINAL	Cambion	4899-01-05
J1	CONNECTOR, N/SMA	OSM	21031
J7,10	CONNECTOR, SMA/RG-316/U	Solitron	2943-6001

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
R1	RESISTOR, Variable, 100K	Clrstat	RV6NAYSD104A
R2	RESISTOR, Wire-Wound, 33 ohm, 20%, 3W	Ohmite	
U1,2	INTEGRATED CIRCUIT, Regulator	Fairchild	78GKC
W2	CABLE, SMA/.085	MTC	MT332-01-XX.X-(
W3	CABLE, SMA/.085	MTC	MT332-01-XX.X-(
W4	CABLE, SMA/.085	MTC	MT332-01-XX.X-(
W5	CABLE, SMA/.085	MTC	MT332-01-XX.X-(
W8	CABLE, SMA/.085	MTC	MT332-01-XX.X-(
W3	CABLE, SMA/.085	MTC	MT332-01-XX.X-(
Z4	ISOLATOR, 4-8 GHz	AEC	9-0408-11
Z6	ISOLATOR, 8-12 GHz	AEC	9-0812-12
Z8	ISOLATOR, 12-18 GHz	AEC	9-1218-21
Z9	PIN DIODE SWITCH	Gen-Mic	M871-8-33
Z14	DIRECTIONAL DETECTOR	Krytar	1818S

A4B1-2, OSCILLATOR ASSEMBLY

Z1	OSCILLATOR, YIG, 2-4 GHz	Avantek	ASF-9882/M
Z3	OSCILLATOR, YIG, 4-8 GHz	Avantek	SF6-1001/M
Z5	OSCILLATOR, YIG, 8-12 GHz	S-D	SDYX-3000-152
Z7	OSCILLATOR, YIG, 12-18 GHz	S-D	SDYX-3001-152

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A4B2, OSCILLATOR CONTROL BOARD			
C1,2,3,4,5,6,7,8	CAPACITOR, Ceramic, .luf, 20%, 100VDC	Erie	8131-100-651-104M
D1,2,3,4,5,6,7,8, 9,10,11,12	DIODE, Silicon		1N4148
Q1,2,3,4,5,6,7,8,9	TRANSISTOR, PNP		2N5193
Q10,11	TRANSISTOR, NPN		2N3904
Q12,13	TRANSISTOR, PNP		2N3906
R1,3,5,18,20,22, 35,37,52,54,56 72,73,74,75	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R2	RESISTOR, Composition, 220 ohms, 5%, 1/4W		RC07GF201J
R4	RESISTOR, Composition, 390 ohm, 5%, 1/4W		RC07GF391J
R6,9,23,26,40,43, 59,62	RESISTOR, Variable, 10K	Beckman	62PAR-10K
R7,19,24,36,41, 55,60	RESISTOR, Composition, 510 ohm, 5%, 1/4W		RC07GF511J
R8,25,42,61	RESISTOR, Composition, 33K, 5%, 1/4W		RC07GF333J
R10,27,44,63	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
R11,12,21,28,29, 45,46,64,65	RESISTOR, Composition, 1K, 5%, 1/4W		RC07GF102J
R13,14,15,16,30, 31,32,33,47,48 49,50,66,67,68,69	RESISTOR, Composition, 100K, 5%, 1/4W		RC07GF104J
R17,34,51,70	RESISTOR, Wire-Wound, 1.0 ohm, 1.5W	Ohmite	995-1-1.0 ohm

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
R38,53,57	RESISTOR, Composition, 1.5K, 5%, 1/4W		RC07GF152J
R71	RESISTOR, Composition, 20K, 5%, 1/4W		RC07GF203J
U2,4,6,8	INTEGRATED CIRCUIT, Op Ampl	NSC	LM1458
U5,7	INTEGRATED CIRCUIT, Regulator	Fairchild	78GKC
XU5,7	SPACER	ROB	RC-703062-1
XQ10,11,12,13	SPREADER	THERM	7717-247

A4B4, PULSE MOD RELAY DRIVER

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
D1,2,4,5,8	DIODE, Silicon		1N4148
Q1	TRANSISTOR, PNP		2N5193
Q2,3	TRANSISTOR, PNP		2N2905A
Q4,5	TRANSISTOR, NPN		2N3904
R1,5,9	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R2	RESISTOR, Composition, 1.5K, 5%, 1/4W		RC07GF152J
R3,6,7,10	RESISTOR, Composition, 20K, 5%, 1/4W		RC07GF203J
R4,8	RESISTOR, Composition, 3.9K, 5%, 1/4W		RC07GF392J
R11,12	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
XQ1	WASHER, Nylon		#2663

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A4B5, 2-18 GHz FILTER RELAY DRIVER			
D1,2,4,5,7,8	DIODE, Silicon		1N4148
Q1	TRANSISTOR, PNP		2N5193
Q2,3	TRANSISTOR, PNP		2N2905A
Q4,5	TRANSISTOR, NPN		2N3904
R1,5,9	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R2	RESISTOR, Composition, 470 ohm, 5%, 1/4W		RC07GF471J
R3,6,7,10	RESISTOR, Composition, 20K, 5%, 1/4W		RC07GF203J
R4,8	RESISTOR, Composition, 3.9K, 5%, 1/4W		RC07GF392J
R11,12	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
XQ1	WASHER, Nylon		#2663
A4B7, LEVEL BOARD			
C1,6,10,12,13,15, 16,21	CAPACITOR, Ceramic, .01uf, 20%, 100VDC	Sprague	TG-S10
C2,3,4,8,17,18,22	CAPACITOR, Ceramic, .1uf, 20%, 100VDC	Erie	8131-100-651-104M
C5,7,9,11,23	CAPACITOR, Tantalum, 1uf, 10%, 35VDC	Kemet	T310B106K035AS
C14,20	CAPACITOR, Ceramic, .001uf, 20%, 1KVDC	Sprague	5GA-D10
C19	CAPACITOR, .05uf,	Sprague	TG-D50

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
D1,2,3,4,6,7,8,9, 10,11,12	DIODE, Silicon		1N4148
D5	DIODE, Silicon		1N4001
J1,2	CONNECTOR, SMC	AEP	109
K1,2	RELAY, Dual DPDT	AMP	53451-1
Q1,2,3	TRANSISTOR, PNP		2N3906
Q4	TRANSISTOR, NPN		2N3904
R1,12,13,33,34,37, 38,39,41,48,51, 52,55,58	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R2,34,36	RESISTOR, Composition, 8.2K, 5%, 1/4W		RC07GF822J
R3,26,42,44	RESISTOR, Metal Film, 1.00K, 1%, 1/4W		RN55D1001F
R4	RESISTOR, Metal Film, 100 ohm, 1%, 1/4W		RN55D1000F
R5	RESISTOR, Metal Film, 909 ohm, 1%, 1/4W		RN55D9090F
R6	RESISTOR, Metal Film, 1.50K, 1%, 1/4W		RN55D1501F
R7,32	RESISTOR, Variable, 2K	Beckman	62PAR-2K
R8,59	RESISTOR, Composition, 100 ohm, 5%, 1/4W		RC07GF101J
R9,10	RESISTOR, Composition, 100K, 5%, 1/4W		RC07GF104J
R11,53	RESISTOR, Variable, 10K	Beckman	62PAR-10K
R14,15	RESISTOR, Wire-Wound, 100 ohm, 1-1/2W	Ohmite	995-1.5A 100 ohm

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
R16,18,20,22	RESISTOR, Composition 18 ohm, 5%, 1/4W		RC07GF180J
R17,19,21,23,	RESISTOR, Variable, 50 ohm	Beckman	62PAR-50 ohm
R4	RESISTOR, Composition, 15K, 5%, 1/4W		RC07GF153J
R25,29,30,45	RESISTOR, Metal Film, 2.00K, 1%, 1/4W		RN55D2001F
R27	RESISTOR, Variable, 1K	Dale	8487-1K
R28	RESISTOR, Metal Film, 20.0K, 1%, 1/4W		RN55D2002F
R31	RESISTOR, Metal Film, 22.6K, 1%, 1/4W		RN55D2262F
R40,50	RESISTOR, Composition, 100K, 5%, 1/4W		RC07GF104J
R43	RESISTOR, Composition, 30K, 5%, 1/4W		RC07GF303J
R46,47,49	RESISTOR, Composition, 1K, 5%, 1/4W		RC07GF102J
R54	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
R56	RESISTOR, Composition, 27K, 5%, 1/4W		RC07GF273J
R57	RESISTOR, Composition, 2K, 5%, 1/4W		RC07GF202J
R60	RESISTOR, Composition, 200K, 5%, 1/4W		RC07GF204J
U1,5	INTEGRATED CIRCUIT, Op Ampl	NSC	LM318
U2,7	INTEGRATED CIRCUIT Buffer	NSC	LH0002CH

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
U3	INTEGRATED CIRCUIT Decoder	NSC	SN7445
U4	INTEGRATED CIRCUIT, Log Ampl	T-I	SN76502
U6,9	INTEGRATED CIRCUIT, Op Ampl	NSC	LH0022CH
U8,10	INTEGRATED CIRCUIT, Op Ampl	NSC	LM1458
XU1,2,5,6,9	SPREADER	THERM	7717-246N

A4B7A1, 2-18 GHz DETECTOR PRE-AMPLIFIER

C1,3	CAPACITOR, Ceramic, .01uf, 20%, 100VDC	Sprague	TG-S10
C2	CAPACITOR, Mica, 5pf, 5%, 500VDC	Elmenco	DM15-050J
D1	DIODE, Zener		1N5225
E1 thru E6	TERMINAL	Cambion	1457-02-01
R1,4	RESISTOR, Metal Film, 1.00K, 1%, 1/4W		RN55D1001F
R2	RESISTOR, Metal Film, 20.0K, 1%, 1/4W		RN55D2002F
R3,7	RESISTOR, Variable, 10K	Dale	8487-10K
R5	RESISTOR, Metal Film, 15.0K, 1%, 1/4W		RN55D1502F
R6,8	RESISTOR, Metal Film, 51.K, 1%, 1/4W		RN55D5112F
U1	INTEGRATED CIRCUIT,	NSC	LM321
U2	INTEGRATED CIRCUIT	NSC	LM318
XU1,2	SPREADER	THERM	7717-246N

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A4B7A2, EXT DETECTOR PRE-AMPLIFIER			
C1,3	CAPACITOR, Ceramic, .01uf, 20%, 100VDC	Sprague	TG-S10
C2	CAPACITOR, Mica, 5pf, 5%, 500VDC	Elmenco	DM15-050J
D1	DIODE, Zener		1N5225B
E1 thru E6	TERMINAL	Cambion	1457-02-01
R1,4	RESISTOR, Metal Film, 1.00K, 1%, 1/4W		RN55D1001F
R2	RESISTOR, Metal Film, 30.1K, 1%, 1/4W		RN55D3012F
R3,7	RESISTOR, Variable, 10K	Dale	8487-10K
R5	RESISTOR, Metal Film, 15.0K, 1%, 1/4W		RN55D1502F
R6,8	RESISTOR, Metal Film, 51.K, 1%, 1/4W		RN55D5112F
U1	INTEGRATED CIRCUIT,	NSC	LM321
U2	INTEGRATED CIRCUIT	NSC	LM318
XU1,2	SPREADER	THERM	7717-246N
A4B7A3, .01-2 GHz DETECTOR PRE-AMPLIFIER			
C1,3	CAPACITOR, Ceramic, .01uf, 20%, 100VDC	Sprague	TG-S10
C2	CAPACITOR, Mica, 5pf, 5%, 500VDC	Elmenco	DM15-050J
D1	DIODE, Zener		1N5225B
E1 thru E6	TERMINAL	Cambion	1457-02-01

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
R1,4,5	RESISTOR, Metal Film, 1.00K, 1%, 1/4W		RN55D1001F
R2	RESISTOR, Metal Film, 30.1K, 1%, 1/4W		RN55D3012DF
R3,7	RESISTOR, Variable, 10K	Dale	8487-10K
R6,8	RESISTOR, Metal Film, 51.1K, 1%, 1/4W		RN55D5112F
U1	INTEGRATED CIRCUIT	NSC	LM321
U2	INTEGRATED CIRCUIT	NSC	LM318
XU1,2	SPREADER	THERM	7717-246N

A4B8, TRANSFER RELAY DRIVER

D1,2,4,5,8	DIODE, Silicon		1N4148
Q1	TRANSISTOR, PNP		2N5193
Q2,3	TRANSISTOR, PNP		2N2905A
Q4,5	TRANSISTOR, Npn		2N3904
R1,5,9	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R2	RESISTOR, Composition, 1.5K, 5%, 1/4W		RC07GF152J
R3,6,7,10	RESISTOR, Composition, 20K, 5%, 1/4W		RC07GF203J
R4,8	RESISTOR, Composition, 3.9K, 5%, 1/4W		RC07GF392J
R11,12	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
XQ1	WASHER, Nylon	HHS	#2663

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A4B10, .4-2 GHz FILTER RELAY DRIVER			
D1,2,4,5,7,8,9	DIODE, Silicon		1N4148
Q1	TRANSISTOR, PNP		2N5193
Q2,3	TRANSISTOR, PNP		2N2905A
Q4,5,6	TRANSISTOR, NPN		2N3904
R1,5,9,13	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R2	RESISTOR, Composition, 1.5K, 5%, 1/4W		RC07GF152J
R3,6,7,10,11,12	RESISTOR, Composition, 20K, 5%, 1/4W		RC07GF203J
R4,8	RESISTOR, Composition, 3.9K, 5%, 1/4W		RC07GF392J
R14,15,16	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
XQ1	WASHER, Nylon	HHS	#2663
A4B12, ATTENUATOR DRIVER BOARD			
D1,2,3,4,5,6,7,8, 9,10,11,12,13, 14,15,16	DIODE, Silicon		1N4001
D17	DIODE, Silicon		1N4148
E1,2,3,4,5,6,7,8, 9,10,11,12,13, 14,15	TERMINAL, Swage-On	Useco	2520-B
R1 thru 9	RESISTOR, Composition, 5%, 1/4W		RC07GF104J
U1	INTEGRATED CIRCUIT, Hex Inverter		SN7406
U2,3,4,5	INTEGRATED CIRCUIT, Driver	NSC	LM75451

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A4B13, RF CONTROL FILTER BOX			
FL1-FL39	FILTER-CONN	Erie	1203-050
A4-J9	CONNECTOR, 41 Pin	Bendix	PT02-20-41P
A4B14, PIN DRIVER BOARD			
C1,2,3,4	CAPACITOR, Tantalum, 1uf, 10%, 35VDC	Kemet	T310B105K035AS
D1,2,3,4,5,6,7,8	DIODE, Silicon		1N4148
E1-E18	TERMINAL, Swage-On	USECO	2520-B
J1	CONNECTOR, SMC	AEP	109
Q1,2,3,4,5	TRANSISTOR, NPN		2N3904
R1,3,5,7	RESISTOR, Composition, 47K, 5%, 1/4W		RC07GF473J
R2,4,6,8,9,10,11, 12,21,22,23,24,	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R13,14,15,16	RESISTOR, Composition, 20K, 5%, 1/4W		RC07GF203J
R17,18,19,20	RESISTOR, Composition, 220 ohm, 5%, 1/4W		RC07GF221J
R25	RESISTOR, Variable, 5K	Beckman	62PR-5K
R26	RESISTOR, Composition, 2K, 5%, 1/4W		RC07GF202J
R27,28,29,30,31	RESISTOR, Composition, 1K, 5%, 1/4W		RC07GF102J

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
U1	INTEGRATED CIRCUIT, Translator	NSC	DS1488J
U2,3,4,5	INTEGRATED CIRCUIT, Buffer Ampl	NSC	LH0002CH
XU2,3,4,5	SPREADER	THERM	7717-247
XU2,3,4,5	SPREADER	THERM	7717-246N

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A5, FREQUENCY DISPLAY			
A5B1	A/D CONVERTER BOARD	MTC	SG-811 BM-51
A5B2	DISPLAY DRIVER BOARD	MTC	SG-811 BM-52
A5B3	DISPLAY BOARD	MTC	SG-811 BM-53
A5B1, A/D CONVERTER BOARD			
C1,7	CAPACITOR, Tantalum, 15uf, 20%, 20VDC	Kemet	T310B156K020AS
C2	CAPACITOR, Tantalum, 100uf, 10%, 20VDC	Kemet	T310D107K020AS
C3	CAPACITOR, Ceramic, .33uf, 10%, 50VDC	G-E	75F4R5A334
C4,6,8,14,15,16, 19,20,21	CAPACITOR, Ceramic, .1uf, 20%, 100VDC	Erie	8131-100-651-104M
C5	CAPACITOR, Tantalum, 22uf, 10%, 15VDC	Kemet	T310B226K015AS
C9	CAPACITOR, Film, .0047uf, 10%, 80VDC	Sprague	192P44729R8
C18	CAPACITOR, Ceramic, .01uf, 20%, 100VDC	Sprague	TG-S10
J1	CONNECTOR, 9-Pin	Cinch	DE-9P-V
R1	RESISTOR, Composition, 100 ohm, 5%, 1/4W		RC07GF101J
R2	RESISTOR, Composition, 1K, 5%, 1/4W		RC07GF102J
R3	RESISTOR, Composition, 3.3K, 5%, 1/4W		RC07GF332J
R4	RESISTOR, Metal Film, 5.62K, 1%, 1/4W		RN55D5621F
R5	RESISTOR, Variable, 10K	Dale	8487-10K

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
R5	RESISTOR, Variable, 10K	Dale	8487-10K
p R6	RESISTOR, Variable, 100 ohm	Beckman	62PAR-100 ohm
R7	RESISTOR, Variable, 10K	Beckman	62PAR-10K
R8	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R38	RESISTOR, Composition, 1 Meg, 5%, 1/4W		RC07GF105J
R39	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
R40	RESISTOR, Composition, 390K, 5%, 1/4W		RC07GF394J
R41	RESISTOR, Metal Film, 20.0K, 1%, 1/4W		RN55D2002F
U1	INTEGRATED CIRCUIT, Op Ampl	NSC	LM307N
U2	INTEGRATED CIRCUIT, Regulator	Fairchild	78GU1C
U3	INTEGRATED CIRUCIT, A/D Converter	Motorola	MC1405CP
U4	INTEGRATED CIRCUIT, CMOS Logic	Motorola	MC14435CP
U5	INTEGRATED CIRCUIT, Latch/Decoder	Motorola	MC14543CP
U8	INTEGRATED CIRCUIT, Counter	Motorola	MC14518CP
U9	INTEGRATED CIRCUIT, Hex Gate	Motorola	MC14572CP
U10	INTEGRATED CIRCUIT, Flip-Flop	Motorola	MC14013CP

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A5B2, DISPLAY DRIVER BOARD			
C12,13	CAPACITOR, Tantalum, 100uf, 10%, 20VDC	Kemet	T310D107K020AS
C17	CAPACITOR, Ceramic, .luf, 20%, 100VDC	Erie	8131-100-651-104M
D4,6	DIODE, Silicon		1N4148
Q2	TRANSISTOR, NPN		2N3904
Q5,6,7	TRANSISTOR, PNP		2N4402
R9,10	RESISTOR, Composition, 51 ohm, 5%, 1/4W		RC07GF510J
R15	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R18,19,20,27	RESISTOR, Composition, 1.3K, 5%, 1/4W		RC07GF132J
R24,26,29	RESISTOR, Composition, 1.5K, 5%, 1/4W		RC07GF152J
R25,28,30	RESISTOR, Composition, 1K, 5%, 1/4W		RC07GF102J
R31,32,33,34,35, 36,37	RESISTOR, Composition, 390 ohm, 5%, 1/4W		RC07GF391J
U6.7	INTEGRATED CIRCUIT, Driver	Motorola	MC75491CP
A5B3, DISPLAY BOARD			
DS1,2,3,4	DISPLAY, 7 Segment	H-P	5082-7650

REF DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A6, REMOTE ATTENUATOR CONTROL BOARD			
C1	CAPACITOR, Tantalum, 1uf, 10%, 35VDC	Kemet	T310B105K035AS
D1,2	DIODE, Silicon		1N4148
E1 thru E15	TERMINAL Swage-On	USECO	2520-B
K1	RELAY, Dual DPDT	AMP	53451-1
Q1	TRANSISTOR, PNP		2N3906
R1	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R2	RESISTOR, Composition, 8.2K, 5%, 1/4W		RC07GF822J
XQ1	SPREADER	THERM	7717-247

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A7, INTERNAL PULSE GENERATOR			
C1	CAPACITOR, Mica, Selected Value	Elmenco	DM15-XXXJ
C2	CAPACITOR, Tantalum, 1uf, 10%, 35VDC	Kemet	T310B105K035AS
C3	CAPACITOR, Mica, Selected Value	Elmenco	DM15-XXXJ
C4	CAPACITOR, Ceramic, .001uf, 20%, 100VDC	Sprague	5GA-D10
C5,6,8	CAPACITOR, Mica, 200pf, 5%, 500VDC	Elmenco	DM15-201J
C7	CAPACITOR, Mica, 820pf, 5%, 500VDC	Elmenco	DM15-821J
C9	CAPACITOR, Ceramic, .01uf, 20%, 100VDC	Sprague	TG-S10
C10	CAPACITOR, Film, Selected Value		
D1	DIODE, Silicon		1N4001
D3,4,5,6	DIODE, Silicon		1N4148
E1, thru E13	TERMINAL	Useco	2520-B
J1,2,3	CONNECTOR, SMC	AEP	109
K1	RELAY, Dual DPDT	AMP	53451-1
Q2,4	TRANSISTOR, NPN		2N3904
Q5,7	TRANSISTOR, PNP		2N2905
Q6	TRANSISTOR, NPN		2N2270
R1,18,20	RESISTOR, Composition, 100 ohm, 5%, 1/4W		RC07GF101J

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A7, INTERNAL PULSE GENERATOR			
R2,5,19	RESISTOR, Variable, 5K	Beckman	62PAR-5K
R3	RESISTOR, Composition, 1K, 5%, 1/4W		RC07GF102J
R4	RESISTOR, Composition, 2.7K, 5%, 1/4W		RC07GF272J
R6.7	RESISTOR, Composition, 5.1K, 5%, 1/4W		RC07GF512J
R8,17	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R9,10,12,15	RESISTOR, Composition, 820 ohm, 5%, 1/4W		RC07GF821J
R11,13,14	RESISTOR, Composition, 200 ohm, 5%, 1/4W		RC07GF201J
R16	RESISTOR, Composition, 15 ohm, 5%, 1/4W		RC07GF150J
U1	INTEGRATED CIRCUIT, One-Shot	NSC	SN74123
XQ2,4	SPREADER	THERM	7717-247

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A8, D/A CONVERTER BOARD			
C1,2,3	CAPACITOR, Ceramic, .luf, 20%, 100VDC	Erie	8131-100-651-104M
D1	DIODE, Silicon		1N4001
D2	DIODE, Silicon		1N4148
DAC 1	D/A CONVERTER, BCD 4 Digit	Datel	DAC-169-16D
K1	RELAY	G-B	835C-1
Q1	TRANSISTOR, PNP		2N3906
R1	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R2	RESISTOR, Composition, 8.2K, 5%, 1/4W		RC07GF811J
R3	RESISTOR, Variable, 500 ohm	Beckman	62PAR-500 ohm
R4	RESISTOR, Composition, 1 Meg, 5%, 1/4W		RC07GF105J
R5	RESISTOR, Variable, 100K	Beckman	62PAR-100K
XQ1	SPREADER	THERM	7717-247

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A9, IEEE 488 BUSS INTERFACE			
A9B1	IEEE 488 MICROPROCESSOR	MTC	SG-811 BM-91
A9B2	RECEIVE DATA INTERFACE	MTC	SG-811 BM-92
A9B3	IEEE 488 POWER SUPPLY	MTC	SG-811 BM-93
A9B1, IEEE 488 MICROPROCESSOR			
A9B1J1	SOCKET, 16 Pin	EMC	7016-265-5
A9B1J2	CONNECTOR	AMPH	57-20240-2
C1	CAPACITOR, Mica 10pf, 5%, 500VDC	Elmenco	DM15-100J
C2,3,4,6	CAPACITOR, Tantalum, 1uf, 10%, 10VDC	Kemet	T310A105M010AS
C5,7,8,10,11,12, 13,14	CAPACITOR, Ceramic, .1uf, 20%, 100VDC	Erie	8131-100-651-104M
C9	CAPACITOR, Tantalum, 10uf, 10%, 10VDC	Kemet	T310B106M010AS
L1	INDUCTOR, Ferrite	Ferox	VK-200-10/3B
Q1	TRANSISTOR, NPN		2N3904
R1,2,3,4,5,6,7,9, 10,11,12	RESISTOR, Composition, 4.7K, 5%, 1/4W		RC07GF472J
R8	RESISTOR, Composition, 51K, 5%, 1/4W		RC07GF513J
U1	INTEGRATED CIRCUIT,	Motorola	MC6802P
U2	INTEGRATED CIRCUIT	INTEL	2758
U3	INTEGRATED CIRCUIT	Motorola	MC68488
U4	INTEGRATED CIRCUIT	NSC	74LS145

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
U5	INTEGRATED CIRCUIT,	NSC	74LS00
U6,7,8,9	INTEGRATED CIRCUIT,	Motorola	MC3448P
XU1,2	SOCKET, Strip 20 Pin	EMC	7195-295-5
XU3	SOCKET, Strip 12 Pin	EMC	7195-295-5
Y1	CRYSTAL, Series, 3.5 MHz	CTS	

A9B2, RECEIVE DATA INTERFACE

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
AB2J1	SOCKET, 16 Pin	EMC	7016-265-5
C1,3,4	CAPACITOR, Ceramic, .1uf, 20%, 100VDC	Erie	8131-100-651-104M
C2	CAPACITOR, Tantalum, 10uf, 10%, 25VDC	Kemet	392C106K025AS
C5	CAPACITOR, Tantalum, 2.2uf, 10%, 20VDC	Kemet	T310B225K020AS
L1	INDUCTOR, Ferrite	Ferox	VK-200-10/3B
R1,2,3,4,5,6,7,8, 9,10,11,12,13,14, 15.16.17,18,19, 20,21	RESISTOR, Composition, 4.7K, 5%, 1/4W		RC07GF472J
S1	SWITCH, DIP	AMP	435166-5
U1	INTEGRATED CIRCUIT	NSC	74LS145
U2,3	INTEGRATED CIRCUIT	NSC	74LS02
U4 thru 11	INTEGRATED CIRCUIT	NSC	74LS373
XS1	SOCKET, 16 Pin	Cinch	133-51-02-006(1)

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
A9B3FL1	FILTER CONN	USCC	1020-000
A9B3P1	CONNECTOR, Plug	Winch	M4P-LS-H10
PS1	POWER SUPPLY, Module	MIL	F5SA1AK2

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
OPTION 1 - .01-2 GHz COVERAGE			
A4-AT1	ATTENUATOR, 20 dB	Solitron	929-6185-20
A4B8	TRANSFER RELAY DRIVER BOARD	MTC	SG-811 BM-48
A4-K3	RELAY, COAX	Teledyne	CS37S6D
A4-W24 (w/Opt 3,3A)	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W24 (w/Opt 5)	CABLE, SMA/,085	MTC	MT332-01-XX.X-01
A4-W24 (no Opt)	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W25	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W26	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W27	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W28	CABLE, XMA/.085	MTC	MT332-01-XX.X-01
A4-W29 (wo/Opt 3A)	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W29 (w/Opt 3)	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W38	CABLE, SMA/.085	MTC	MT332-02-XX.X-01
A4-Z16	MIXER	Vari-L	DBM-601
A4-Z17	OSCILLATOR, 2.3 GHz	EMF	1002151
A4-Z18	AMPLIFIER, .01-2 GHz	W-J	WJ-6203-5
A4-Z19	L.P. FILTER	K&L	8L120-2100-0
A4-Z21	SAMPLER, 15 dB	MIC-LAB	HM-15F
A4-Z22	DETECTOR	H-P	33330B

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
OPTION 2 - 70 dB STEP ATTENUATOR			
A1B1-S2	SWITCH, Rotary, 4P12T	Grayhill	71AD30-04-1-AJN
A4B12	ATTENUATOR DRIVE BOARD	MTC	SG-811 BM-412
A4-W35	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W36	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-Z15	ATTENUATOR, 70 dB	H-P	33321H
A6	REMOTE ATTENUATOR CONTROL BOARD	MTC	SG-811 BM-60
OPTION 2A - 110 dBSTEP ATTENUATOR			
A1B1-S2	SWITCH, Rotary, 4P12T	Grayhill	71AD30-04-1-AJN
A4-AD7	ADAPTER, SMA, Right Angle	Solitron	2994-6002
A4B12	ATTENUATOR DRIVER BOARD	MTC	SG-811 BM-412
A4-W35	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-Z15	ATTENUATOR, 110 dB	H-P	33322H
A6	REMOTE ATTENUATOR CONTROL BOARD	MTC	SG-811 BM-60

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
OPTION 3 - 2-18 GHz FILTER			
A1B1-R2	RESISTOR, Variable, 25K	A-B	70A1N048R253U
A1B1-S3	SWITCH, DPDT	C-H	SF22SCW-191
A3B9	FILTER TRACKING/ DRIVER BOARD	MTC	SG-811 BM-39
A4B5	2-18 GHz FILTER RELAY DRIVER BOARD	MTC	SG-811 BM-45
A4-K2	RELAY, COAX Transfer	Teledyne	CS37S6D
A4-W21 (wo/Opt 5)	CABLE	MTC	MT332-01-XX.X-01
A4-W21 (w/Opt 5)	CABLE	MTC	MT332-01-XX.X-01
A4-W22	CABLE	MTC	MT332-01-XX.X-01
A4-W23	CABLED	MTC	MT332-01-XX.X-01
A4-Z13	FILTER, YIG, 2-18 GHz	S-D	SDYF-4000-113

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
OPTION 3A - .4-18 GHz FILTER			
A1B1-R2	RESISTOR, Variable, 25K	A-B	70A1N048R253U
A1B1-S3	SWITCH, DPDT	C-H	SF22SCW-191
A3B9	FILTER TRACKING/ DRIVER BOARD	MTC	SG-811 BM-39
A4B5	2-18 GHz FILTER RELAY DRIVER BOARD	MTC	SG-811 BM-45
A4B10	.4-2 GHz FILTER RELAY DRIVER BOARD	MTC	SG-811 BM-410
A4-K2	RELAY, COAX Transfer	Teledyne	CS37S6D
A4-K4	RELAY, COAX, Transfer	Teledyne	CS37S6D
A4-W21 (wo/Opt 5)	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W21 (w/Opt 5)	CABLE SMA/.085	MTC	MT332-01-XX.X-01
A4-W22	CABLE SMA/.085	MTC	MT332-01-XX.X-01
A4-W23	CABLE SMA/.085	MTC	MT332-01-XX.X-01
A4-W30	CABLE SMA/.085	MTC	MT332-01-XX.X-01
A4-W31	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W32	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-Z13	FILTER, YIG, 2-18 GHz	S-D	SDYF-4000-113
A4-Z20	FILTER, YIG, .4-2 GHz	YIG-Tek	102-7

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
OPTION 4 - RF SAMPLE 2-18 GHz			
A1B2-J18	CONNECTOR, Bulkhead	Solitron	2990-6005
A1B3-W2	CABLE, SMA/.085	MTC	MT A-332-01-05.0-(
A4-J2	CONNECTOR, Bulkhead	Solitron	2906-6002
A4-W9	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W10	CABLE SMA/.085	MTC	MT332-01-XX.X-01
A4-W11	CABLE SMA/.085	MTC	MT332-01-XX.X-01
A4-W12	CABLE SMA/.085	MTC	MT332-01-XX.X-01
A4-W13	CABLE SMA/.085	MTC	MT332-01-XX.X-01
A4-W14	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W15	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W16	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W37	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-Z1A	COUPLER, 2-4 GHz, 10 dB	Narda	4013C-10
A4-Z4A	COUPLER, 4-8 GHz, 10 dB	Narda	4014C-10
A4-Z6A	COUPLER, 8-12 GHz, 10 dB	Narda	4015C-10
A4-Z8A	COUPLER, 12-18 GHz, 10 dB	Narda	4016B-10
4-Z9A	PIN DIODE, Switch SP4T	GEN-MIC	M871-8-33

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
OPTION 5 - PULSE MODULATOR			
A1B1-R8	RESISTOR, Variable, 50K	A-B	70A1N048R253U
A1B1-S4	SWITCH, Push	Grayhill	30-3
A1B1-S14	SWITCH, Rotary	Grayhill	71AD30-02-2-AJN
A1B2-J8	CONNECTOR, Bulkhead	OSM	21172
A1B5-A7P1	CONNECTOR	AMP	51749-1
A1B5-A7P2	CONNECTOR	AMP	51749-1
A1B5-A7P2	CONNECTOR	AMP	51749-1
A1B5-J15	CONNECTOR, Bulkhead	AMPH	86350-1050
A4B4	PULSE MODULATOR RELAY DRIVER BOARD	MTC	SG-811 BM-44
A4-K1A,K1B	RELAY, COAX	Teledyne	CS33S6D
A4-W17	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W18	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W19	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-W20	CABLE, SMA/.085	MTC	MT332-01-XX.X-01
A4-Z12	PIN DIODE	GEN-MIC	DM864H
A4-Z12P3	CONNECTOR	AEP	51749-1
A7	INTERNAL PULSE GENERATOR BOARD	MTC	SG-811 BM-70

REF. DESIGN.	DESCRIPTION	MFR	DRAWING/ PART NO.
OPTION 6 - DIGITAL FREQUENCY CONTROL			
A8	DIGITAL FREQUENCY CONTROL BOARD	MTC	SG-811 BM-80
OPTION 6A - IEEE 488 BUSS INTERFACE			
A1B5-A9P1	CONNECTOR	Viking	3VH28/1CN5
A3-A8J1	CONNECTOR	Viking	2VH18/1AN5
A8	DIGITAL FREQUENCY	MTC	SG-811 BM-90

MANUAL CHANGES

Model Number: SG-811A/B

Date Printed: May 1978

This supplement contains information for correcting manual errors and for adapting the manual to instruments containing changes made after the printing of the manual.

TO USE THIS SUPPLEMENT:

Make all appropriate serial number related changes indicated in the tables below.

Serial Number	Make Changes
143-165	1, 2
133-172	2
113 & Up	3

Serial Number	Make Changes

CHANGE 1

Page 5-52, Figure 5-19:

Add Figure 5-19A supplied with this manual change.

Page 6-60:

Add A4-Z12A, FILTER, K&L, 3H10-2/18-0/OP.

Page 4-18, Paragraph 4.17:

At the end of Paragraph 4.17 add the following:

"Z12A (1-18 GHz) High-Pass Filter inserted between K1 and Z12 prevents the pulse drive feedthru from reflecting back to Z9 which prevents Z9 from being modulated. This filter improves the RF pulse fidelity".

Figure 7.13, Sheet 1 of 2:

Add A4-Z12A between K1-A (J1) and Z12 as shown in partial schematic Figure 1 of this manual change.

4/8/80

CHANGE 2

Page 5-4, U3 Pins 1, 2, 3 waveform:

Change U3 pins 1, 2, 3 to U3 pins 1, 2, 5.

Page 5-4, all waveforms:

Change all periods of waveforms from ms to us.

Page 5-5, all waveforms:

Change the periods of waveforms from ms to us.

Page 5-7, all waveforms:

Change the periods of waveforms from ms to us

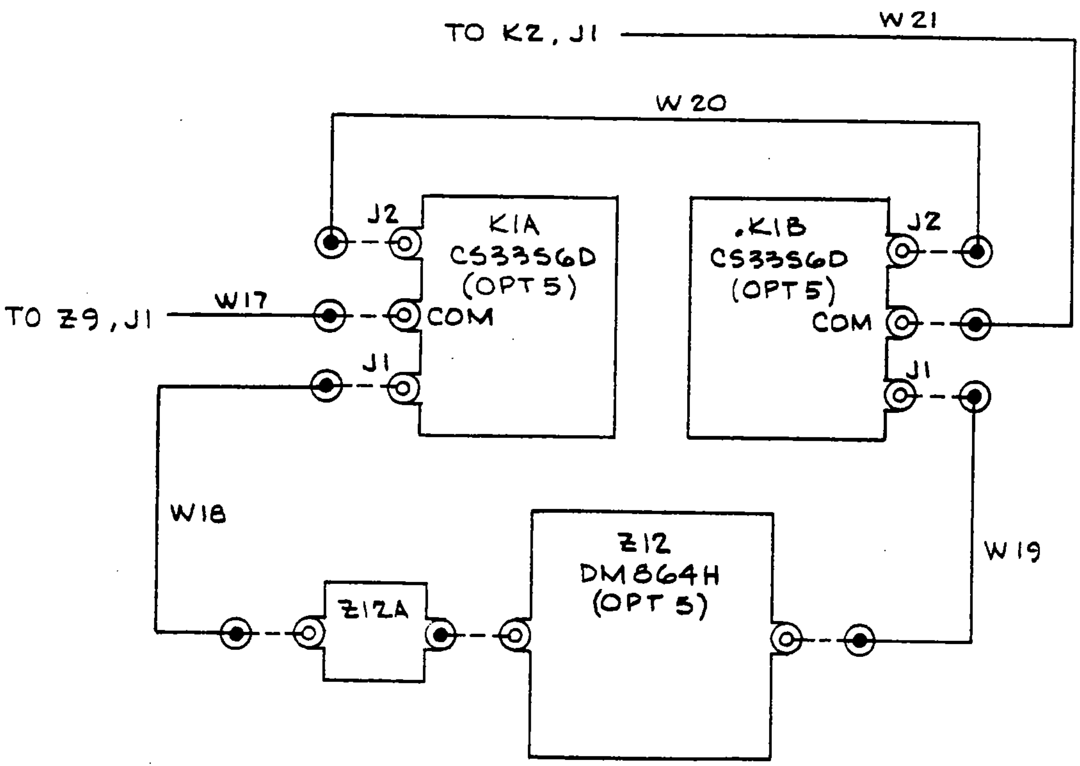
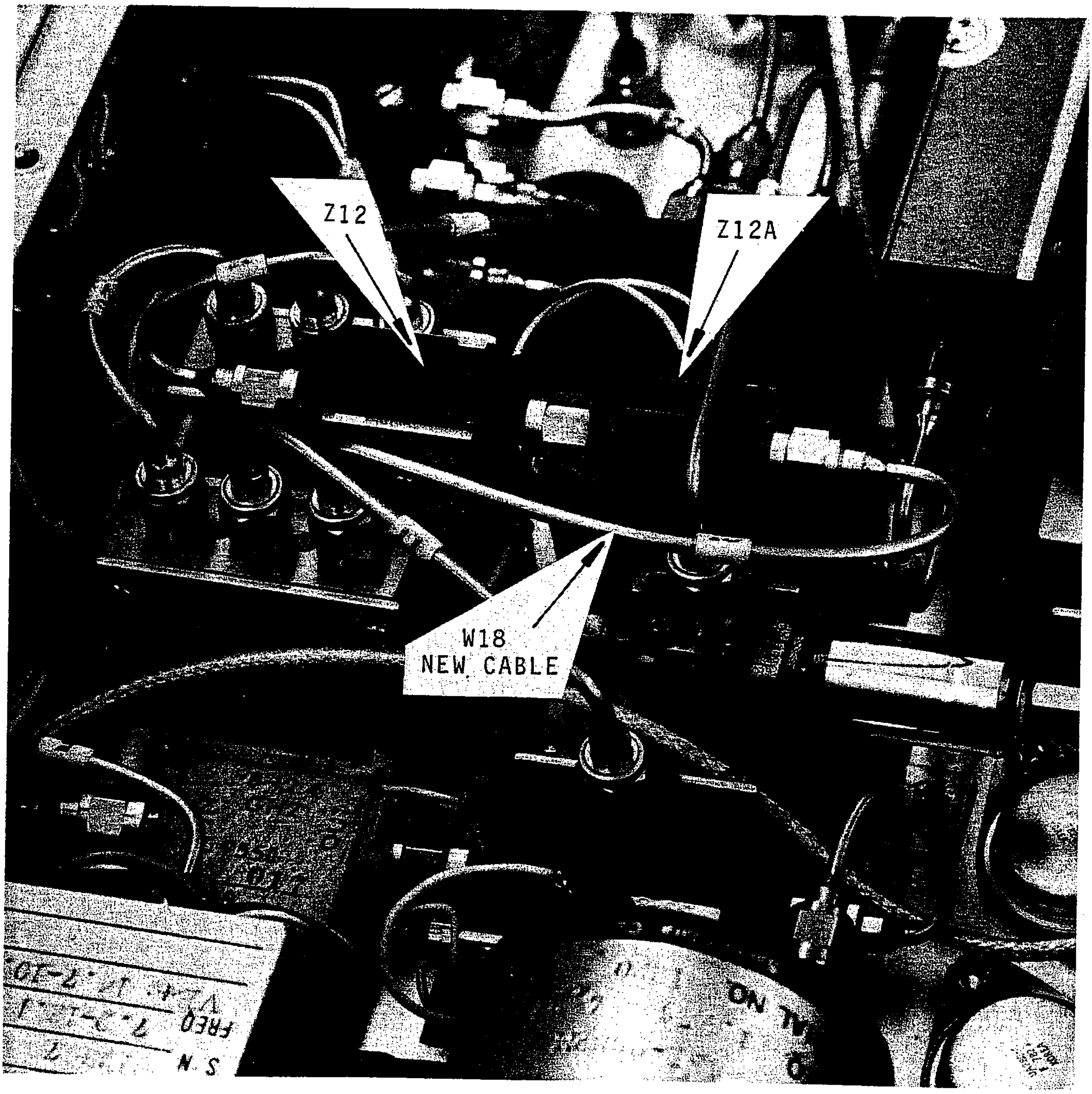


FIGURE 1 - P/O Figure 7-13, Wiring Diagram, RF Unit
(1 of 2) (Change 1)

1/2/79



RF UNIT, TOP (Partial View), A4
FIGURE 5.19A

CHANGE 3

Page 1-7, Specifications, Note (2):

Accuracy is ± 0.2 dB in one dB steps over a 0-9 dB range of digital inputs through the rear panel REMOTE CONTROL INPUT Connector. Panel meter is calibrated linearily in dBm and reads output power directly. If Option 2 or 2A is installed, subtract the step attenuator setting from the meter reading.

Pin assignments on the 50 pin REMOTE CONTROL INPUT Connector (Amphenol 57-40500) are as follows:

PIN NO.	ATTEN VALUE	
7	1	Positive True TTL Logic
8	2	
9	4	
10	8	

In addition pin 15 is the REMOTE ATTENUATION ENABLE and is driven by TTL negative true logic.

This SG-811 contains a 4 1/2 digit Frequency Display. The Description & Theory, Alignment & Maintenance, and Parts List is described in this addendum.

This addendum replaces the sections 4.11 and 5.10 pertaining to A5 in the standard manual.

The Frequency Display is a 4 1/2 digit voltmeter using dual-slope integration. Integrated circuits U2 and U3 are specifically designed to operate together to form the analog-to-digital conversion. The input signal to the basic meter function connects between pins 10 and 11 of U2, and at this point has a range of 0 to +1.9999 volts.

The input voltage from the meter tracking circuits varies from about 0 to +9 volts. Resistors R1 and R2 divide this input by 5 to bring it within the range of the basic circuit. Operational amplifier U1 buffers the input to U2, and any zero offset is compensated by trimmer R3.

Timer U4 supplies the clock signal for the analog-to-digital conversion and the multiplexing of the display. The multiplexed BCD output appears at pins 20, 21, 22, and 23 of U2, with the digit select outputs at pins 19, 24, 25, 26 and 27. The digit select outputs of U2 connect to display driver U6 through BCD adder U9. On bands 1-5 (.01-18 GHz), there is no addition. On band 6 (18-26 GHz), 14000 is added to the display. On band 7 (26-40 GHz) 24000 is added to the display. U6 converts the BCD output to drive the 7-segment LED displays. The five digits are sequentially scanned by the digit select outputs and switching transistors Q1-Q5.

Trimmer R10 adjusts the full scale meter range. Regulator U5 supplies +5 volts to the meter circuits.

For bands 6 and 7, the BCD addition is done by U7, U9, U10 and associated circuits. U7 is a nines complement and selects the number to the input of BCD adder U9. U8, a dual flip-flop, detects and temporarily stores a carry out of U9. U9 adds two BCD numbers to the output of U8 to provide the sum plus a carry output. U10 is a quad 2-input NAND gate which decodes the BCD band input to control the adder circuits.

The sequence for operation in band 6 is as follows. The multiplexed display is scanned from the least significant digit to the most significant digit. As the three least significant digits are scanned, diodes D3, D4 and D5 set U7 to supply the number 0 to the BCD adder U9. When the 4th digit is scanned, the number 4 is decoded and added to the multiplexed BCD output of U2. If the sum of 4 plus the U2 output exceeds 9, a carry out of U9 pin 7 sets a flip-flop in U8. When the 5th or most significant digit is scanned, the number 1 is decoded and added to U2 output. At the same time, if a carry was present from the previous digit, it is fed to the carry in of U9 from a second flip-flop of U8. The least significant digits are scanned again, the flip-flops of U8 are reset, and the sequence repeats.

The operation for band 7 is similar, except the number added to the most significant digit is 2 instead of 1.

The digital frequency display is a digital voltmeter which displays 0.010 to 18.000 as the input voltage varies from +.005 to +9.0 volts. If the generator has Option 10 (18-40 provision) the display reads to 40.000 in band 7.

The display is disengaged from the mainframe by removing the top cover of the SG-811 and the four knurled screws holding the display to the mainframe. Access to its components requires removing the 11 flat head screws which join the two sections of its case.

5.10.1 ALIGNMENT

Check that the input to the display is correct by measuring the generator output frequency using a frequency counter and measuring the voltage input to the display at pin 6 of its connector or at pin V of A3B5, using a digital voltmeter. Tune the generator for a frequency output of 18.00 GHz as read on the counter. The voltage should be between +8.91 and +9.09 volts. If not, the problem is in the tuning curcuits.

The display is aligned by tuning the generator to its lowest frequency and adjusting R3 so that the display equals the frequency counter readout. Tune to the highest frequency but no greater than 18.00 GHz, and adjust R10 for the correct readout. Repeat the above until the readings at both frequencies are correct.

5.10.2 REPAIR

Voltage can be measured by removing the A5 module from the mounting bracket. Loosen the four thumb screws, two at each side, and lift the module out. Remove the screws that secure the cover and remove it.

Set the front panel controls as follows:

BAND: To 12-18 GHz.

M_3: Tuning for 18.000 GHz on display.

Check the following voltages:

	1	2	3	4	5	6	7	8	9
J1	+15.0	-15.0	0	0	--	+9.0	--	--	--
U1	--	+2.0	+2.0	-15	--	+2.0	+15	--	--
U5	+15.0	+5	0	--	--	--	--	--	--

For additional voltages and waveforms for the dual-slope integration circuit and the mulitplexing circuit, refer to the manufacturers data sheets.

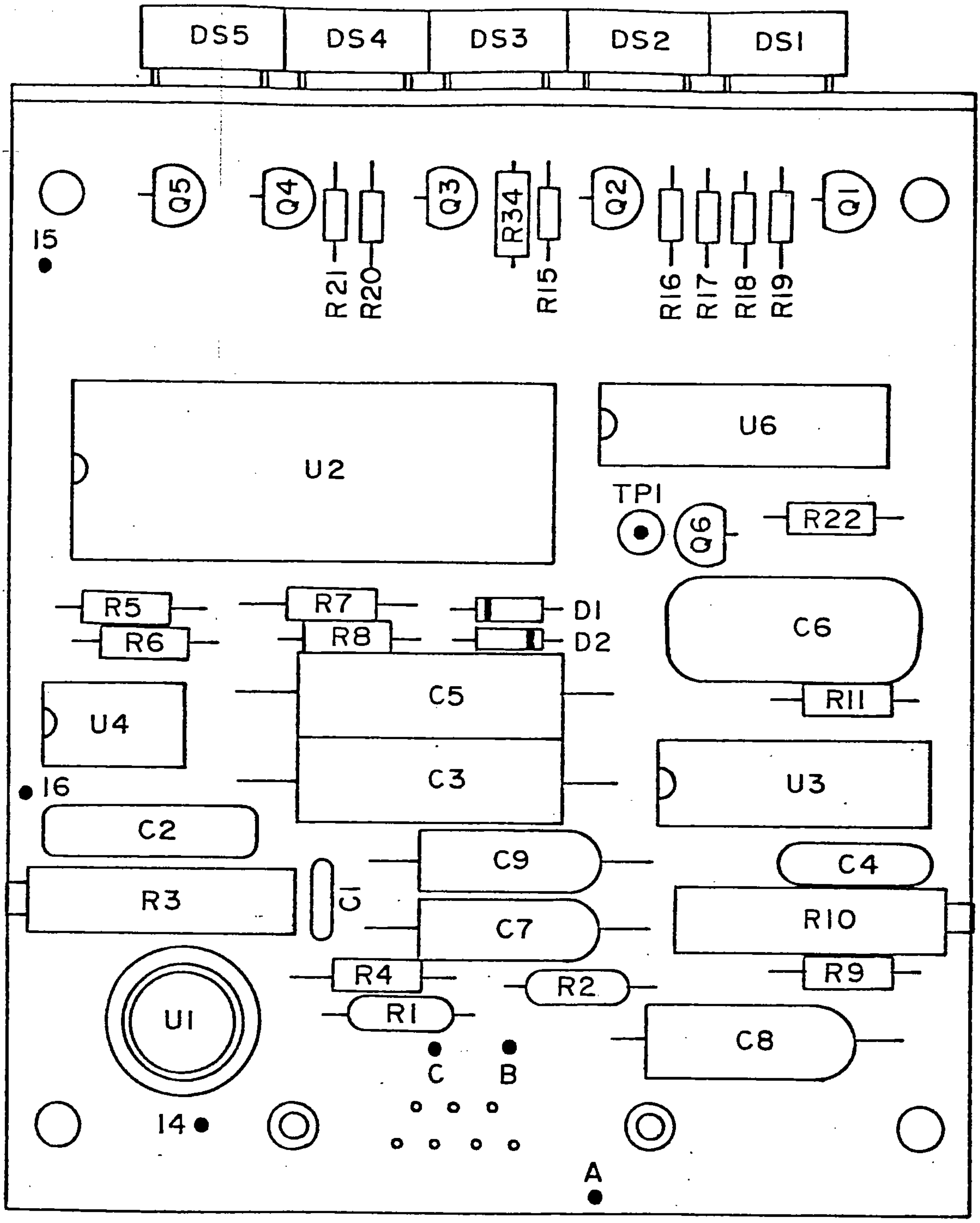


Figure 5.15

SG-811
A5B1-COMPONENT LOCATION,
A/D CONVERTER

79A51-352

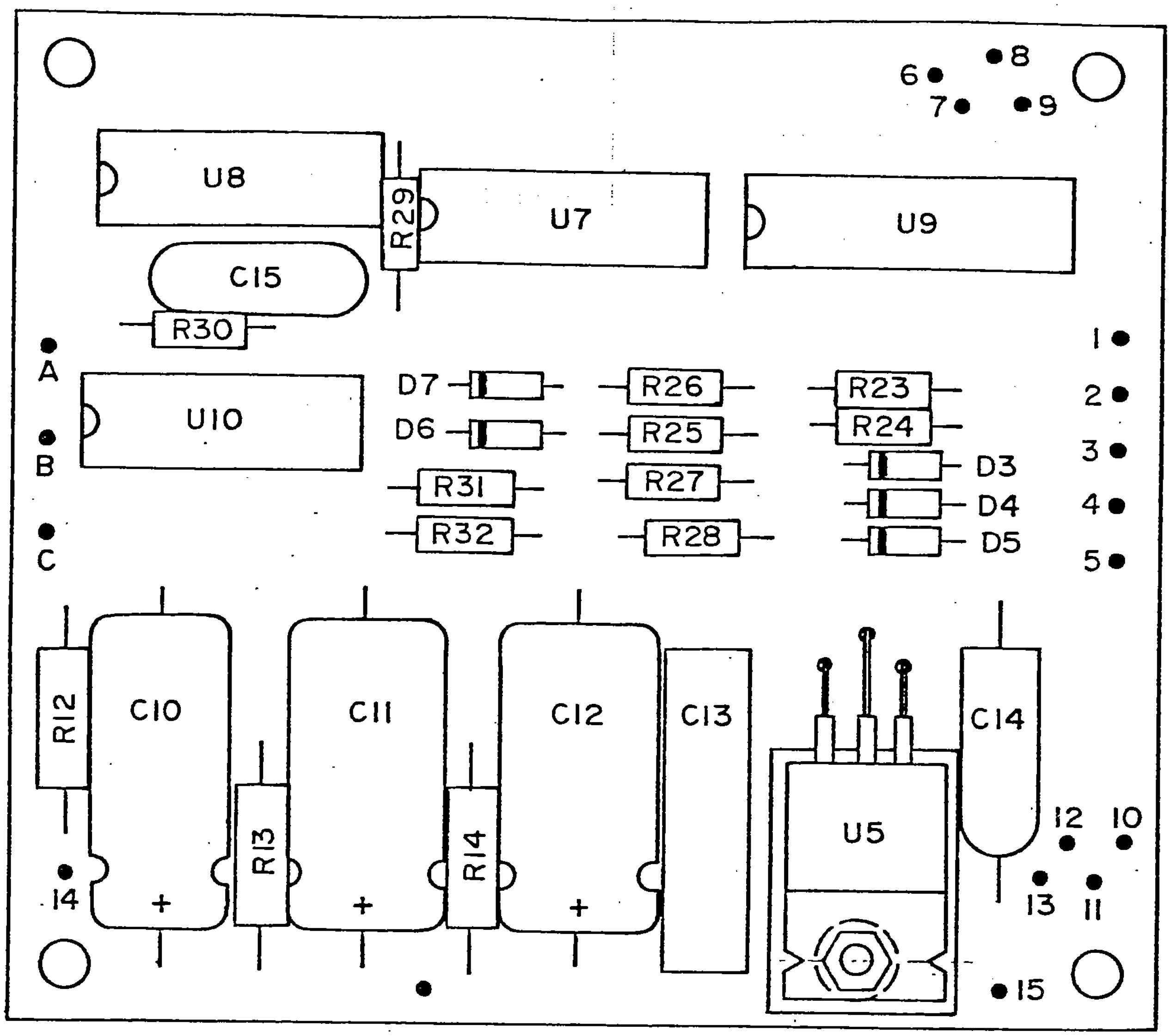


Figure 5.16

SG-811
A5B2 – COMPONENT LOCATION,
REGULATOR (40 GHz)

79A52-354

REF DESIGN	DESCRIPTION	MFR.	Drawing/ PART NO.
A5, FREQUENCY DISPLAY			
A5B1	A/D CONVERTER BOARD	MTC	SG-811 BM-51
A5B2-1	REGULATOR BOARD	MTC	SG-811 BM-52
A5B2-2	18-40 GHz Option (Opt 10)	MTC	SG-811 BM-52
A5B1, A/D CONVERTER BOARD			
C1	CAPACITOR, Ceramic, .1uf, 20%, 100 VDC	Erie	8131-100-651
C2	CAPACITOR, Film, .001uf, 10%, 100 VDC	Sprague	225P-1029/WD
C3,5	CAPACITOR, Film, 1.0uf, 10%, 100 VDC	GE	BA14A105A
C4	CAPACITOR, Film, 300pf, 5%, 500 VDC	Elmenco	DM15-301J
C6	CAPACITOR, Film, .22uf, 10%, 100 VDC	Sprague	225P2249/XD3
C7,8,9	CAPACITOR, Tantalum, 10uf, 10%, 20 VDC	Kemet	T310B106K020
D1,2	DIODE, Silicon,		1N4148
DS1,2,3,4,5	DISPLAY, 7-Segment	H-P	5082-7730
J1	CONNECTOR, 9 Pin	Cinch	DE-9P-V
Q1,2,3,4,5,6	TRANSISTOR, NPN		2N3904
R1	RESISTOR, Film, 20.0K, 1%, 1/4W		RN55D2002F
R2	RESISTOR, Film, 5.62K, 1%, 1/4W		RN55D5621F
R3	RESISTOR, Variable, 10K, 10%, 3/4W	Dale	8487-103

REF DESIGN	DESCRIPTION	MFR.	Drawing/ PART NO.
R4,11	RESISTOR, Composition, 100K, 5%, 1/4W		RC07GF104J
R5	RESISTOR, Composition, 2K, 5%, 1/4W		RC07GF202J
R6	RESISTOR, Composition, 2.7K, 5%, 1/4W		RC07GF272J
R7	RESISTOR, Composition, 36K, 5%, 1/4W		RC07GF363J
R8	RESISTOR, Composition, 300K, 5%, 1/4W		RC07GF304J
R9	RESISTOR, Composition, 510 ohms, 5%, 1/4W		RC07GF511J
R10	RESISTOR, Variable, 1K, 10%, 3/4W	Dale	8487-102
R15,16,17,18,19, 20,21	RESISTOR, Composition, 220 ohms, 5%, 1/4W		RC07GF221J
R22	RESISTOR, Composition, 47K, 5%, 1/4W		RC07GF473J
R23	RESISTOR, Composition, 330 ohms, 5%, 1/4W		RC07GF331J
U1	INTEGRATED CIRCUIT, Amplifier	Fairchild	uA741HC
U2	INTEGRATED CIRCUIT, Digital Processor	Intersil	ICL7103ACPI
U3	INTEGRATED CIRCUIT, Digital Processor	Intersil	ICL8052CPD
U4	INTEGRATED CIRCUIT, Timer	Signetics	NE555V
U6	INTEGRATED CIRCUIT, Decoder	NSC	74LS47

REF DESIGN	DESCRIPTION	MFR.	Drawing/ PART NO.
A5B2-1, REGULATOR BOARD			
C10,11,12	CAPACITOR, Electrolytic, 100uf, -10/+150, 20 VDC	CDE	WBR-100-25
C13	CAPACITOR, Ceramic, .33uf, 10%, 50 VDC	GE	75F4R5A334
C14	CAPACITOR, Tantalum, 22uf, 10%, 10 VDC	Kemet	T310C226K020
R12,13,14	RESISTOR, Composition, 22 ohms, 5%, 1/2W		RC20GF220J
U5	INTEGRATED CIRCUIT, Regulator	Fairchild	uA7805UC
A5B2-2, 18-40 GHz, Option 10			
C10,11,12	CAPACITOR, Electrolytic, 100uf, -10/+150, 20 VDC	CDE	WBR-100-25
C13	CAPACITOR, Ceramic, .33uf, 10%, 50 VDC	GE	75F4R5A334
C14	CAPACITOR, Tantalum, 22uf, 10%, 10 VDC	Kemet	T310C226K020
C15	CAPACITOR, Film, .001uf, 10%, 100 VDC	Sprague	225P10291WD3
D3,4,5,6,7	DIODE, Silicon		1N4148
R12,13,14	RESISTOR, Composition, 22 ohms, 5%, 1/2W		RC07GF220J
R24,25	RESISTOR, Composition, 2K, 5%, 1/4W		RC07GF202J
R26,27,28,29 31,32,33	RESISTOR, Composition, 100K, 5%, 1/4W		RC07GF104J

REF DESIGN	DESCRIPTION	MFR.	Drawing/ PART NO.
R30	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
U5	REGULATOR, 5 Volt	Fairchild	uA7805C
U8	FLIP-FLOP	National	MC14013CP
U9	ADDER	National	MC14560CP
U10	NAND Gate	National	MC14011CP

SUPPLEMENT
TO
SG-811 SWEPT SIGNAL GENERATOR
FOR
IEEE 488 BUS INTERFACE
OPTION 6A

March 1979

1.0 GENERAL

This supplement describes the installation, operation and maintenance of the IEEE 488-1975 Bus Interface (Option 6A) for the SG-811 Swept Signal Generator.

This option is contained within the mainframe and allows the SG-811 to be efficiently utilized as a test instrument under control of an IEEE 488-1975 bus. The following generator functions can be controlled through this interface.

MODE
BAND
FREQUENCY
ATTENUATION

Refer to section 4.0 for programming details.

2.0 INTERFACE CHARACTERISTICS

2.1 CABLE CONNECTOR

The rear panel connector is wired according to the IEEE standard with the 24 pin connector signal descriptions are as follows:

Contact No	Description
1	D101
2	D102
3	D103
4	D104
5	EO1
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	Shield
13	D105
14	D106
15	D107
16	D108
17	REN
18	GND (6)
19	GND (7)
20	GND (8)
21	GND (9)
22	GND (10)
23	GND (11)
24	GND (Logic)

NOTE: The number in parenthesis give the connector pin number with which the particular ground is associated.

D101-D108 are data lines. The data transmitted on these lines are typically in the form of an ASCII code which utilizes only seven lines. In some cases the eight bit is used for parity checks but this is typically not the case.

DAV, NRFD and NDAC are the three lines used for "handshake" purposes to insure the correct transfer of data at a rate acceptable to all listeners. The transfer rate is controlled by the slowest device on the line.

DAV (Data Valid) - the talker controls this line and sets the line true when the data on the line should be considered valid.

NRFD (Not Ready For Data) - this is a listener controlled line to indicate to the talker that it is not ready for data.

NDAC (Not Data Accepted) - this is a listener controlled line to indicate to the talker that it is not ready to have the data removed from the lines by the talker.

The interface bus uses negative-true logic as shown below.

Negative True Logic

High State = "0" = False = $\geq$2.0V
Low State = "1" = True = $\leq$0.8V

The following five lines are referred to as "management" lines since they help to define the purpose of certain messages, and control data flow over the bus.

ATN (Attention) - When false, the data lines carry data, but when true, they carry address or commands.

IFC (Interface Clear) - Used to place the system in a known idle state.

SRQ (Service Request) - Used to obtain the attention of the controller for some type of service, such as a printer signaling that it is out of paper.

REN (Remote Enable) - This line helps to select between local and remote control.

EOI (End or Identify) - Used to indicate the end of a multiple byte transfer or in conjunction with the ATN line to perform a parallel polling sequency.

The rear panel connector is mounted horizontally to allow stacking of connectors without extreme physical stress on the panel or connectors.

2.2 ADDRESS

An eight pole dip-switch is accessible from the rear panel to specify the "address" of the instrument when being controlled via the bus. Only five of the poles are used.

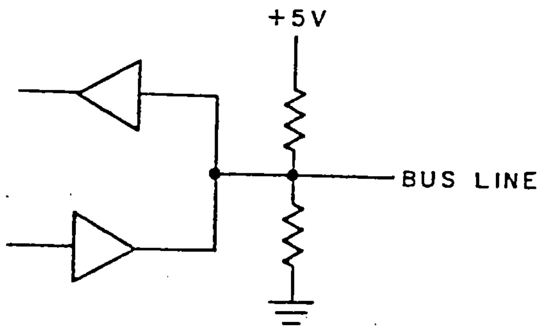
The numbered poles set up the instrument address. Figure 2.1 shows the relevant portion of the address switch programmed to designate the instrument as address number "9". When a rocker switch is depressed on the side nearest the numbers, it is considered on. Each switch that is "on" is added to form a complete address number. In the case of Figure 1 the "1" and "8" switches are on and thus the number 9 is the instrument address. If a controller were to send an SG-811 command to address 7 no changes in instrument operation would occur; but if the same command were sent to address 9, the instrument would respond as commanded.

2.3 BUS LINE LOADING

Each of the signal lines of the SG-811 interface conforms to the requirements of the IEEE 488-1975 for bus loading. It also has the following added features:

a. Power up/down protection to prevent invalid information from being transmitted on the bus lines during power up or down.

b. There is no bus loading when power is turned off. Typically, not more than one-half of the instruments on the bus should be turned off at any one time. This requirement insures adequate and correct bus loading because most instruments use the following bus line bias arrangement.



The SG-8112 can be turned off without adding to the "one-half off" count. It can be regarded as an open circuit when in a power-off condition.

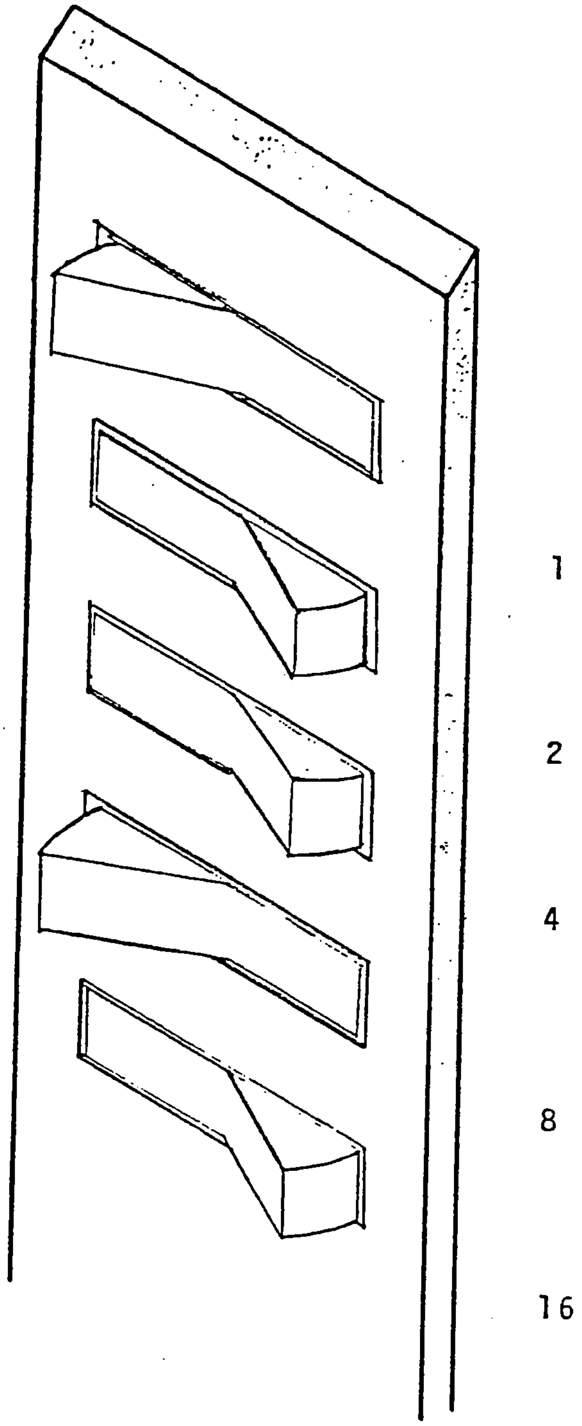


FIGURE 2.1
ADDRESS SWITCH

3.0 THEORY OF OPERATION

The SG-811, IEEE 488 bus interface is an eight bit microprocessor controlled interface designed for maximum flexibility while possessing a minimum parts count and low power consumption.

The interface is housed within two metal boxes, one being the +5 volt power supply and the interface itself which contains three printed circuit boards (A9B1, A9B2, A9B3). Circuit board A9B3 is the microprocessor board used to control data flow and to process data. A9B2 is the address board used to select the IEEE 488 address and a decoder (U2) to select the output latches on A9B1. A9B1 is basically a set of addressable latches to store data from A9B3 and output the data to the SG-811 parallel input connector.

3.1 MICROPROCESSOR (A9B3)

3.1.1 CENTRAL PROCESSOR

U1 is a Motorola MC6802, 8-bit NMOS microprocessor with internal RAM and internal clock. The CPU operates at a frequency equal to .25 times the internal clock frequency. In this case the internal clock frequency is 3.58 MHz. Pin 37 of the CPU is the output for the system clock frequency (≃895 kHz). The CPU (also the rest of the system) operates from a single 5 volt supply.

3.1.2 PROM

The system program is contained within a 1K x 8 un-erasable PROM (INTEL 2758). The 2758 was selected due to its use of a single 5 volt power supply, and its pin-for-pin compatibility with a 2716 which is a 2K x 8 in the same basic package, should a very long program be necessary for a special application.

3.1.3 INTERFACE ADAPTER

The Motorola MC68488 is used in this design to obtain maximum programming flexibility. The MC68488 handles all necessary handshaking and protocol messages automatically without involving programming steps. Thus, the microprocessor can be busy performing other tasks while the MC68488 is interfacing with the 488 bus and as a result, saving bus time.

3.1.4 BUS TRANSCEIVERS

Between the MC68488 and the 488 are four bus transceivers. These devices contain receivers, transmitters, and the bias networks to satisfy the IEEE 488 bus loading requirements.

3.1.5 OPERATION

At turn on the microprocessor puts the unit in the "local" mode and waits for a command from the controller to specify the desired generator operation. The contents of the rear panel dip switch are read, processed and stored in a register within the MC68488. The MC68488 now waits to be addressed by the controller. During this time the microprocessor continues to poll the address switch, and MC68488, to test for a change in the address or received data.

Once the unit is addressed, the MC68488 sets a bit in one of its registers to tell that it has been addressed. The MC6802 recognizes the set bit and then starts polling a different register to see if the MC68488 has data, or if it has just been addressed. If it has received data the MC68488 holds up the bus operation until the microprocessor has removed the data from the MC68488. While the MC6802 processes the data and puts it in temporary storage, the MC68488

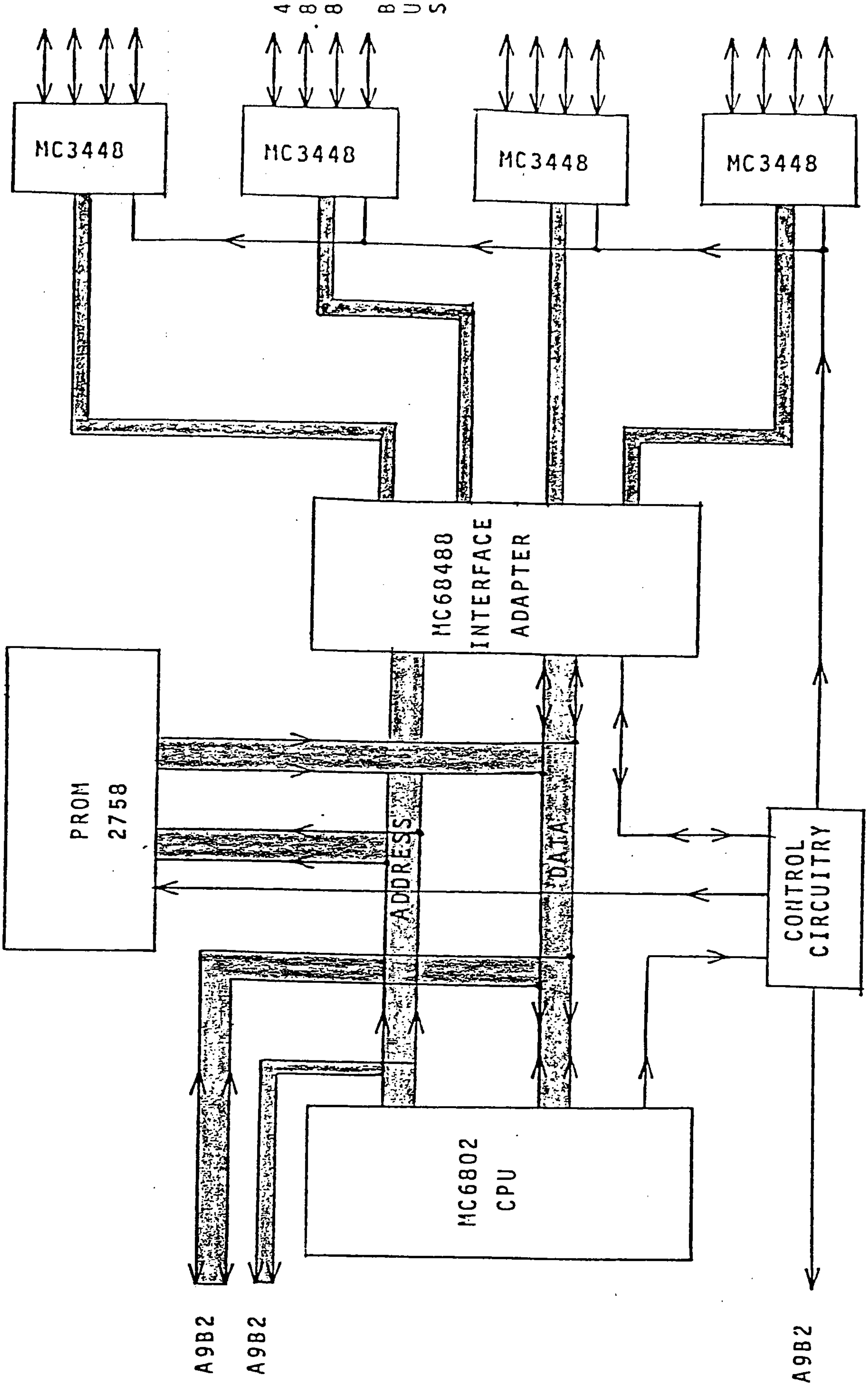


FIGURE 3.1
MICROPROCESSOR BLOCK DIAGRAM (A9B3

retrieves the next byte of data from the bus. (thus we can see that the bus functions as a "bit parallel-byte serial" system of data transfer). Once the MC6802 has completed its task, it can go back to the MC68488 and obtain more data from the MC68488 if it is available.

Once the unit has received all its necessary data, it will obtain the desired data from temporary storage, and process the data ns store the information in the correct addressable latches on board A9B1. There the data will be directed to the rest of the SG-811 in order to complete the programming function.

Greater detail concerning the actual programming techniques, data manipulation and data transfer will be covered in a later section.

3.2 DECODER (A9B2 - U2)

This device is primarily responsible for routing of data to the latches on A9B1. This integrated circuit is a BCD-Decimal decoder with only one output low at any one time. The 1-2, 4-8 inputs to the device allow seven different addresses to be selected (1-2-4 inputs) and the "8" input is used as a chip enable. Only after the microprocessor sets bit 8 low can data be stored in the latches on A9B1.

3.2.1 LATCHES (A9B1 - U2/U7)

These devices are CMOS, 8 bit latches with tri-state outputs in a 20 pin package. U1 is used just as a buffer to limit the number of devices tied directly to the microprocessor data bus. Pin 11 of the latches are the latch enable lines and when this line goes high the data from the bus is transferred to the latch output.

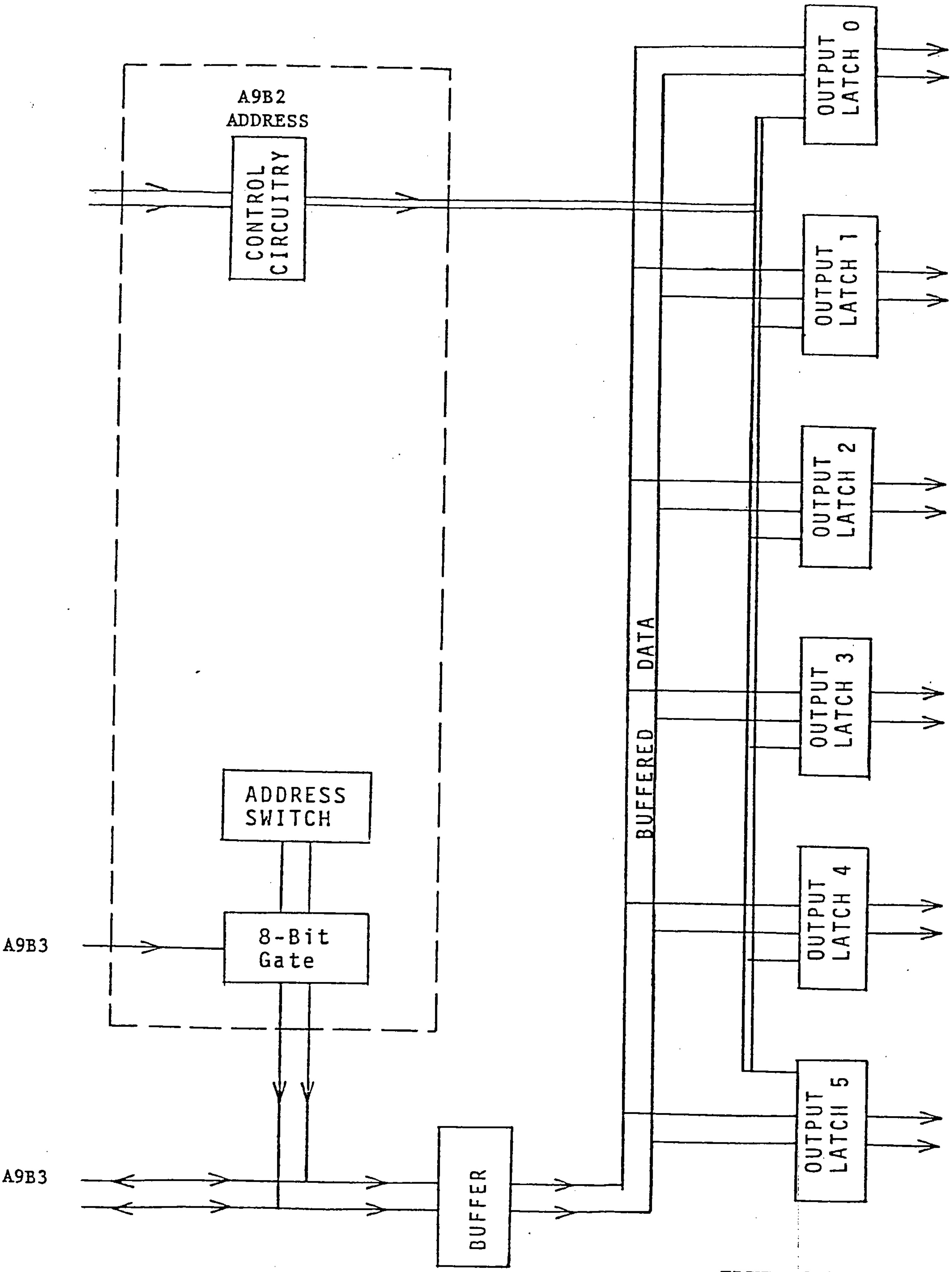


FIGURE 3.2
DATA OUTPUT (A9B1)

ASC11 CODE

3 MSB's

4 LSB's

	000	001	010	011	100	101	110	111
0000	NUL 0	DLE 16	SP 32	0 48	@ 64	P 80	` 96	p 112
0001	SOH 1	DC1 17	33	1 49	A 65	Q 81	a 97	q 113
0010	STX 2	DC2 18	" 34	2 50	B 66	R 82	b 98	r 114
0011	ETX 3	DC3 19	# 35	3 51	C 67	S 83	c 99	s 115
0100	EOT 4	DC4 20	$ 36	4 52	D 68	T 84	d 100	t 116
0101	ENQ 5	NAK 21	% 37	5 53	E 69	U 85	e 101	u 117
0110	ACK 6	SYN 22	& 38	6 54	F 70	V 86	f 102	v 118
0111	BEL 7	ETB 23	' 39	7 55	G 71	W 87	g 103	w 119
1000	BS 8	CAN 24	(40	8 56	H 72	X 88	h 104	x 120
1001	HT 9	EM 25	) 41	9 57	I 73	Y 89	i 105	y 121
1010	LF 10	SUB 26	* 42	: 58	J 74	Z 90	j 106	z 122
1011	VT 11	ESC 27	+ 43	; 59	K 75	91	k 107	{ 123
1100	FF 12	FS 28	, 44	< 60	L 76	92	l 108	124
1101	CR 13	GS 29	- 45	= 61	M 77	93	m 109	} 125
1110	SO 14	RS 30	. 46	> 62	N 78	↑ 94	n 110	126
1111	SI 15	US 31	/ 47	? 63	O 79	- 95	o 111	↓ 127

ASC11 CODE CHART

4.0 PROGRAMMING

A common "language" must exist for good communication. The following paragraphs define which generator functions are controllable from the bus, what symbols or messages will be recognized by the SG-811 IEEE 488 interface, and what are the limitations.

BAND:

Band Number	Frequency Range
1	.01-2 GHz
2	2-4 GHz
3	4-8 GHz
4	8-12 GHz
5	12-18 GHz
8	2-18 GHz (Crossbanding)
?	Local Control

ATTENUATOR:

0-119 dB in 1 dB step and local control.

FREQUENCY CONTROL:

This is a digital number from 0000-9999 (4 BCD numbers) used to control frequency. Frequency resolution depends on mode selected.

MODE:

Various modes can be specified by the 488 bus as shown below:

Mode Number	Description
0	LOCAL
1	CW
2	Δ F
3	F_1-F_2
4	BAND
5	EXT Δ F (Analog)
6	EXT F_1-F_2 (Analog)
7	EXT BAND (Analog)
8	PHASE LOCK
9	SYNTHESIZE
J	EXT BAND (Digital)
K	EXT Δ F (Digital)
L	EXT F_1-F_2 (Digital)

Further explanation of related programming will be covered later.

4.1 GENERAL

Problems arise in programming due to the different symbols (or languages) used in various parts of the system. For example a controller will probably have a keyboard which has an ASCII interface. If a "5" is punched on the keyboard it goes out on the bus as 0110101 (Hexidecimal 35 or Decimal 53). An "A" would be 1000001 (Hex. 41, or Decimal 65).

Confusion could occur. To prevent such problems, certain restrictions are made in programming and some specialized "characters" must be defined for use in this system.

There are 128 ASCII characters as shown on the ASCII code chart on the following page. There are 33 special function characters typically used for device controls such as:

CR = Carriage Return
SP = Space
FF = Form Feed

Since these characters have no meaning for the SG-811, they will be ignored by the microprocessor interface (at least from the user's veiwpoint). Similiarly, different controllers send different figures such as (. periods or decimal points), (, commas) or " quotes). No information will be transmitted via these symbolts. The SG-811 interface ignores the first 48 characters (except CR which can be used by the microprocessor but not by the user for programming).

Of the remaining ASCII numbers, five have unique meanings. These five characters are: "A", "B", "F", "M", and "?". These characters and their significance will be covered in the applicable function description covered in the following paragraphs of the section.

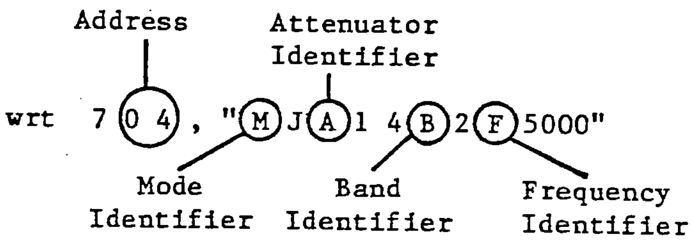
Examples shown will use the format of an HP-9825 controller. For example, wrt 704, "A23B2MJF5000" would result in an SG-811 with an address of "4" being set with an attenuator setting of 23 dB below the front panel setting, in band 2 (2-4 GHz) with Mode J (Digital Control of frequency) and set to F (5000) which would result in an output at about 3.0 GHz.

The purpose of the uniquely selected characters described previously is to allow the change of a single function value without the need to redefine a previously define function value.

If the band function is already set to the desired band but an attenuator setting is to be changed, it would be undesirable to have to specify the desired band again. Also, a particular order of commands would be undesireable. The following designations should be fairly obvious once presented.

Function	Identifier
Attenuator	A
Band	B
Frequency	F
Mode	M

Upon receiving these characters, the microprocessor will jump to the correct part of the program, process the data and set the correct enable lines to allow the proper operation of the desired function.



MODE = J
ATTEN = 14 dB
BAND = 2
F = Midband $\frac{5000}{10000}$

As explained previously, order is not important. Thus, the following two commands would result in the same generator operation.

```
wrt 704, "MJB2F5000A14"
     or
wrt 704, "A14F5000MJB2"
```

If a band were to be swept, the following sequence of commands would also be desirable to save time since the attenuator, band and mode would not have to be re-transmitted each time.

```
wrt 704, "MJB2A14"
for I = 0 to 9999
I/1000    X
wrt 704, "F", X
next I
```

The bus has no control over the SG-811 unless the "LOCAL-REMOTE" toggle switch on the rear panel of the generator is in the "REMOTE" position.

At turn on, even though the rear panel toggle switch is in the "REMOTE" position, the instrument is fully controllable by the front panel controls. The microprocessor sets the instrument to the "LOCAL" mode at turn on as well as "LOCAL" control for Attenuator and Band.

4.2 ATTENUATOR

The step attenutor in the SG-811 is controllable over the full range from 0 to 119 dB in 1-dB steps via the interface Bus. Since it is a step attenuator control and not a level control, it is not possible to have negative attenuation. The interface will interpret the value presented as an absolute value of attenuation. Thus, both of the following commands would result in identical output levels.

wrt 704, "A-65" = wrt 704, "A65"

Note also that the following commands would result in the same level.

```
65    X
wrt 704, "A", X
```

It may be desirable to return attenuator control to the front panel sometime after the bus has exercised control of the attenuator. It may also be undesirable to return all of the functions to local control, so a technique to return the attenuator only to local control is included in the programming. This is done by using the character "?" following a capital "A".

wrt 704, "A?"

Two digits are utilized to control the attenuator setting to cover the range from 0 to 119 dB. Further explanation is necessary to prevent confusion. Immediately the question comes up "How are the settings from 100-199 covered since there are 3 digits present but only two are used by the microprocessor?" The answer is that the least significant digit is decimal (BCD) but the most significant digit is hexidecimal. This maintains consistency with signal generators which do not have General Purpose Interface Adapters. It also saves processing time.

NUMBER SYSTEM CHART

Decimal	Binary	Hexidecimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
N/A	1010	A (10)
N/A	1011	B (11)
N/A	1100	C (12)
N/A	1101	D (13)
N/A	1110	E (14)
N/A	1111	F (15)

Using the four LSB's of the ASCII characters utilized as a hexidecimal number makes programming straightforward. The following examples illustrate this.

Functional Identifier

wrt 704, "A:9" = 109 dB

wrt 704, "AJ9" = 109 dB

wrt 704, "AZ9" = 109 dB

Note that a "colon", a "J", and a "Z" all result in the same attenuator setting. evaluating the ASCII codes shows why.

: = 011 1010
J = 100 1010
Z = 101 1010

The four least significant bits are equal.

wrt 704, "A99" = 99 dB

wrt 704, "AJ9" = 109 dB

wrt 704, "AK9" = 119 dB

Another possible source of confusion is that most controllers do not transmit leading zeros. If the attenuation is to be less than 10 dB this may be a problem. If 3 dB of attenuation is desired, a possible command would be wrt 704, "A03" but the value can not be entered as a variable within a computer program with ease. A more desirable command may be as shown.

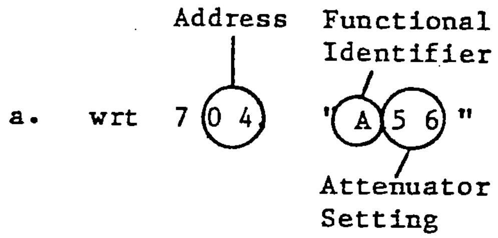
X/Y → T (Assume X/Y = 3)
wrt 704, "A", T

The controller would probably send a "3.0" which would result in a 30 dB setting instead of 3 dB. The following modification to the program will solve the problem.

X/Y → T; T/10 → T
wrt 704, "A", T

Thus the controller would send a "0.3" sequence which, since the decimal point is ignored, would result in the correct attenuator setting.

As a brief summary, understanding the following examples should result in a workable and useful knowledge of the attenuator function in the SG-811 Signal Generator.



b. wrt 704, "A?" = Return to local attenuator control

c. wrt, "AJ5" = 105 dB attenuator setting

d. wrt, "AK5" = 115 dB attenuator setting.

4.3 BAND (B)

The band function is basically the same as the attenuator function. It only has one digit following the "function identifier character" and only numbers between 1 and 8 plus the "return to local" command (?).

The following examples are explanatory.

Command	Frequency Range
wrt 704, "B1"	.01-2 GHz
wrt 704, "B2"	2.0-4.0 GHz
wrt 704, "B3"	4.0-8.0 GHz
wrt 704, "B4"	8.0-12.0 GHz
wrt 704, "B5"	12.0-18 GHz
wrt 704, "B8"	2-18 GHz (Crossband)
wrt 704, "B?"	LOCAL Control

The examples shown in the discussion are fairly simple to translate to another type of controller's language.

4.4 MODE (M)

There are thirteen different modes available to the SG-811 user via the interface bus control. These modes will be listed and briefly discussed, but more detailed information is located in section 3.6 of the SG-811 manual.

Mode Number	Mode Description
0	LOCAL
1	CW
2	ΔF
3	F_1-F_2
4	BAND
5	EXT ΔF (Analog)
6	EXT F_1-F_2
7	EXT BAND (Analog
8	Ø LOCK
9	SYNTHESIZER
J	EXT BAND (Digital)
Z	EXT ΔF (Digital)
L	EXT F_1-F_2 (Digital)

Mode 0 (L"LOCAL") returns all tuning and sweep functions (excluding band control) to front panel controls.

Modes 1 through 4 set the mode of the instrument but parameters are set by a combination of front panel controls and external analog input voltages.

Modes 5 through 7 set the mode of operation. Sweep parameters are set by a combination of front panel controls and external analog input voltage.

Modes 8 through 9 activate the YIG fine tuning coils and allow the generator to be utilized in a phase locked system.

Modes J, K and L use an internal D/A converter to allow Digital Control of the frequency; ΔF or F_1-F_2 sweep. The digital information is also received via the 488 bus.

As described previously, the mode is characterised by a single number which varies not from 0-12 but 0-L.

ASCII	Character	Hexidecimal Value
100 1010	J	A
100 1011	K	B
100 1100	L	C

The last four bits of the ASCII code are the numbers required for correct programming results.

4.5 FREQUENCY (F)

Programming of frequency can only be used in three of the thirteen modes described previously. However, one of the most common modes may be to set a frequency output by program control via the bus. This mode and frequency control will be described in detail. The three modes which use this function are:

Mode J EXT Band (Digital)
Mode K EXT ΔF (Digital)
Mode L EXT F_1-F_2 (Digital)

A four digit BCD DAC receives this data. Thus it is important that the data be decimal in nature rather than binary.

```
0   wrt 704, "B2, MK A40"
1   For I = 0 to 9999
2   I/1000    X
3   wrt 704, "F", X
4   wait 100
5   next I
```

The above program would sweep from 2 to 4 GHz in 10,000 steps, but it would not be exactly 2 to 4 GHz but more likely 1.9 to 4.1 GHz since the SG-811 is set-up to insure that no holes can exist at cross-over points even with a slight drift over a long period of time. With this in mind it is not difficult to write a program such that a frequency can be entered at the computer keyboard and transmittted via the interface bus to the SG-811 to obtain the desired output frequency within a reasonable tolerance.

The "EXT ΔF" and "EXT F_1-F_2" modes similiarly can be utilized via the "Frequency" control once a basic understanding of the modes is obtained.

5.0 MAINTENANCE

If an apparent failure has occurred, the first step is to reset the microprocessor by turning off the SG-811 and turning on the unit again. Next, try to program the instrument again. Check the rear panel to insure that the "LOCAL-REMOTE" switch is in the "REMOTE" position. Check the address switch.

If the unit has worked in the past with the commands given, open the unit and check that the power supply voltage is 5.0 $\pm$.25V. Typical supply current is .6A. If it is decided that the interface is defective, the unit should be disassembled. Check that there are no shorts when the boards are layed out prior to turn on. The three boards in the unit can now be handled as separate units.

5.1 MICROPROCESSOR BOARD (A9B3)

The following test sequence will eliminate some of the more probable failures.

5.1.1 SYSTEM CLOCK

An oscilloscope can be used to verify that the system clock is operating correctly. Connect the scope probe to pin 37 of U1, 1 v/cm, and verify that a TTL level signal at aout 900 kHz is present. Test the remaining pins on U1 and verify the following list.

Pin No.	Signal	Pin No.	Signal
1	GND	21	GND
2	≃ 5V	22	
3	≃ 5V	23	TTL Switching
4	≃ 5V	24	TTL Switching
5	TTL Switching	25	TTL Switching
6	≃ 5V	26	TTL Switching
7	N/A	27	TTL Switching
8	≃ 5V	28	TTL Switching
9	TTL Switching	29	TTL Switching
10	TTL Switching	30	TTL Switching
11	TTL Switching	31	TTL Switching
12	TTL Switching	32	TTL Switching
13	TTL Switching	33	TTL Switching
14	TTL Switching	34	TTL Switching
15	TTL Switching	35	≃ +5
16	TTL Switching	36	≃ +5
17	TTL Switching	37	System Clock
18	TTL Switching	38	N/A
19	TTL Switching	39	N/A
20	TTL Switching	40	≃ 5V

NOTE: TTL Switching signal is a signal which does not have a definite frequency or pattern but depends on the part of a program at which the unit is operating.

This is the heart of the system and if it appears to be functioning as shown previously, continue on to the following test.

Check pin 20 of 2758 (U2) to verify that the device is being accessed. The chip is selected when this voltage is low. A TTL level switching signal should be present.

There are only two test on U5.

1. Verify a TTL level switching signal at pin 3.

2. Check for a negative going pulse at pin 4 of U3.

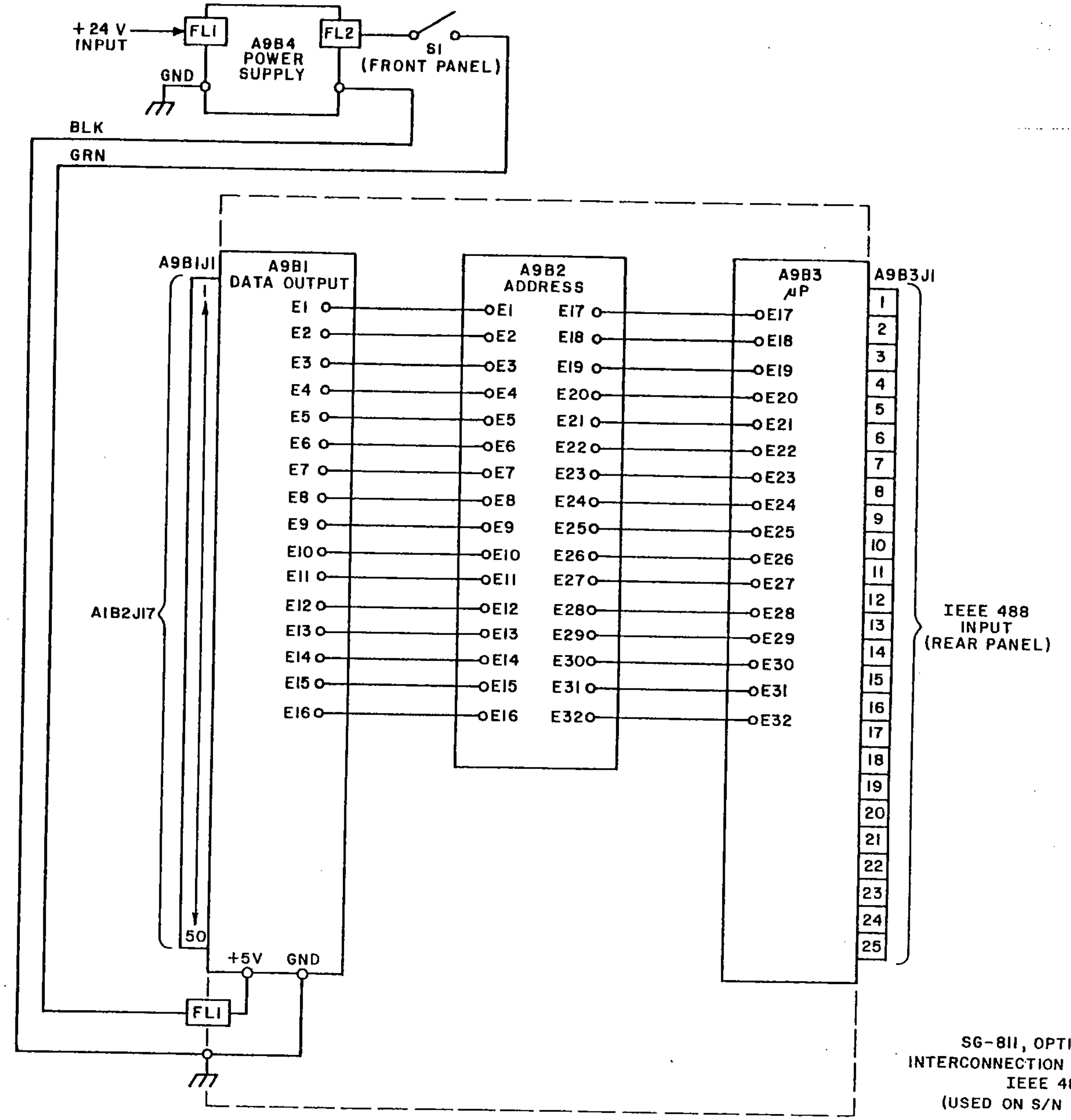
REF. DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A8, D/A CONVERTER BOARD			
C1,2,3	CAPACITOR, Ceramic, .luf, 20%, 100VDC	Erie	8131-100-651-104M
D1	DIODE, Silicon		1N4001
D2	DIODE, Silicon		1N4148
DAC 1	D/A CONVERTER BCD 4 Digit	Datel	DAC-169-16D
K1	RELAY	G-B	835C-1
Q1	TRANSISTOR, PNP		2N3906
R1	RESISTOR, Composition, 10K, 5%, 1/4W		RC07GF103J
R2	RESISTOR, Composition, 8.2K, 5%, 1/4W		RC07GH822J
R3	RESISTOR, Variable, 500 ohms	Beckman	62PAR-500-Ohm
R4	RESISTOR, Composition, 1M		RC07GF105J
R5	RESISTOR, Variable, 100K	Beckman	62PAR-100K
XQ1	SPREADER	Therm.	7717-247

REF. DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A9B1, DATA OUTPUT, IEEE 488			
A9B1-J1	CONNECTOR, 50 Pin	AMPH	57-10500-27
C1	CAPACITOR, Ceramic, .luf, 20%, 100VDC	Erie	8121-M050-651-104
R1,2,3,4,5, 6,7,8	RESISTOR, Composition, 4.7K, 5%, 1/8W		RC07GF472J
U1,2,3,4,5, 6,7	INTEGRATED CIRCUIT, Octal Latch	NSC	MM74C373
XU1,2,3,4,5, 6,7	SOCKET, Strip, 20 Pin	EMC	7195-295-1
A9B2, ADDRESS, IEEE 488			
C1,3	CAPACITOR, Tantalum, 10uf, 20V	Sprague	196D106X0020CHA1
C2,4,5	CAPACITOR, Ceramic, .luf, 20%, 100V	Erie	8121-M050-651-104
R1,2,3,4,5,6, 7,8,9,10, 11,12,13,14, 15,16,17,18, 19,20,21	RESISTOR, Composition, 4.7K, 5%, 1/8W		RC07GF472J
U1	INTEGRATED CIRCUIT Octal Latch	NSC	MM74C373
U2	INTEGRATED CIRCUIT	NSC	74LS145
U3,4	INTEGRATED CIRCUIT	NSC	74LS02
XU1	SOCKET, Strip, 20 Pin	EMC	7195-295-2
XU2	SOCKET, 16 Pin	EMC	7016-265-5
XU3,4,	SOCKET, 14 Pin	EMC	7014-265-5
XS1	SOCKET, Right Angle	CA Corp	CA-16SE-10RAC3-01

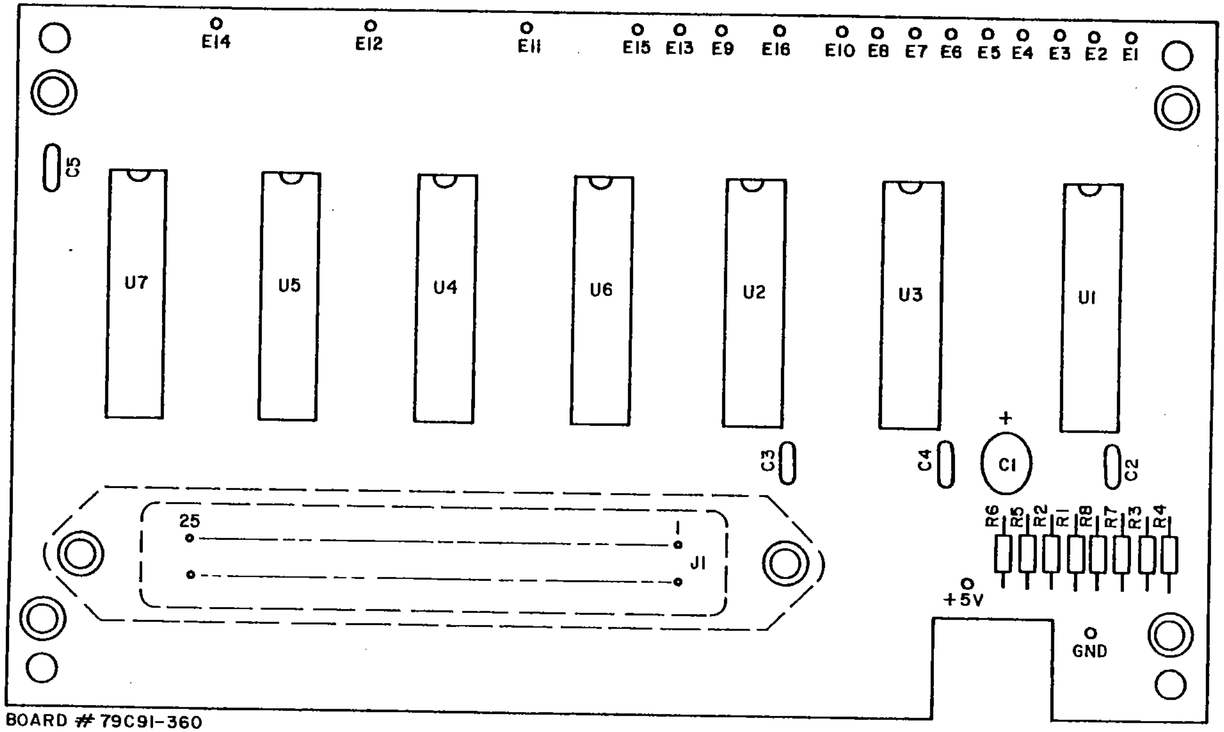
REF. DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A9B3, MICROPROCESSOR, IEEE 488			
C1	CAPACITOR, Mica 10pf, ±.5%, 100V	Erie	8101-100-COGO100D
C2,3,6,7,10, 11,12,13	CAPACITOR, Ceramic, .lyf, 20%, 100V	Erie	8121-M050-651-104M
C3,4,7,9	CAPACITOR, Tantalum, luf, 20%, 50V	Sprague	196D105X0050CHA1
J1	CONNECTOR, 24 Pin	AMPH	57-2024-2
Q1	TRANSISTOR,		2N3904
R1,2,3,4,5, 6,7,8,9,10, 12,13	RESISTOR, Composition, 4.7K, 5%, 1/8W		RC07GF472J
R11	RESISTOR, Composition, 51K, 5%, 1/8W		RC05GF513J
U1	INTEGRATED CIRCUIT	MOT	MC6802P
U2	INTEGRATED CIRCUIT	INTEL	2758
U3	INTEGRATED CIRCUIT	SIG	74LS145N
U4	INTEGRATED CIRCUIT	MOT	SN74LS00N
U5	INTEGRATED CIRCUIT	MOT	MC68488P
U6,7,8,9	INTEGRATED CIRCUIT	MOT	MMC3448AL
XU1,2,5	SOCKET STRIP	EMC	7195-295-25
XU3,6,7,8,9	SOCKET, 16 Pin	EMC	7016-265-5
XU4	SOCKET, 14 Pin	EMC	7014-265-5
Y1	CRYSTAL, 3.5 MHz	IMTRON	3.5 MHz MP-1

REF. DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A9B4, IEEE 488, POWER SUPPLY			
C1,2	CAPACITOR, Electrolytic, 150uf, 50V	CDE	WBR-150-50
C3	CAPACITOR, Ceramic, .1uf, 100V	Erie	8131-100-651-104M
C4	CAPACITOR, Film, .022uf, 100V	Sprague	225P-22391WD3
C5	CAPACITOR, Film, .001uf, 100V	Sprague	225P-10291WD3
C6	CAPACITOR, Electrolytic, 500uf, 16V	CDE	WBR500-16
D1	DIODE		1N5816
FL1,2	FILTER CON	USCC	1020-000
L1	INDUCTOR Core, Toroid Wire, #22 (100T)	MTC Arnold	A-206068-2
L2	INDUCTOR Core, Toroid Wire #22 (2407)	MTC Arnold	A-206068-2
Q1	TRANSISTOR, PNP		2N3720
Q2	TRANSISTOR, PNP		2N3906
R1,2	RESISTOR, Film, 5.11K, 1%, 1/4W		RN55D5111F
R3	RESISTOR, Composition, 100K, 5%, 1/4W		RC07GF104J
R4	RESISTOR, Composition, 47K, 5%, 1/4W		RC07GF473J
R5	RESISTOR, Composition, 100 ohms, 5%, 1/4W		RC07GF101J

REF. DESIGN.	DESCRIPTION	MFR.	DRAWING/ PART NO.
A9B4, IEEE 488, POWER SUPPLY			
R6	RESISTOR, Composition, 270 ohms, 5%, 1/4W		RCO7GF271J
R7	RESISTOR, Composition, 1K, 5%, 1/4W		RCO7GF102J
R8,10	RESISTOR, Film, 4.12K, 1%, 1/4W		RN55D4121F
R9	RESISTOR, Variable, 1K	Beckman	62PAR1K
U1	INTEGRATED CIRCUIT	SG	3524J

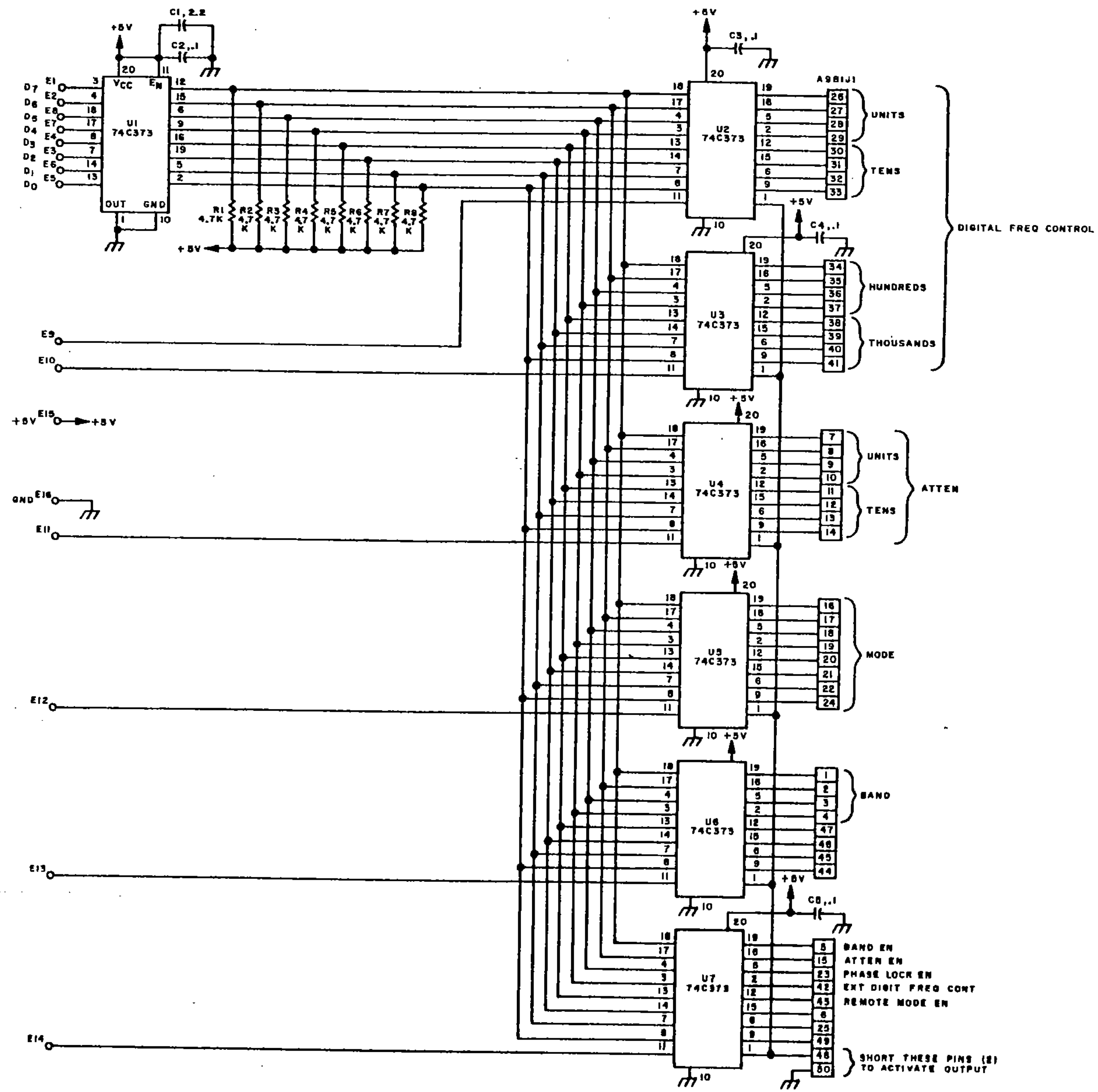


SG-811, OPTION 6A
INTERCONNECTION DIAGRAM, A9
IEEE 488
(USED ON S/N 167 & UP)
79B90-394



BOARD # 79C91-360

SG-811, OPTION 6A
COMPONENT LOCATION, A9B1
DATA OUTPUT IEEE 488
(USED ON S/N 167 & UP)
79B91-383

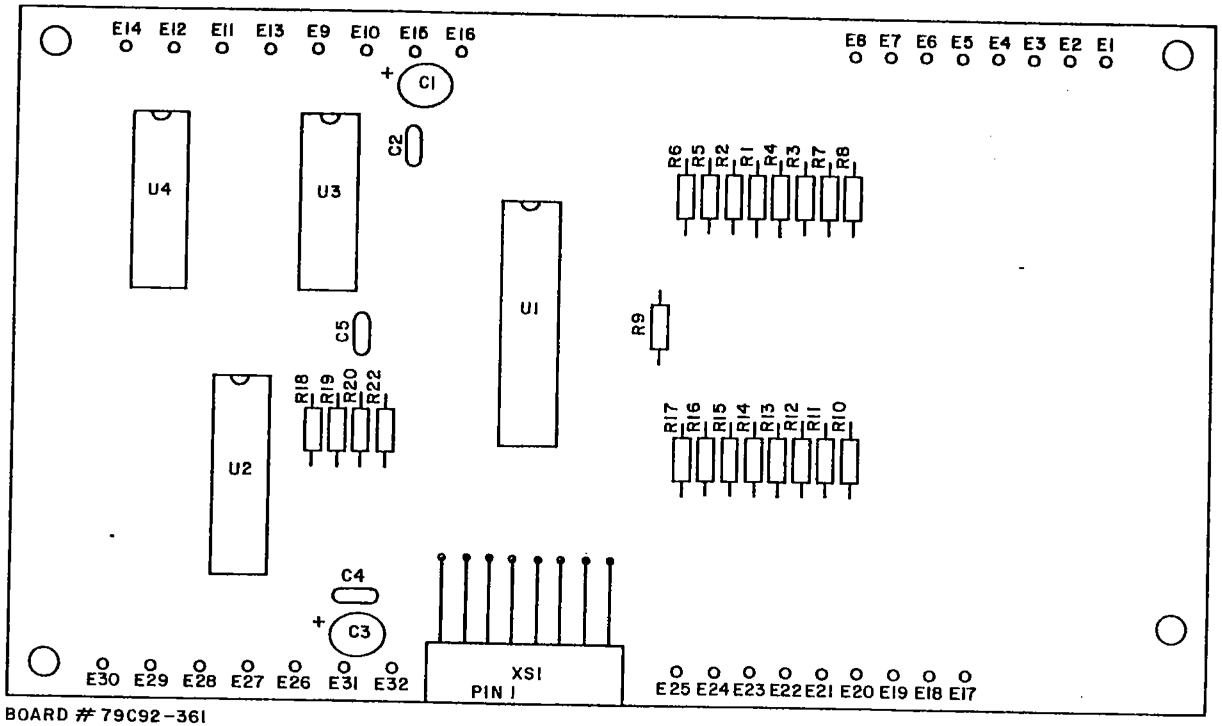


REF DESIGNATIONS	
LAST USED	NOT USED
C5 E15 J1 R8 U7	

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS AND ARE 1/8W
ALL CAPACITOR VALUES ARE IN MICROFARADS

SG-811, OPTION 6A
SCHEMATIC, A981
DATA OUTPUT IEEE 488
(USED ON S/N 167 & UP)

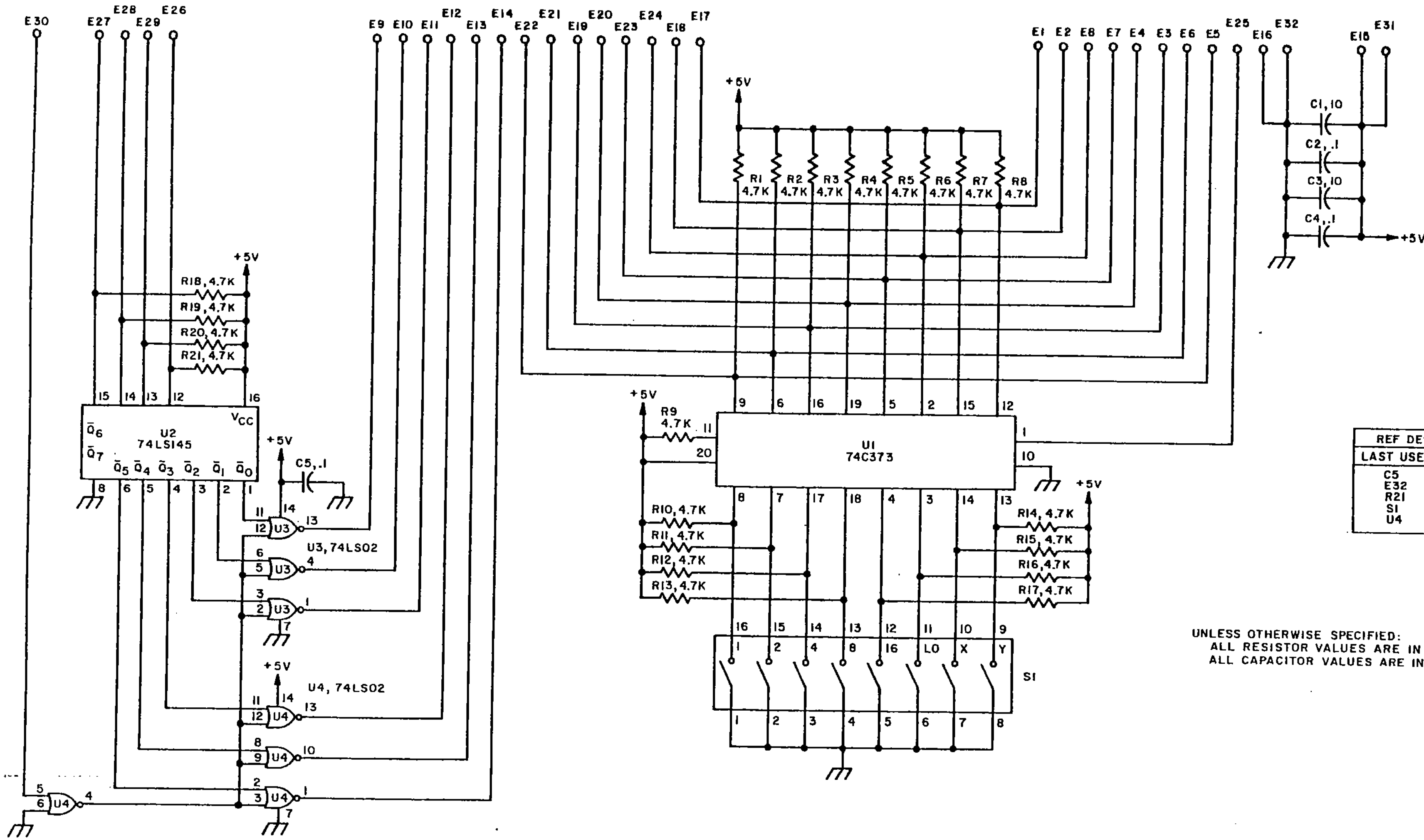
79891-390



BOARD # 79C92-361

SG-811, OPTION 6A
COMPONENT LOCATION, A9B2
ADDRESS IEEE 488
(USED ON S/N 167 & UP)

79B92-384

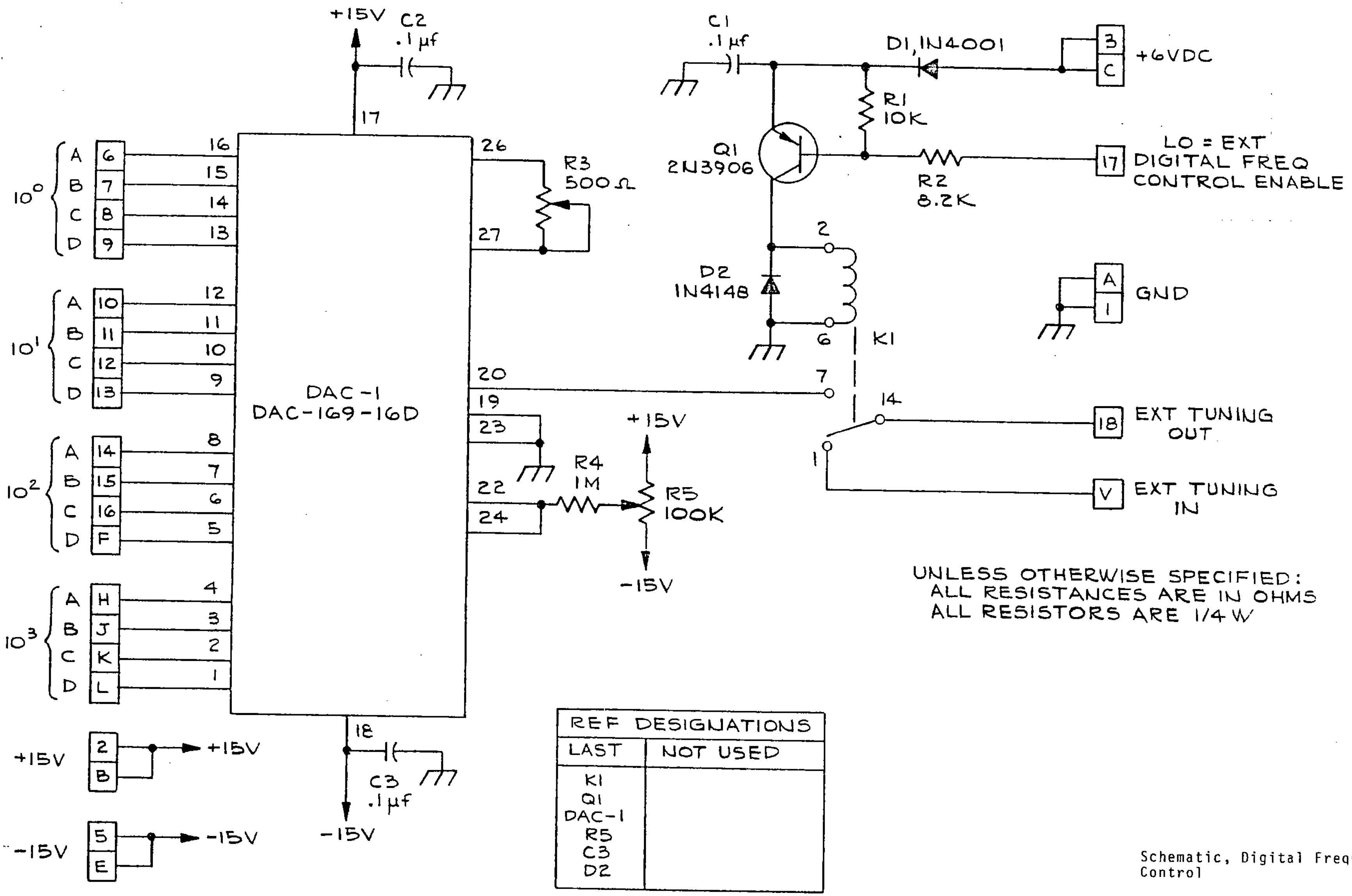


REF DESIGNATIONS	
LAST USED	NOT USED
C5 E32 R21 S1 U4	

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS & 1/8W
ALL CAPACITOR VALUES ARE IN MICROFARADS

SG-811, OPTION 6A
SCHEMATIC, A9B2
ADDRESS IEEE 488
(USED ON S/N 167 & UP)

79B92-393



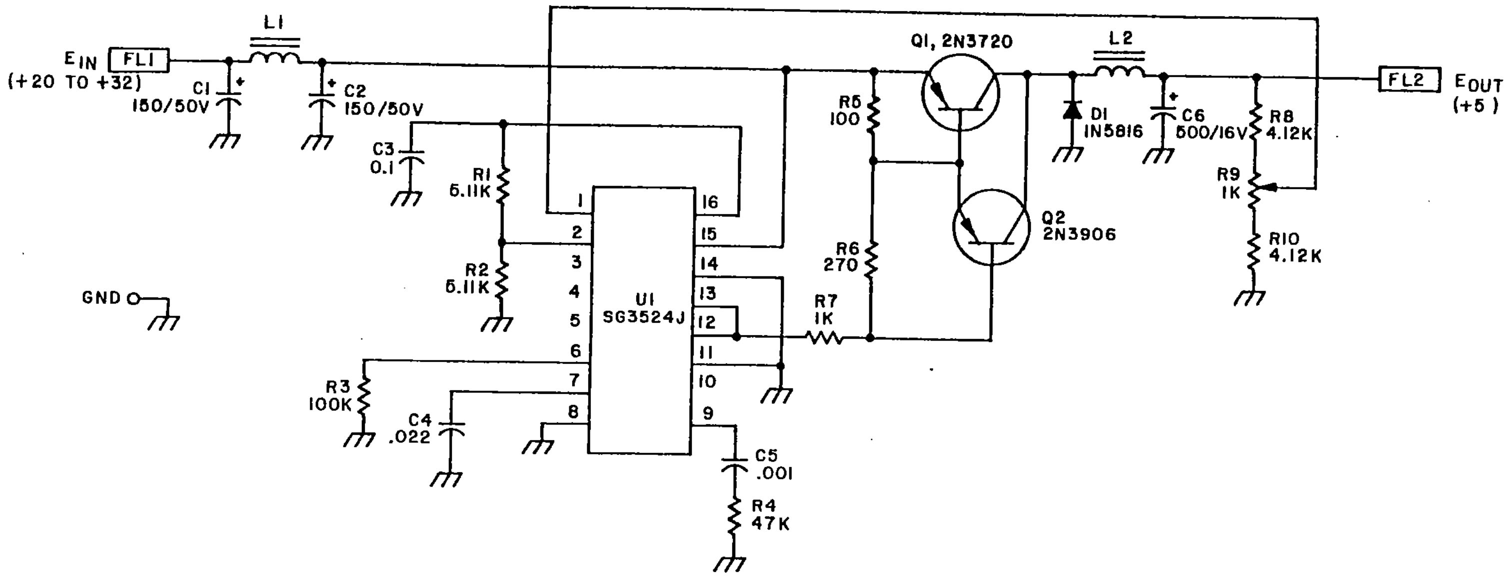
UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W

REF DESIGNATIONS	
LAST	NOT USED
K1 Q1 DAC-1 R5 C3 D2	

Schematic, Digital Frequency Control

79B80-176 (A8)

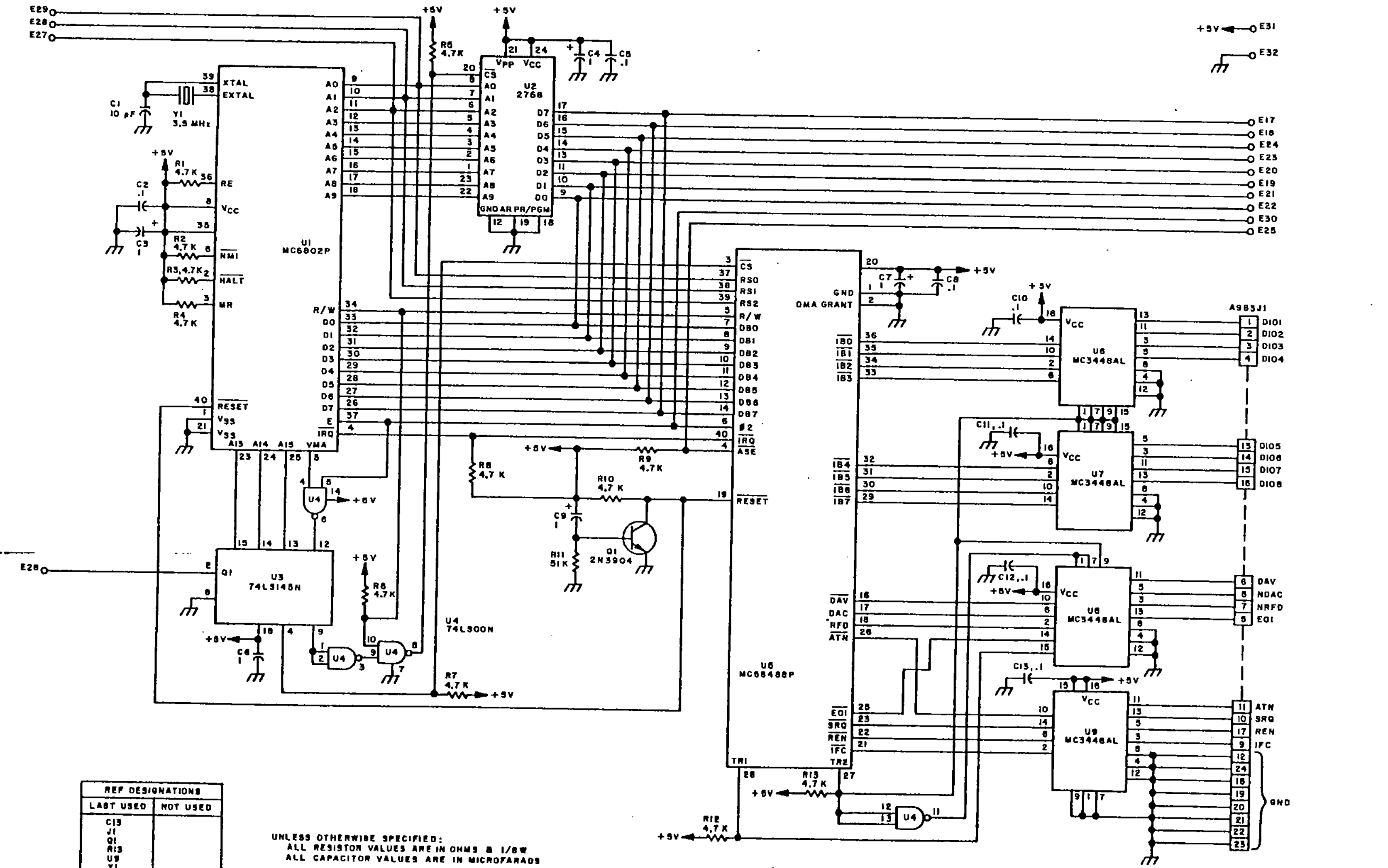
Figure 7.25



REF DESIGNATIONS	
LAST USED	NOT USED
C6 D1 FL2 L2 Q2 R10 U1	

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS & 1/4W
ALL CAPACITOR VALUES ARE IN MICROFARADS

SG-811, OPTION 6A
SCHEMATIC, A9B4
POWER SUPPLY IEEE 488
(USED ON S/N 167 & UP)
79894-392

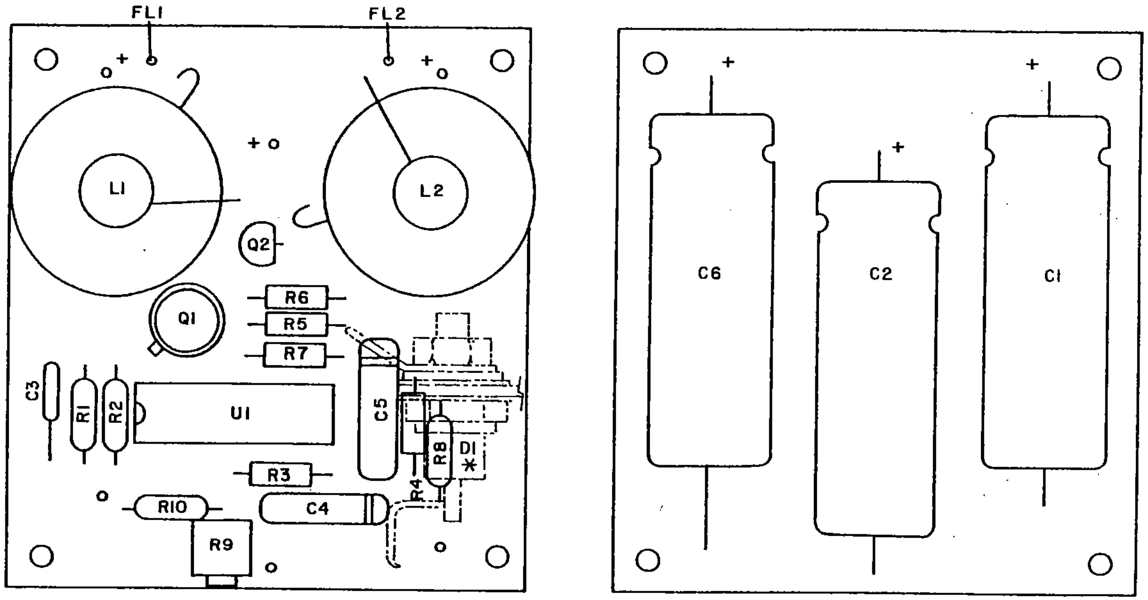


REF DESIGNATIONS	
LAST USED	NOT USED
C13	
J1	
Q1	
R13	
U9	
Y1	

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS & 1/8W
ALL CAPACITOR VALUES ARE IN MICROFARADS

SG-811, OPTION 6A
SCHEMATIC, A9B3
MICROPROCESSOR IEEE 488
(USED ON S/N 167 & UP)

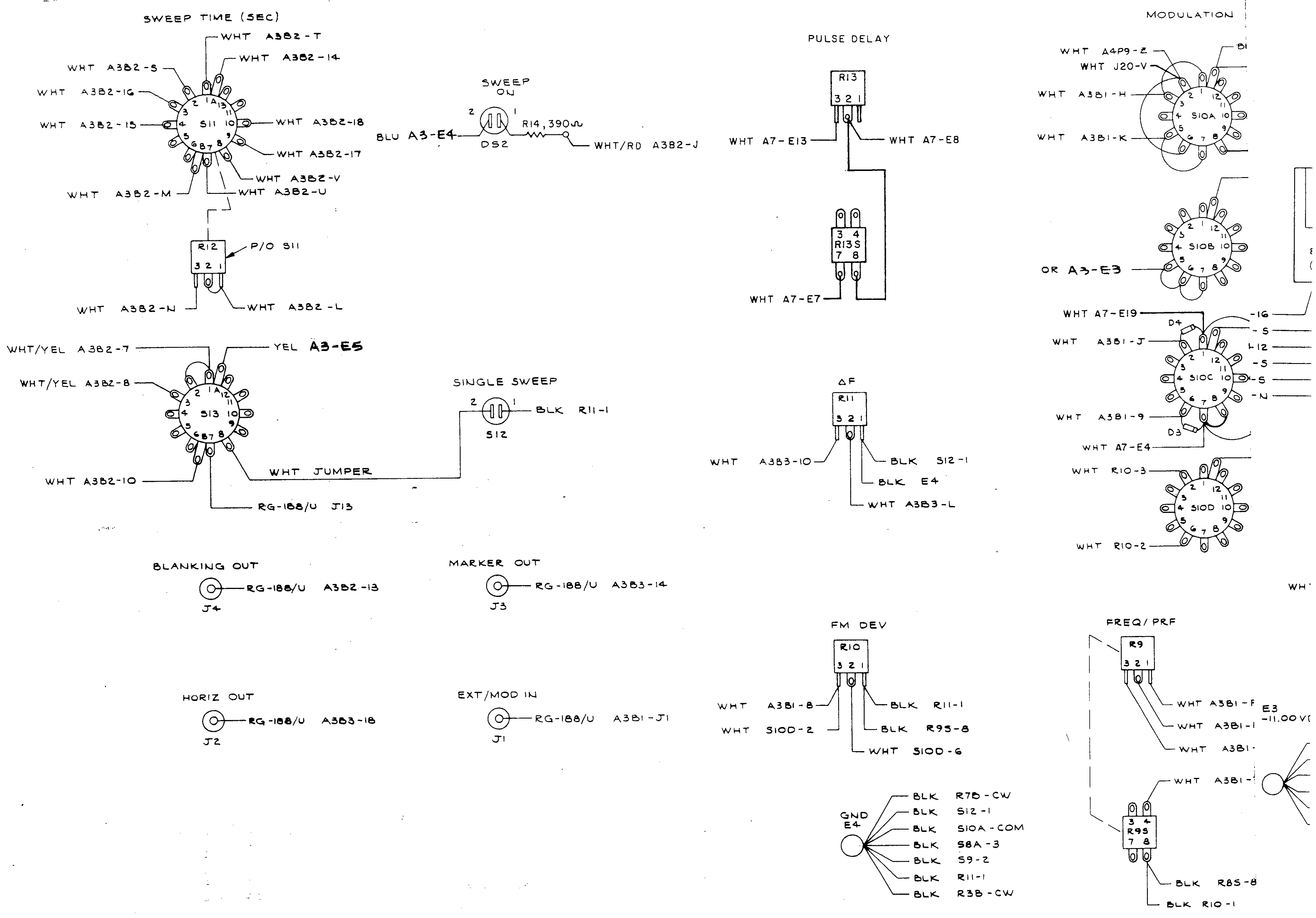
79B93-378



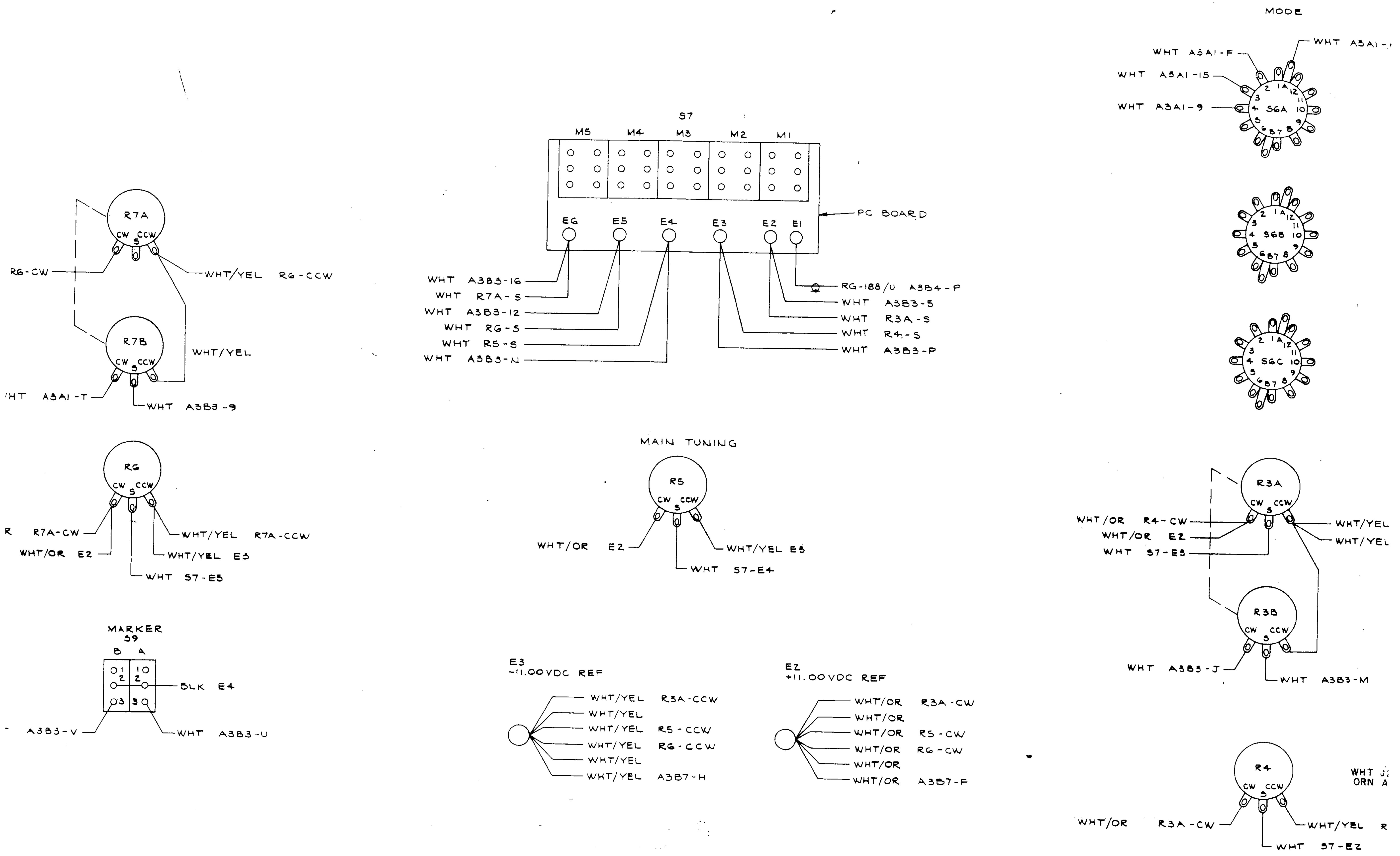
BOARD # 79894-370

* D1 IS MOUNTED ON CHASSIS

SG-811, OPTION 6A
COMPONENT LOCATION, A9B4
POWER SUPPLY IEEE 488
(USED ON S/N 167 & UP)
79894-386



SWEEP TIME (SEC)
WHT A3B2-T
WHT A3B2-14
WHT A3B2-S
WHT A3B2-16
WHT A3B2-15
S11
WHT A3B2-18
WHT A3B2-17
WHT A3B2-V
WHT A3B2-U
WHT A3B2-M
R12
P/O S11
WHT A3B2-N
WHT A3B2-L
SWEEP ON
BLU A3-E4
DS2
R14, 390Ω
WHT/RD A3B2-J
WHT/YEL A3B2-7
YEL A3-E5
WHT/YEL A3B2-8
S13
WHT A3B2-10
WHT JUMPER
RG-188/U J13
SINGLE SWEEP
BLK R11-1
S12
BLANKING OUT
RG-188/U A3B2-13
J4
MARKER OUT
RG-188/U A3B3-14
J3
HORIZ OUT
RG-188/U A3B3-18
J2
EXT/MOD IN
RG-188/U A3B1-J1
J1
PULSE DELAY
R13
WHT A7-E13
WHT A7-E8
R13S
WHT A7-E7
ΔF
R11
WHT A3B3-10
BLK S12-1
BLK E4
WHT A3B3-L
FM DEV
R10
WHT A3B1-8
BLK R11-1
WHT S10D-2
BLK R95-8
WHT S10D-6
GND E4
BLK R78-CW
BLK S12-1
BLK S10A-COM
BLK S8A-3
BLK S9-2
BLK R11-1
BLK R38-CW
MODULATION
WHT A4P9-Z
WHT J20-V
WHT A3B1-H
S10A
WHT A3B1-K
S10B
OR A3-E3
WHT A7-E19
D4
WHT A3B1-J
S10C
WHT A3B1-9
D3
WHT A7-E4
WHT R10-3
S10D
WHT R10-2
FREQ/PRF
R9
WHT A3B1-F
WHT A3B1-I
WHT A3B1-
E3
-11.00V
WHT A3B1-
R95
BLK R85-8
BLK R10-1



MODE
WHT A3A1-F
WHT A3A1-15
WHT A3A1-9
S6A
S6B
S6C
S7
M5
M4
M3
M2
M1
PC BOARD
E6
E5
E4
E3
E2
E1
WHT A3B3-16
WHT R7A-S
WHT A3B3-12
WHT R6-S
WHT R5-S
WHT A3B3-N
RG-188/U A3B4-P
WHT A3B3-5
WHT R3A-S
WHT R4-S
WHT A3B3-P
R7A
CW S CCW
R6-CW
WHT/YEL R6-CCW
R7B
WHT/YEL
WHT A3A1-T
WHT A3B3-9
R6
R7A-CW
WHT/YEL R7A-CCW
WHT/OR E2
WHT/YEL E3
WHT S7-E5
MAIN TUNING
R5
WHT/OR E2
WHT/YEL E3
WHT S7-E4
MARKER
S9
B A
BLK E4
A3B3-V
WHT A3B3-U
E3
-11.00VDC REF
WHT/YEL R3A-CCW
WHT/YEL
WHT/YEL R5-CCW
WHT/YEL R6-CCW
WHT/YEL
WHT/YEL A3B7-H
E2
+11.00VDC REF
WHT/OR R3A-CW
WHT/OR
WHT/OR R5-CW
WHT/OR R6-CW
WHT/OR
WHT/OR A3B7-F
R3A
WHT/OR R4-CW
WHT/OR E2
WHT S7-E3
WHT/YEL
WHT/YEL
R3B
WHT A3B3-J
WHT A3B3-M
R4
WHT/OR R3A-CW
WHT/YEL
WHT S7-E2

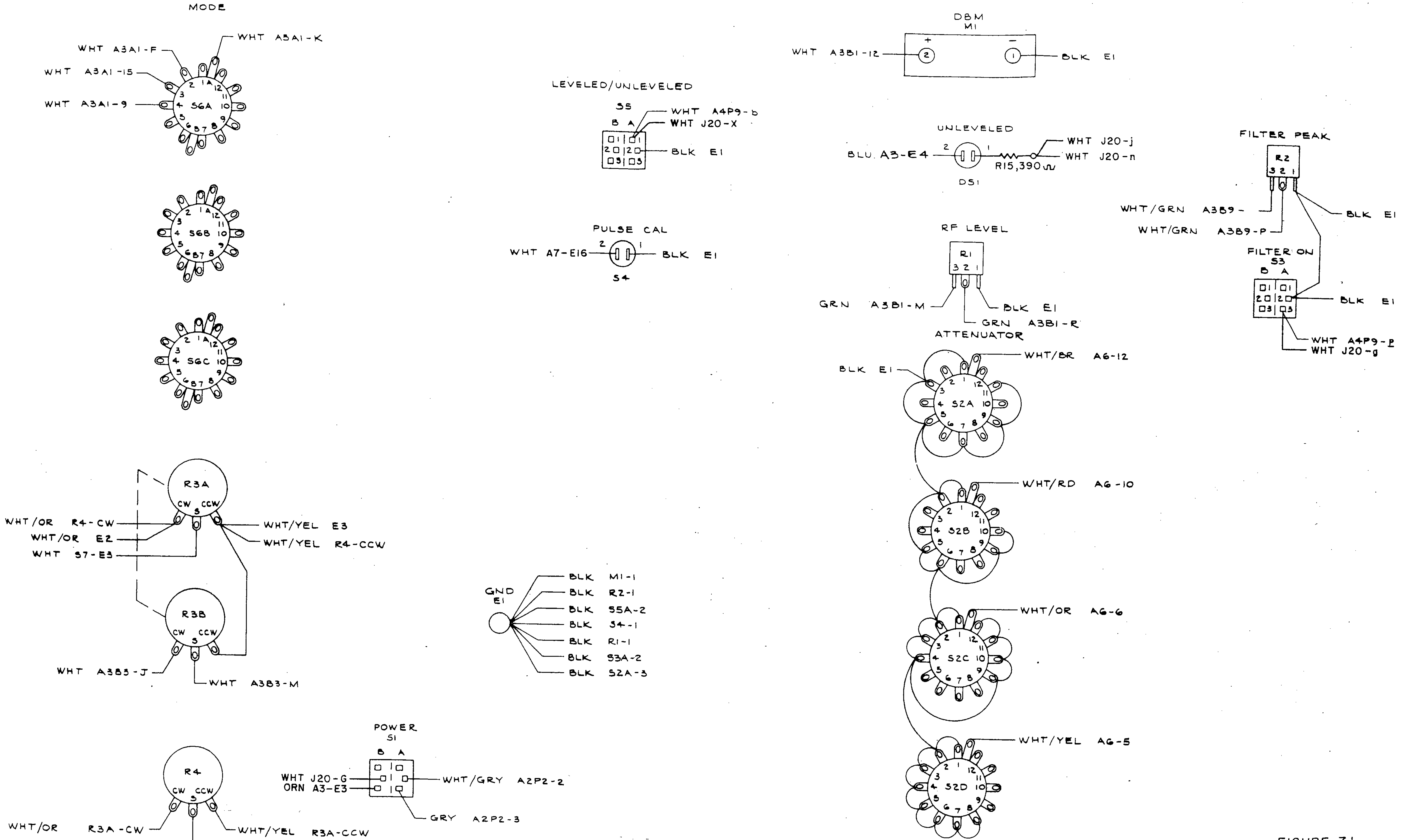
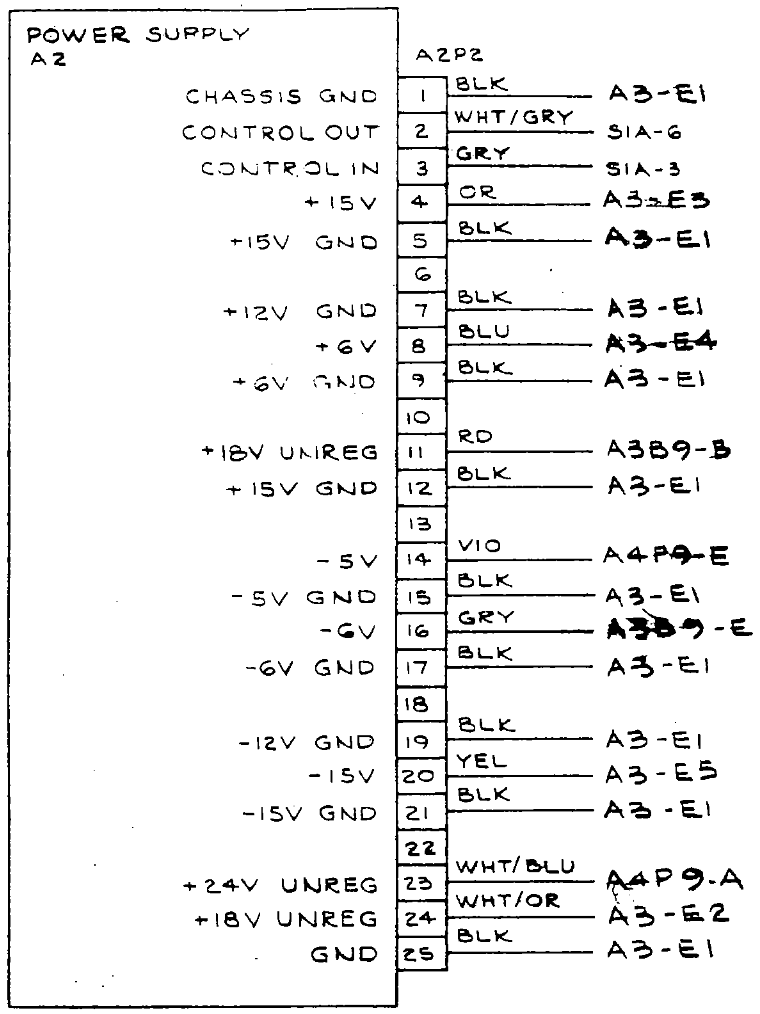
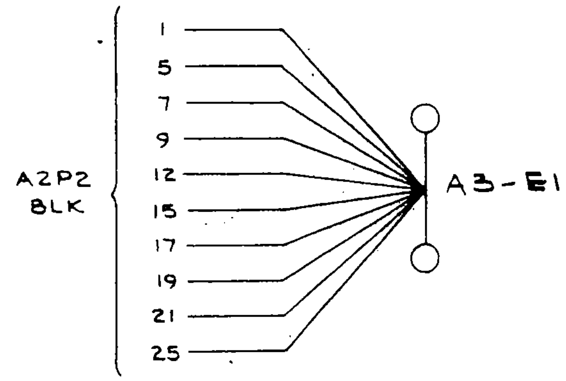
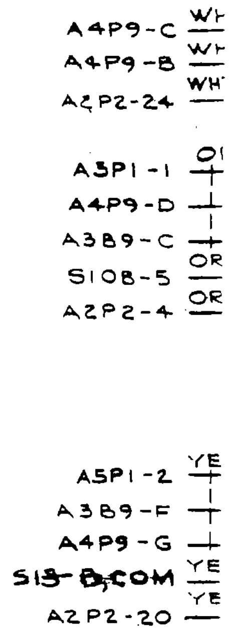


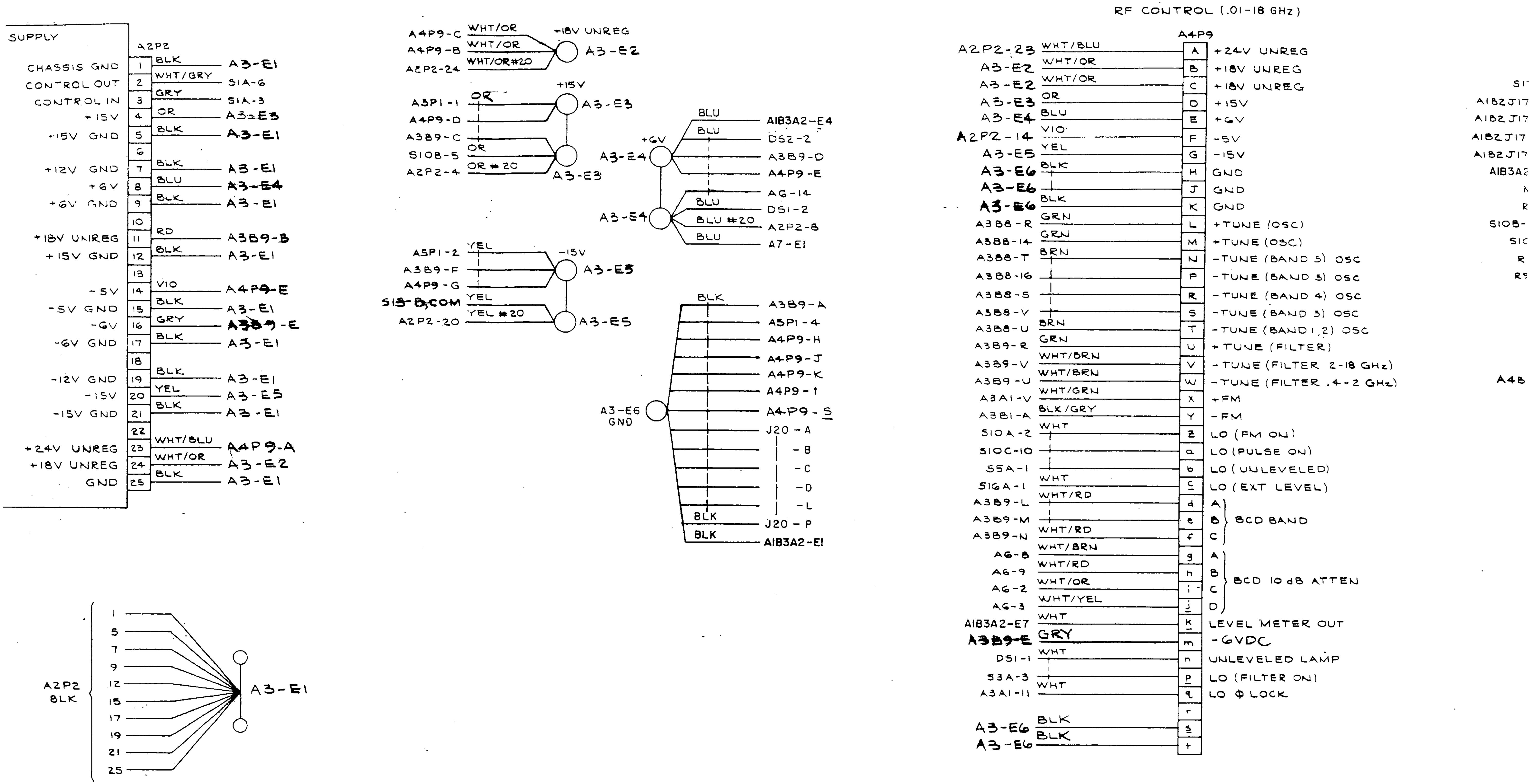
FIGURE 7.1
SYSTEM WIRING DIAGRAM
A1B1-FRONT PANEL,
SHEET 1 OF 3

79R10-425

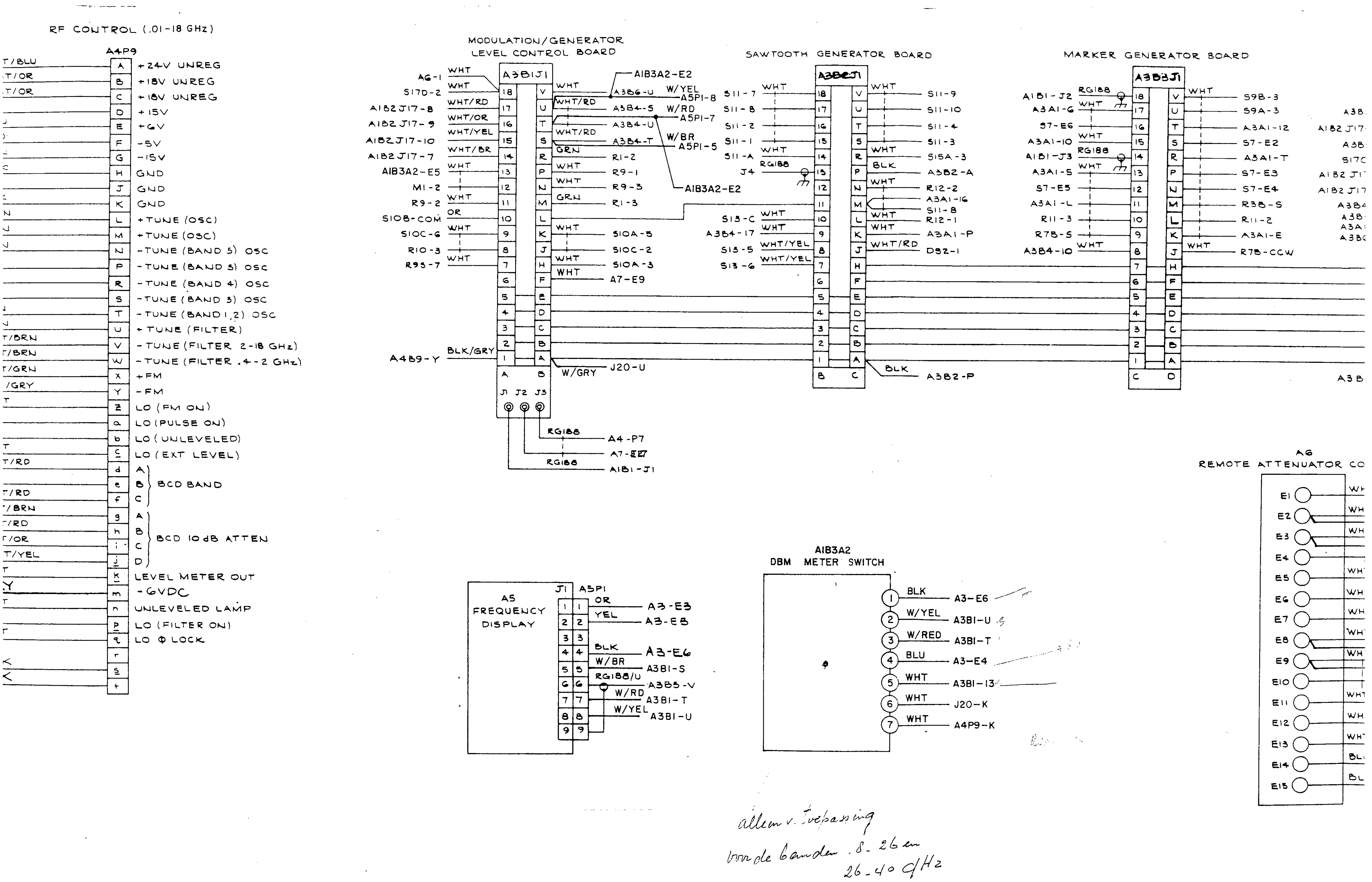

POWER SUPPLY
A2
A2P2
CHASSIS GND 1 BLK A3-E1
CONTROL OUT 2 WHT/GRY S1A-6
CONTROL IN 3 GRY S1A-3
+15V 4 OR A3-E3
+15V GND 5 BLK A3-E1
6
+12V GND 7 BLK A3-E1
+6V 8 BLU A3-E4
+6V GND 9 BLK A3-E1
10
+18V UNREG 11 RD A3B9-B
+15V GND 12 BLK A3-E1
13
-5V 14 VIO A4P9-E
-5V GND 15 BLK A3-E1
-6V 16 GRY A3B9-E
-6V GND 17 BLK A3-E1
18
-12V GND 19 BLK A3-E1
-15V 20 YEL A3-E5
-15V GND 21 BLK A3-E1
22
+24V UNREG 23 WHT/BLU A4P9-A
+18V UNREG 24 WHT/OR A3-E2
GND 25 BLK A3-E1

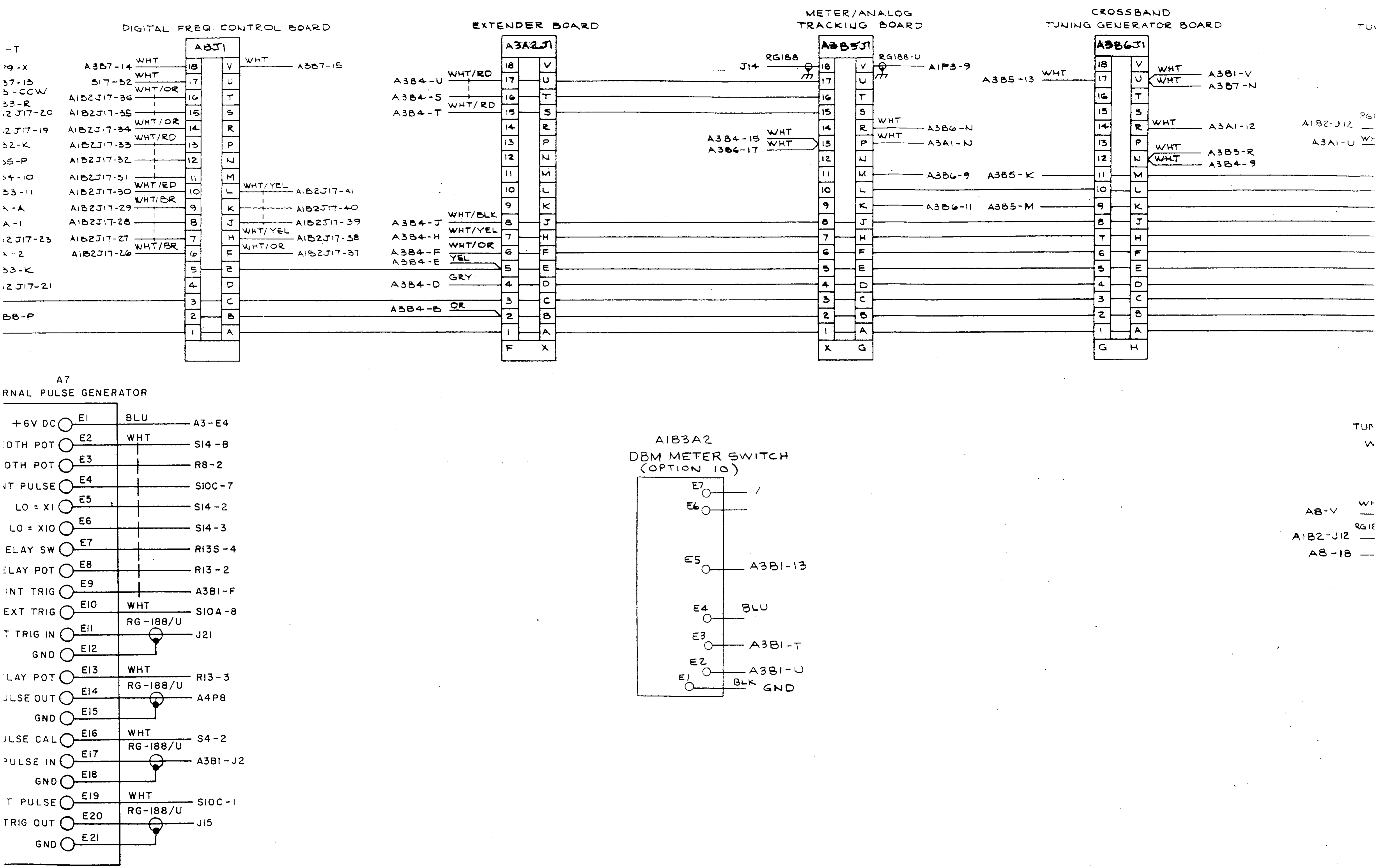

A2P2
BLK
1
5
7
9
12
15
17
19
21
25
A3-E1


A4P9-C
A4P9-B
A2P2-24
A3P1-1
A4P9-D
A3B9-C
S10B-5
A2P2-4
A5P1-2
A3B9-F
A4P9-G
S13-B,COM
A2P2-20

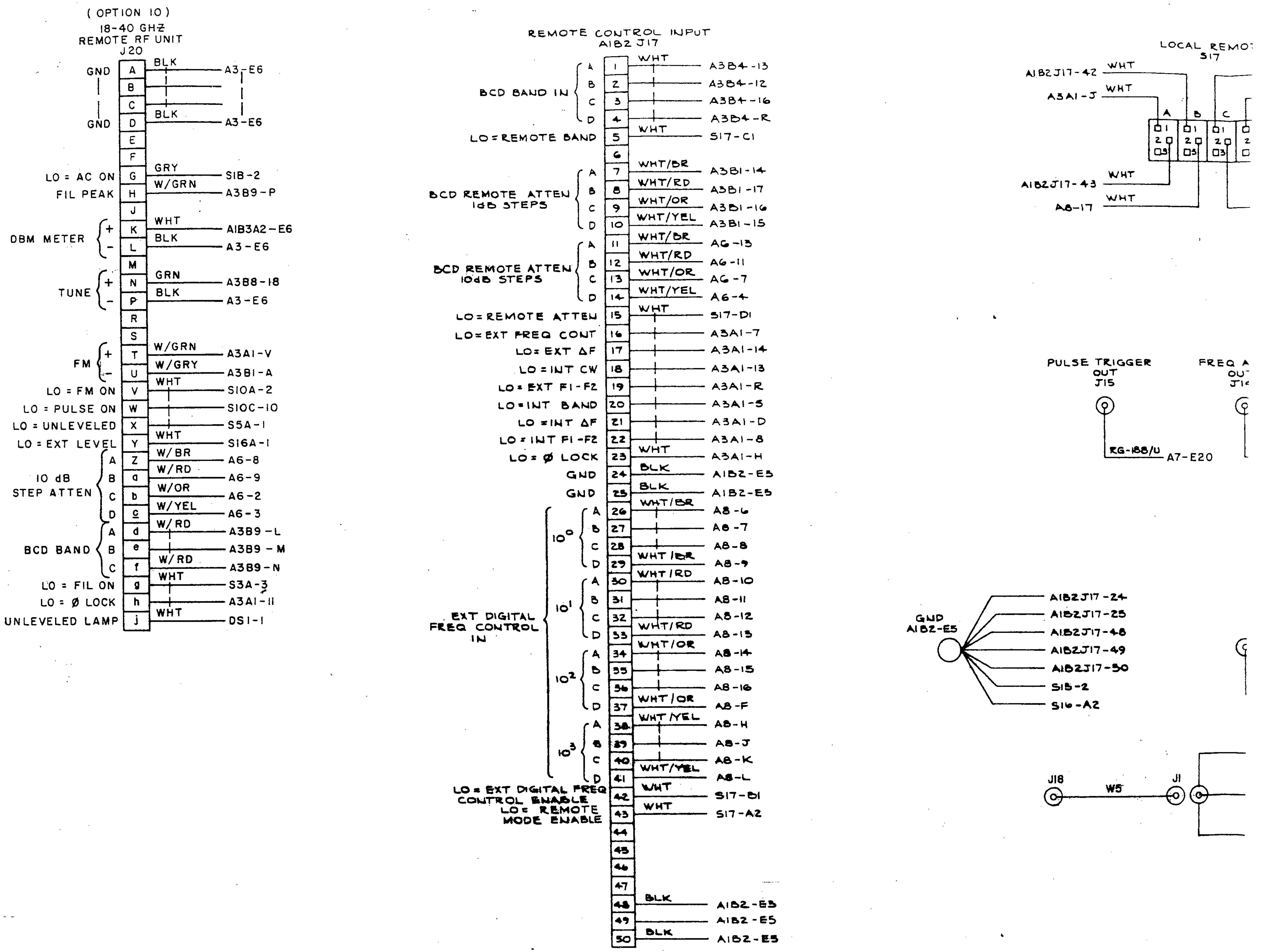


SUPPLY
A2P2
CHASSIS GND 1 BLK A3-E1
CONTROL OUT 2 WHT/GRY S1A-6
CONTROL IN 3 GRY S1A-3
+15V 4 OR A3-E3
+15V GND 5 BLK A3-E1
6
+12V GND 7 BLK A3-E1
+6V 8 BLU A3-E4
+6V GND 9 BLK A3-E1
10
+18V UNREG 11 RD A3B9-B
+15V GND 12 BLK A3-E1
13
-5V 14 VIO A4P9-E
-5V GND 15 BLK A3-E1
-6V 16 GRY A3B9-E
-6V GND 17 BLK A3-E1
18
-12V GND 19 BLK A3-E1
-15V 20 YEL A3-E5
-15V GND 21 BLK A3-E1
22
+24V UNREG 23 WHT/BLU A4P9-A
+18V UNREG 24 WHT/OR A3-E2
GND 25 BLK A3-E1
A2P2 BLK
1 5 7 9 12 15 17 19 21 25
A3-E1
A4P9-C WHT/OR
A4P9-B WHT/OR
A2P2-24 WHT/OR #20
+18V UNREG
A3-E2
+15V
A5P1-1 OR
A4P9-D
A3B9-C
S10B-5 OR
A2P2-4 OR #20
A3-E3
A3-E3
-15V
A5P1-2 YEL
A3B9-F
A4P9-G
S13-B,COM YEL
A2P2-20 YEL #20
A3-E5
A3-E5
+6V
A3-E4
BLU A1B3A2-E4
BLU DS2-2
A3B9-D
A4P9-E
A3-E4
A6-14
BLU DS1-2
BLU #20 A2P2-8
BLU A7-E1
A3-E6
GND
BLK A3B9-A
A5P1-4
A4P9-H
A4P9-J
A4P9-K
A4P9-t
A4P9-S
J20-A
-B
-C
-D
-L
BLK J20-P
BLK A1B3A2-E1
RF CONTROL (.01-18 GHz)
A4P9
A2P2-23 WHT/BLU A +24V UNREG
A3-E2 WHT/OR B +18V UNREG
A3-E2 WHT/OR C +18V UNREG
A3-E3 OR D +15V
A3-E4 BLU E +6V
A2P2-14 VIO F -5V
A3-E5 YEL G -15V
A3-E6 BLK H GND
A3-E6 J GND
A3-E6 BLK K GND
A3B8-R GRN L +TUNE (OSC)
A3B8-14 GRN M +TUNE (OSC)
A3B8-T BRN N -TUNE (BAND 5) OSC
A3B8-16 P -TUNE (BAND 5) OSC
A3B8-S R -TUNE (BAND 4) OSC
A3B8-V S -TUNE (BAND 3) OSC
A3B8-U BRN T -TUNE (BAND 1,2) OSC
A3B9-R GRN U +TUNE (FILTER)
A3B9-V WHT/BRN V -TUNE (FILTER 2-18 GHz)
A3B9-U WHT/BRN W -TUNE (FILTER .4-2 GHz)
A3A1-V WHT/GRN X +FM
A3B1-A BLK/GRY Y -FM
S10A-2 WHT Z LO (FM ON)
S10C-10 a LO (PULSE ON)
S5A-1 b LO (UNLEVELED)
S16A-1 WHT c LO (EXT LEVEL)
A3B9-L WHT/RD d A
A3B9-M e B BCD BAND
A3B9-N WHT/RD f C
A6-8 WHT/BRN g A
A6-9 WHT/RD h B BCD 10 dB ATTEN
A6-2 WHT/OR i C
A6-3 WHT/YEL j D
A1B3A2-E7 WHT k LEVEL METER OUT
A3B9-E GRY m -6VDC
DS1-1 WHT n UNLEVELED LAMP
S3A-3 p LO (FILTER ON)
A3A1-11 WHT q LO Φ LOCK
r
A3-E6 BLK s
A3-E6 BLK t
S1
A1B2J17
A1B2J17
A1B2J17
A1B2J17
A1B3A2
S10B-
S1C
A4B


RF CONTROL (.01-18 GHz)
A4P9
+24V UNREG
+18V UNREG
+18V UNREG
+15V
+6V
-5V
-15V
GND
GND
GND
+TUNE (OSC)
+TUNE (OSC)
-TUNE (BAND 5) OSC
-TUNE (BAND 5) OSC
-TUNE (BAND 4) OSC
-TUNE (BAND 3) OSC
-TUNE (BAND 1,2) OSC
+TUNE (FILTER)
-TUNE (FILTER 2-18 GHz)
-TUNE (FILTER .4-2 GHz)
+FM
-FM
LO (FM ON)
LO (PULSE ON)
LO (UNLEVELED)
LO (EXT LEVEL)
BCD BAND
BCD 10dB ATTEN
LEVEL METER OUT
-6VDC
UNLEVELED LAMP
LO (FILTER ON)
LO Φ LOCK
MODULATION/GENERATOR
LEVEL CONTROL BOARD
A3B1J1
SAWTOOTH GENERATOR BOARD
A3B2J1
MARKER GENERATOR BOARD
A3B3J1
A5
FREQUENCY
DISPLAY
J1 A5P1
A1B3A2
DBM METER SWITCH
A6
REMOTE ATTENUATOR CO
alleen v. toepassing
voor de banden .8 - 26 en
26 - 40 GHz



DIGITAL FREQ. CONTROL BOARD
A3J1
EXTENDER BOARD
A3A2J1
METER/ANALOG TRACKING BOARD
A3B5J1
CROSSBAND TUNING GENERATOR BOARD
A3B6J1
A7
RNAL PULSE GENERATOR
+6V DC
E1
BLU
A3-E4
WHT
S14-B
R8-2
S10C-7
S14-2
S14-3
R13S-4
R13-2
A3B1-F
S10A-8
RG-188/U
J21
GND
R13-3
A4P8
S4-2
A3B1-J2
S10C-1
J15
A1B3A2
DBM METER SWITCH
(OPTION 10)
A3B1-13
A3B1-T
A3B1-U
BLK
GND


(OPTION 10)
18-40 GHZ
REMOTE RF UNIT
J20
GND A BLK A3-E6
B
C
GND D BLK A3-E6
E
F
LO = AC ON G GRY S1B-2
FIL PEAK H W/GRN A3B9-P
J
DBM METER + K WHT A1B3A2-E6
– L BLK A3-E6
M
TUNE + N GRN A3B8-18
– P BLK A3-E6
R
S
FM + T W/GRN A3A1-V
– U W/GRY A3B1-A
LO = FM ON V WHT S10A-2
LO = PULSE ON W S10C-10
LO = UNLEVELED X S5A-1
LO = EXT LEVEL Y WHT S16A-1
10 dB STEP ATTEN A Z W/BR A6-8
B a W/RD A6-9
C b W/OR A6-2
D c W/YEL A6-3
BCD BAND A d W/RD A3B9-L
B e A3B9-M
C f W/RD A3B9-N
LO = FIL ON g WHT S3A-3
LO = Ø LOCK h A3A1-11
UNLEVELED LAMP j WHT DS1-1
REMOTE CONTROL INPUT
A1B2 J17
BCD BAND IN A 1 WHT A3B4-13
B 2 A3B4-12
C 3 A3B4-16
D 4 A3B4-R
LO = REMOTE BAND 5 WHT S17-C1
6
BCD REMOTE ATTEN 1dB STEPS A 7 WHT/BR A3B1-14
B 8 WHT/RD A3B1-17
C 9 WHT/OR A3B1-16
D 10 WHT/YEL A3B1-15
BCD REMOTE ATTEN 10dB STEPS A 11 WHT/BR A6-13
B 12 WHT/RD A6-11
C 13 WHT/OR A6-7
D 14 WHT/YEL A6-4
LO = REMOTE ATTEN 15 WHT S17-D1
LO = EXT FREQ CONT 16 A3A1-7
LO = EXT ΔF 17 A3A1-14
LO = INT CW 18 A3A1-13
LO = EXT F1-F2 19 A3A1-R
LO = INT BAND 20 A3A1-S
LO = INT ΔF 21 A3A1-D
LO = INT F1-F2 22 A3A1-8
LO = Ø LOCK 23 WHT A3A1-H
GND 24 BLK A1B2-E5
GND 25 BLK A1B2-E5
EXT DIGITAL FREQ CONTROL IN
10⁰ A 26 WHT/BR A8-6
B 27 A8-7
C 28 A8-8
D 29 WHT/BR A8-9
10¹ A 30 WHT/RD A8-10
B 31 A8-11
C 32 A8-12
D 33 WHT/RD A8-13
10² A 34 WHT/OR A8-14
B 35 A8-15
C 36 A8-16
D 37 WHT/OR A8-F
10³ A 38 WHT/YEL A8-H
B 39 A8-J
C 40 A8-K
D 41 WHT/YEL A8-L
LO = EXT DIGITAL FREQ CONTROL ENABLE 42 WHT S17-B1
LO = REMOTE MODE ENABLE 43 WHT S17-A2
44
45
46
47
48 BLK A1B2-E5
49 A1B2-E5
50 BLK A1B2-E5
LOCAL REMO
S17
A1B2J17-42 WHT
A3A1-J WHT
A B C
A1B2J17-43 WHT
A8-17 WHT
PULSE TRIGGER OUT J15
RG-188/U A7-E20
FREQ A
GND A1B2-E5
A1B2J17-24
A1B2J17-25
A1B2J17-48
A1B2J17-49
A1B2J17-50
S1B-2
S16-A2
J18 W5 J1

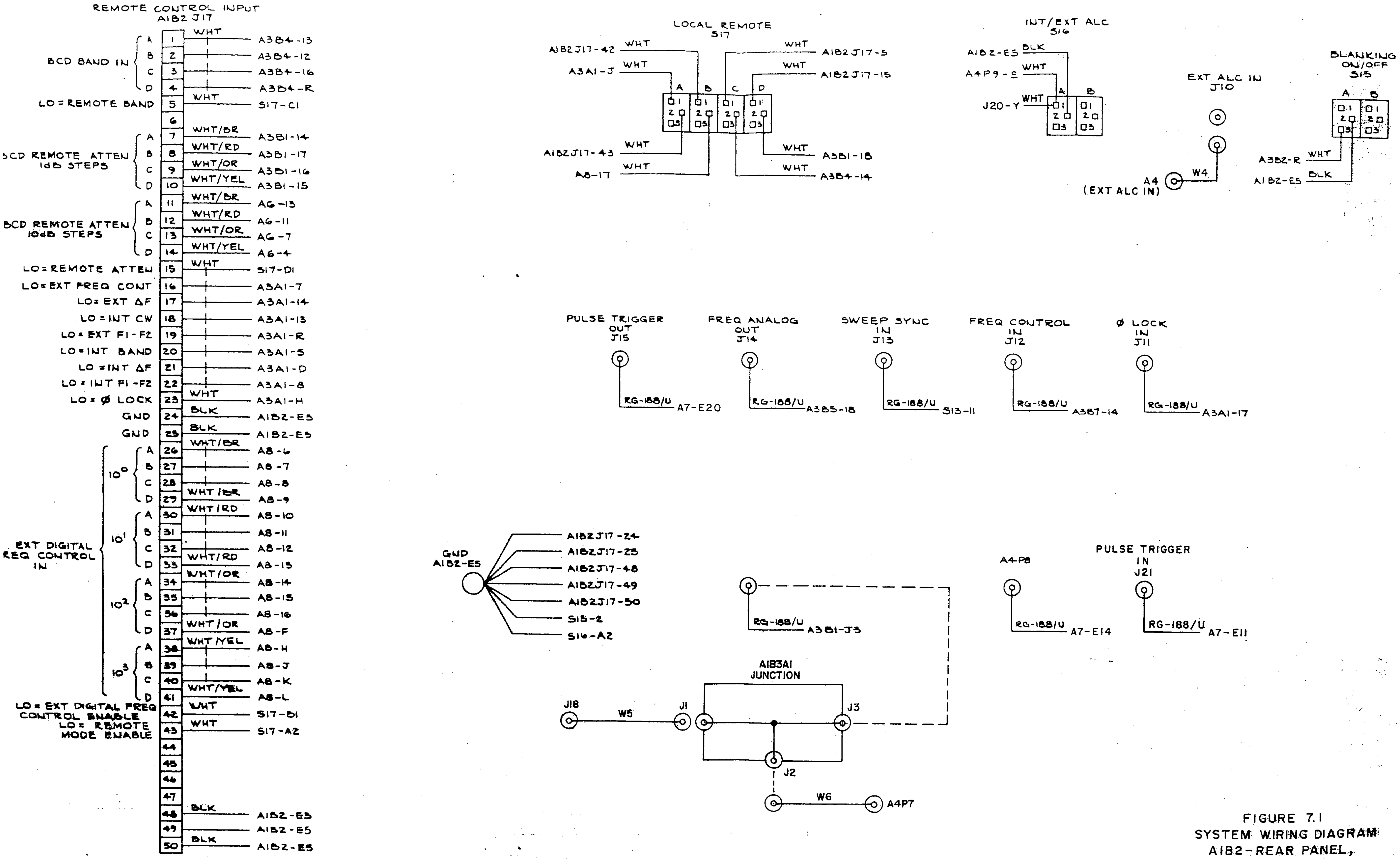
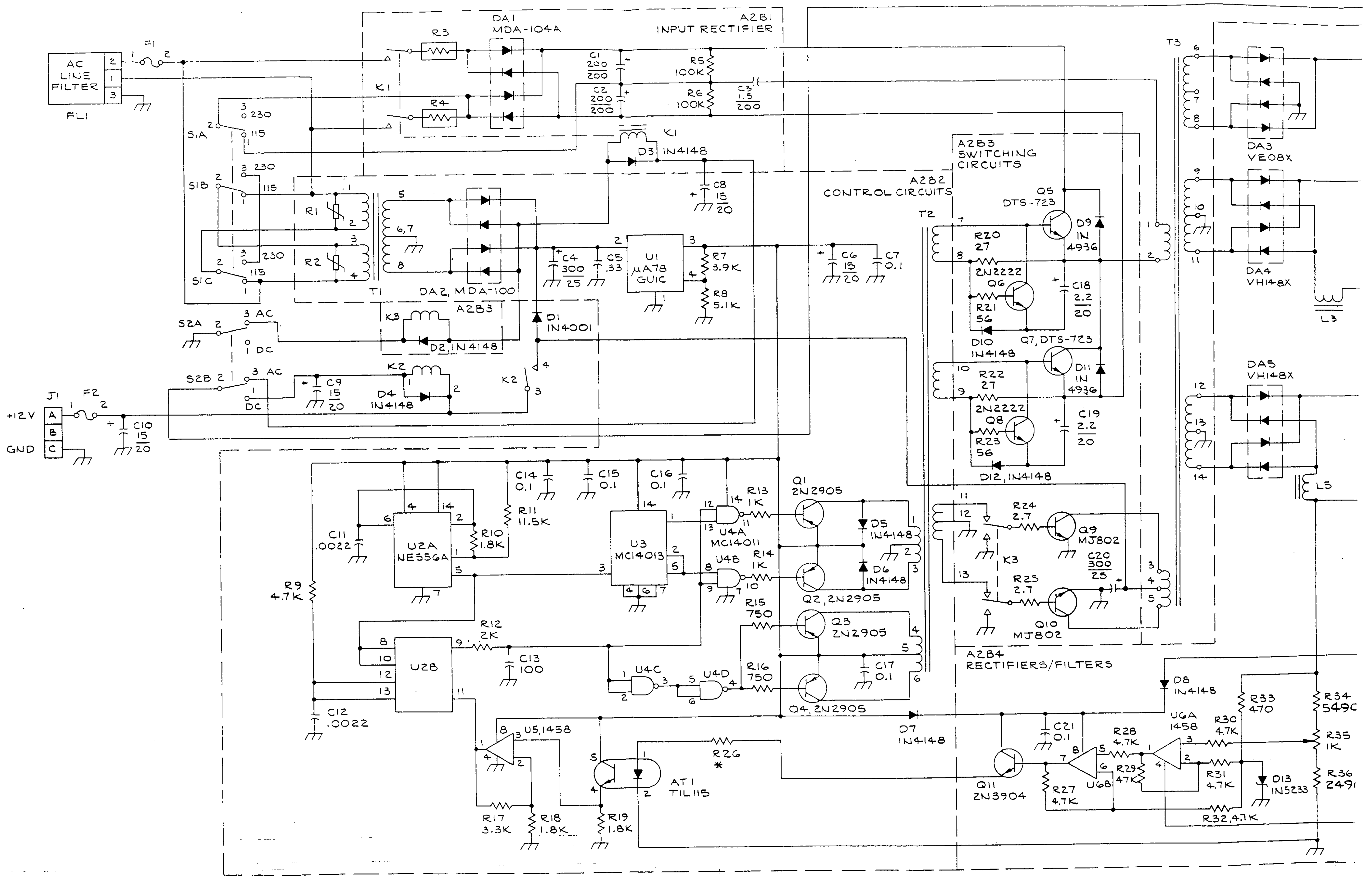


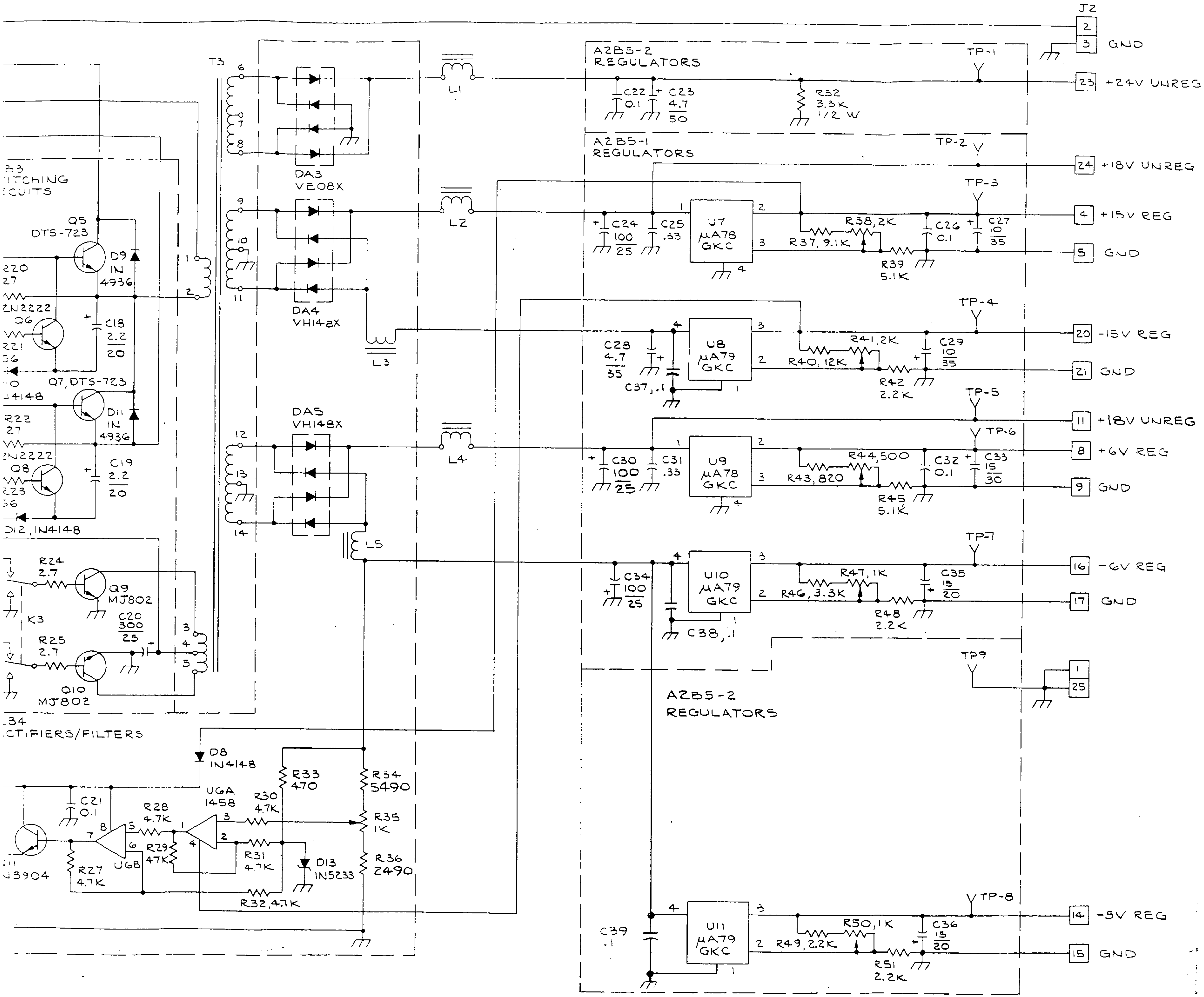
FIGURE 7.1
SYSTEM WIRING DIAGRAM
A1B2-REAR PANEL,
SHEET 3 OF 3

79R10-425



AC LINE FILTER
FL1
F1
DA1 MDA-104A
A2B1 INPUT RECTIFIER
R3
R4
K1
C1 200 200
C2 200 200
R5 100K
R6 100K
C3 1.5 200
S1A 230 115
S1B 230 115
S1C 230 115
D3 IN4148
C8 15 20
R1
R2
T1
DA2, MDA-100
C4 300 25
C5 .33
U1 μA78 GUIC
R7 3.9K
R8 5.1K
C6 15 20
C7 0.1
A2B3
K3
D2, IN4148
D1 IN4001
S2A AC DC
S2B AC DC
K2
C9 15 20
D4 IN4148
J1
F2
+12V
GND
C10 15 20
A2B2 CONTROL CIRCUITS
A2B3 SWITCHING CIRCUITS
T2
Q5 DTS-723
D9 IN 4936
R20 27
2N2222
Q6
R21 56
C18 2.2 20
D10 IN4148
Q7, DTS-723
D11 IN 4936
R22 27
2N2222
Q8
R23 56
C19 2.2 20
D12, IN4148
T3
DA3 VE08X
DA4 VH148X
L3
DA5 VH148X
L5
C14 0.1
C15 0.1
C16 0.1
C11 .0022
U2A NE556A
R10 1.8K
R11 11.5K
U3 MC14013
U4A MC14011
U4B
R13 1K
R14 1K
Q1 2N2905
Q2, 2N2905
D5 IN4148
D6 IN4148
R24 2.7
R25 2.7
Q9 MJ802
Q10 MJ802
K3
C20 300 25
R9 4.7K
U2B
R12 2K
C13 100
C12 .0022
R15 750
R16 750
Q3 2N2905
Q4, 2N2905
C17 0.1
U4C
U4D
A2B4 RECTIFIERS/FILTERS
D7 IN4148
D8 IN4148
U5, 1458
AT1 TIL115
R26 *
R17 3.3K
R18 1.8K
R19 1.8K
C21 0.1
Q11 2N3904
R27 4.7K
U6B
R28 4.7K
R29 47K
U6A 1458
R30 4.7K
R31 4.7K
R32, 4.7K
R33 470
D13 IN5233
R34 549
R35 1K
R36 249

REV. B - C.O #34 PS 7.18.77
REV. C - C.O. #36 PS 7.18.77
REV. D - C.O. #51 PS 11/23/77



UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W
ALL CAPACITORS ARE IN MICROFARADS
* SELECTED VALUE RC07

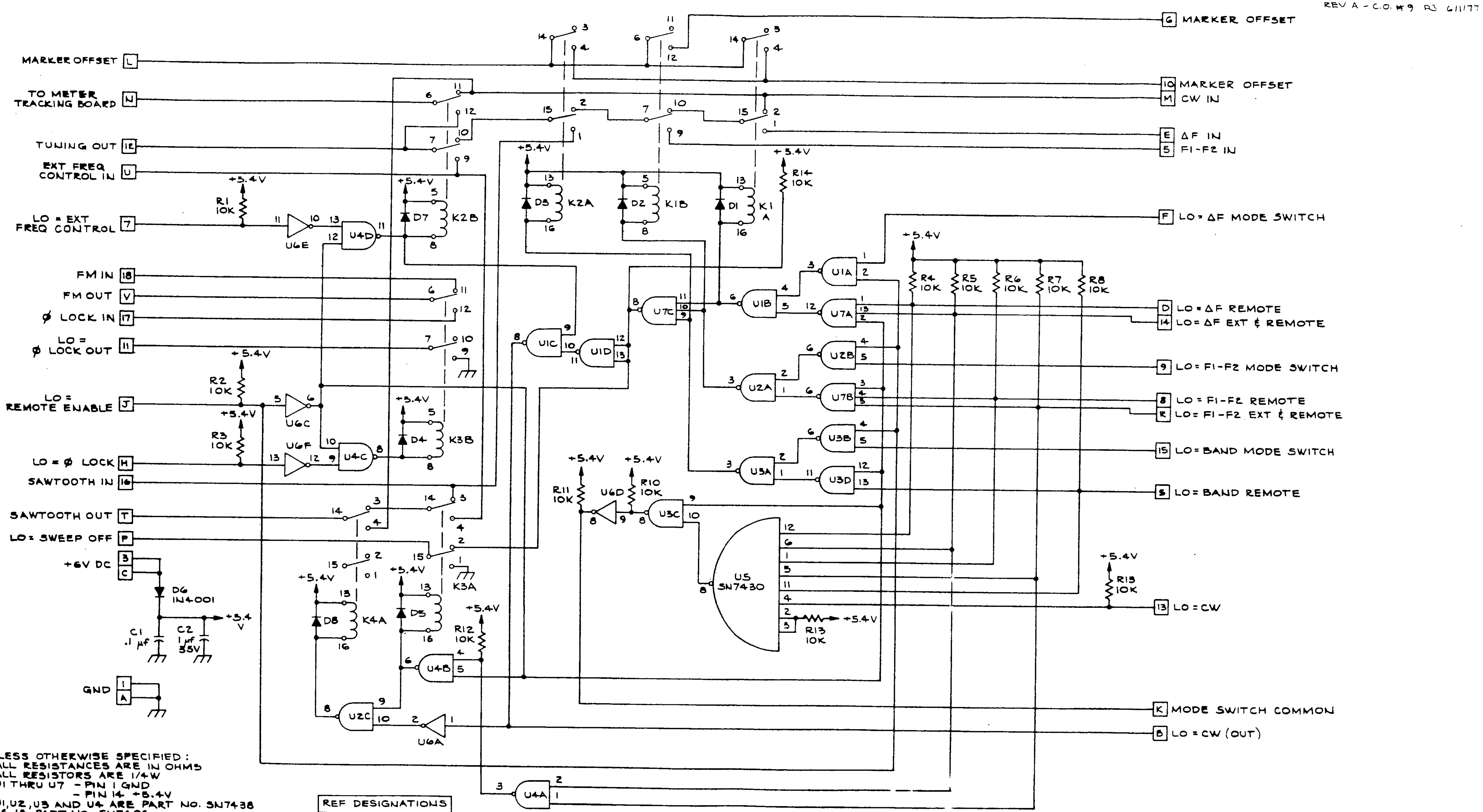
REF DESIGNATION	
LAST	NOT USED
TP9	
R52	
C39	
D13	
Q11	
U11	
AT1	
L5	
F2	
DA5	
T3	
J2	
K3	
L5	
FL1	
S2	

USED ONLY WITH OPTION 7, DC INPUT
C9, C10, C20
D1, D2, D4
F2
J1
K2, K3
Q9, Q10
R24, R25
S2

Schematic, Power Supply

79R20-072D (A2)

Figure 7.2



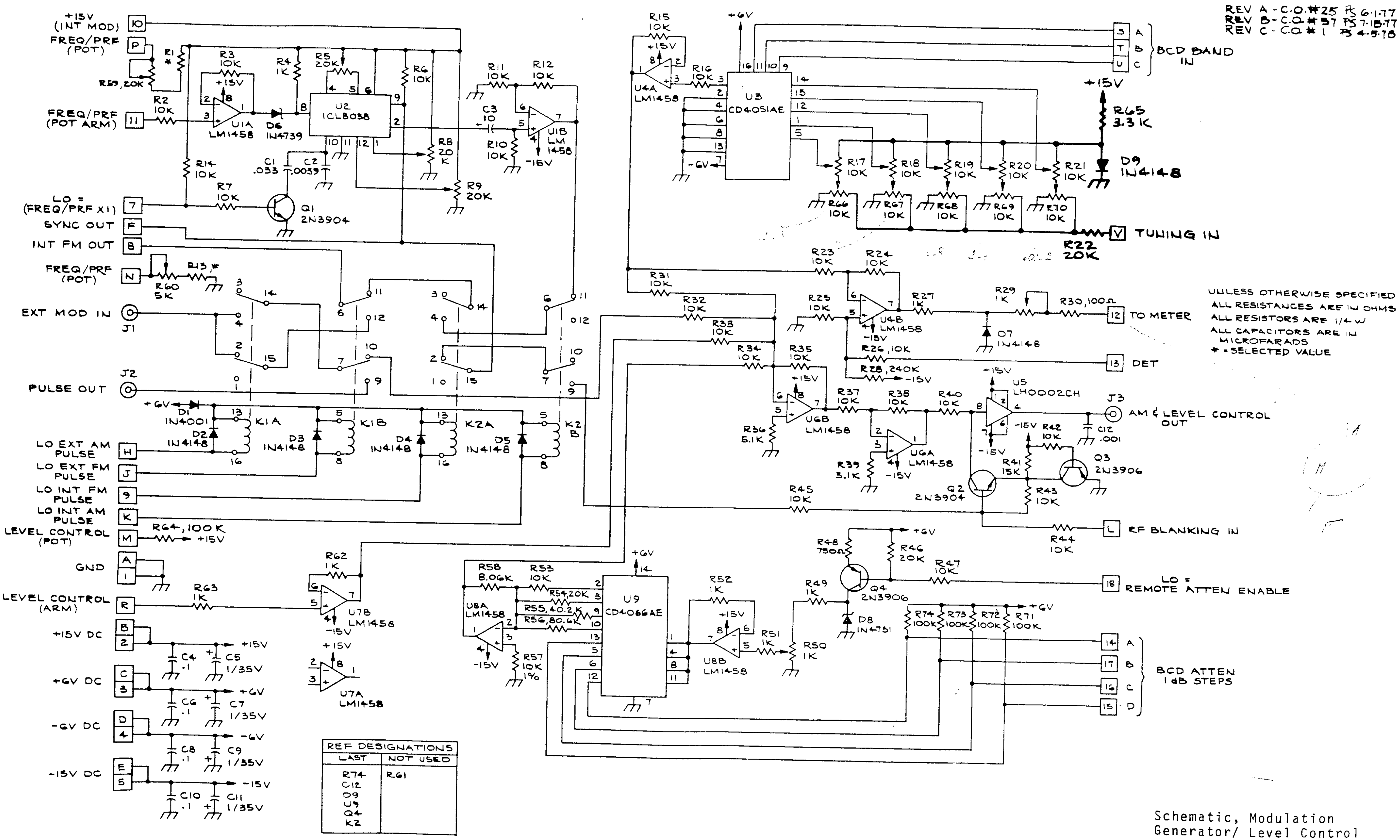
UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4W
U1 THRU U7 - PIN 1 GND
- PIN 14 +5.4V
U1, U2, U3 AND U4 ARE PART No. SN7438
U6 IS PART No. SN7406
U7 IS PART No. SN7410
D1 THRU D5, D7 AND D8 ARE PART No. 1N4148

REF DESIGNATIONS	
LAST	NOT USED
R14 D8 C2 U7 K4	

Schematic, Control Board

79D31-075A (A3A1)

Figure 7.3

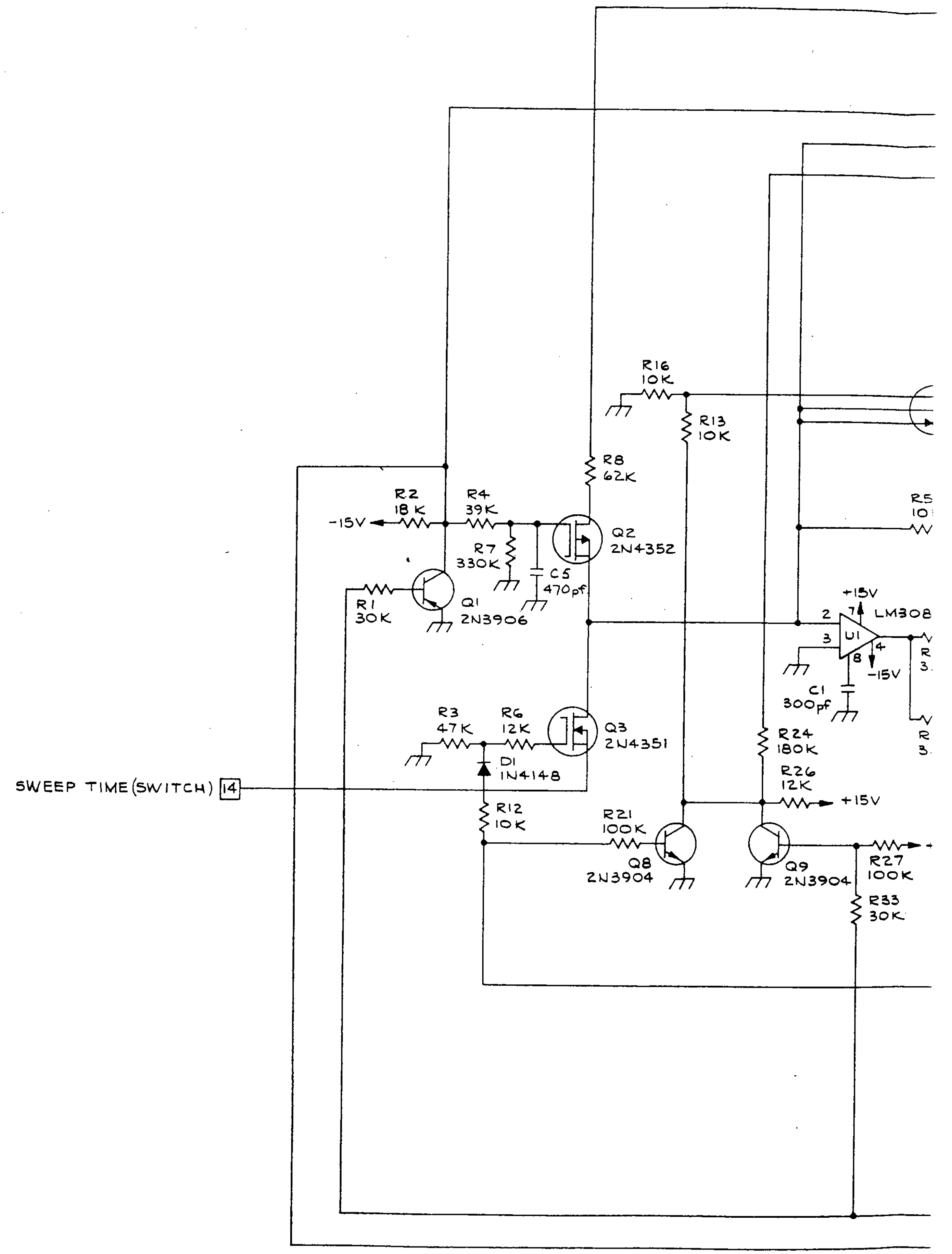


REF DESIGNATIONS	
LAST	NOT USED
R74	R61
C12	
D9	
U9	
Q4	
K2	

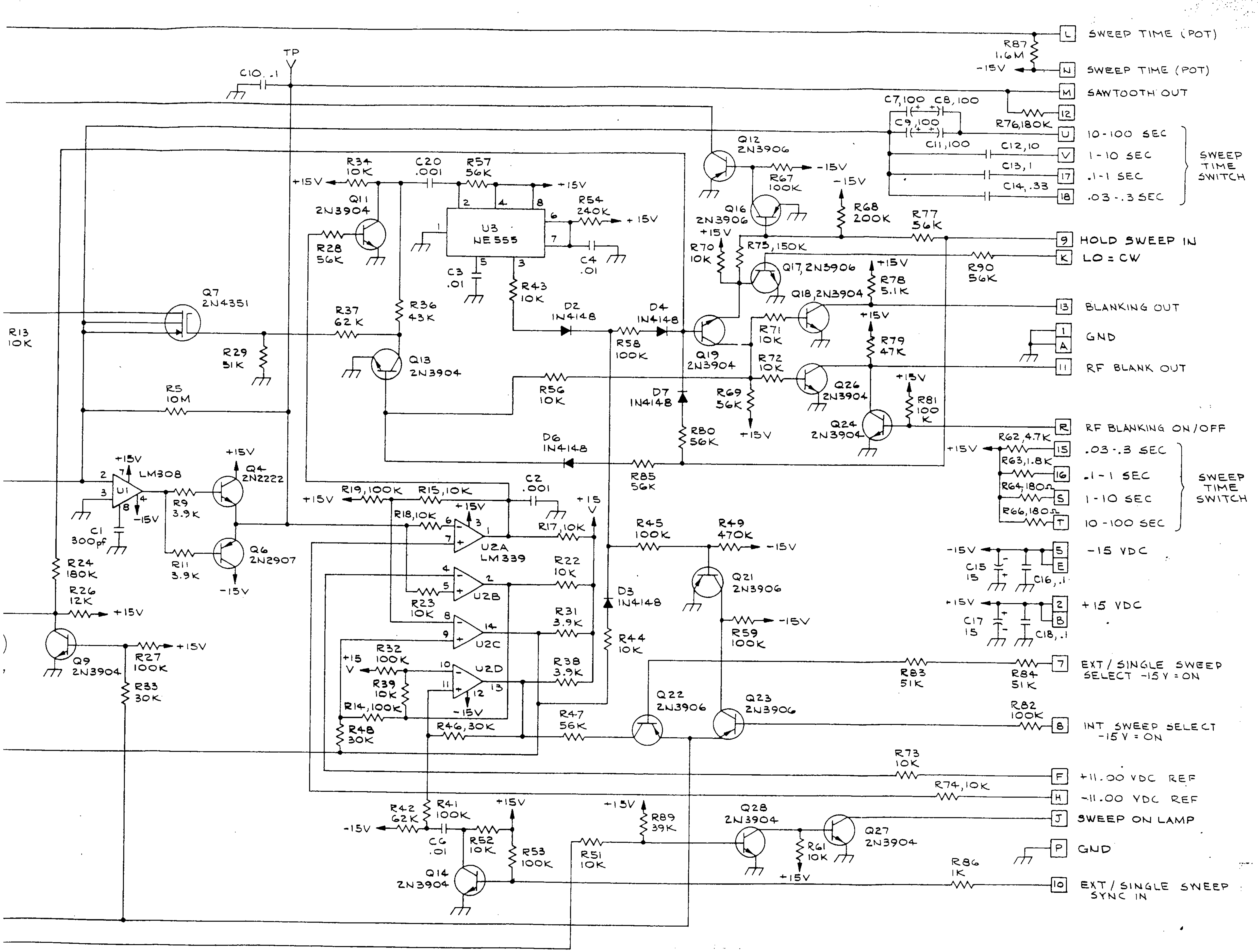
Schematic, Modulation Generator/ Level Control

79D31-023C (A3B1)

Figure 7.4


SWEEP TIME (SWITCH) 14
R16 10K
R13 10K
R8 62K
R2 18K
R4 39K
-15V
R7 330K
C5 470pf
Q2 2N4352
R1 30K
Q1 2N3906
+15V
LM308
U1
C1 300pf
-15V
R3 47K
R6 12K
Q3 2N4351
D1 1N4148
R12 10K
R24 180K
R26 12K
+15V
R21 100K
Q8 2N3904
Q9 2N3904
R27 100K
R33 30K

REV A - C.O. #7 DS 6/1/77
REV B - C.O. #13 PS 6/1/77
REV C - C.O. #20 PS 6/1/77



UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W
ALL CAPACITORS ARE IN MICROFARADS

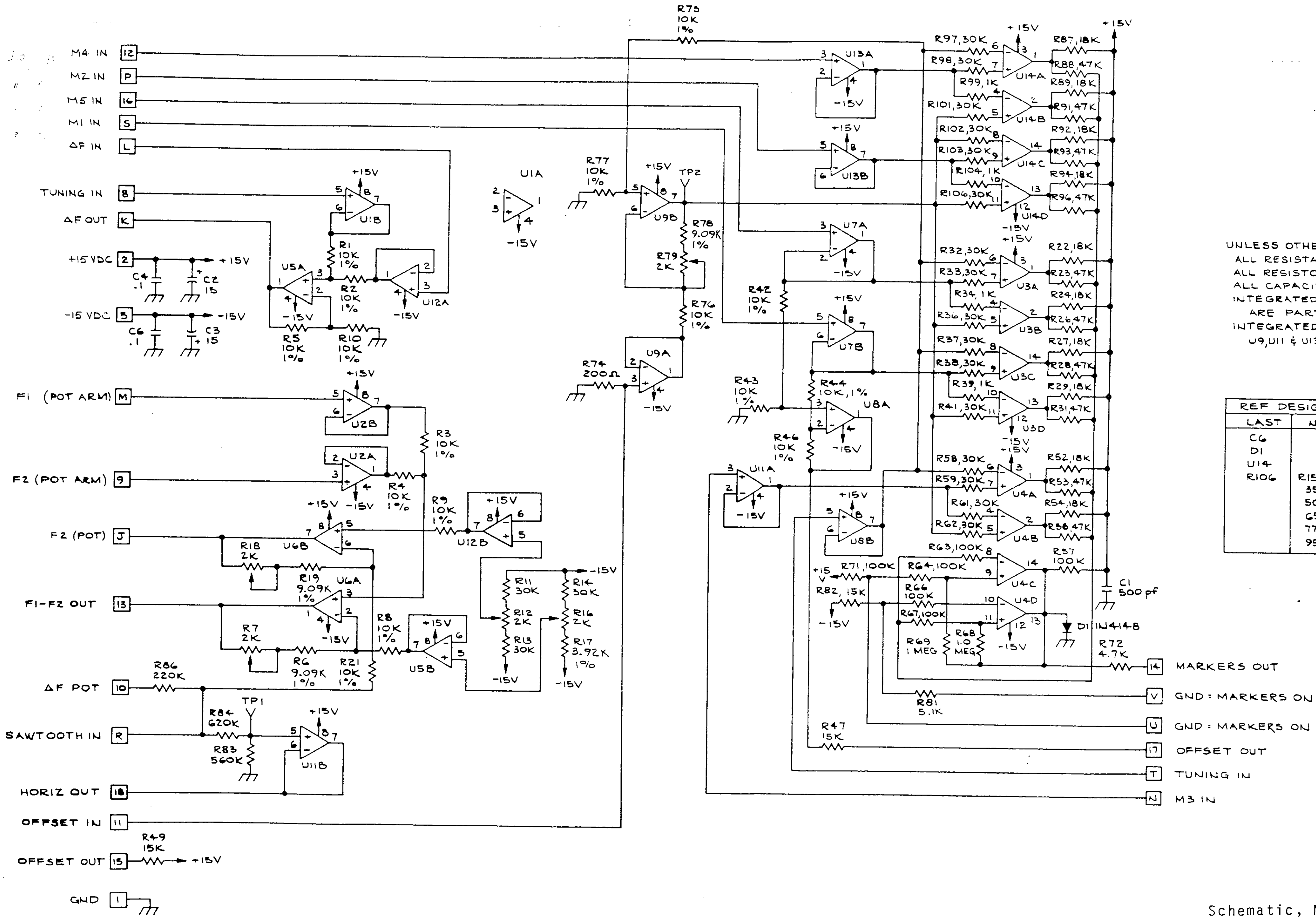
REF DESIGNATIONS	
LAST	NOT USED
D7	D5
U3	
C20	C19
Q28	Q3, 10, 15, 20, 25
R90	R10, 20, 25, 30, 35, 40, 50, 55, 60, 65, 88

Schematic, Sawtooth Generator

79R32-026C (A3B2)

Figure 7.5

REV. A – CO. # 22



UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W
ALL CAPACITORS ARE IN MICROFARADS
INTEGRATED CIRCUITS U3, U4 & U14 ARE PART NO. LM339
INTEGRATED CIRCUITS U1, U2, U5, U6, U7, U8, U9, U11 & U13 ARE PART NO. LM1458

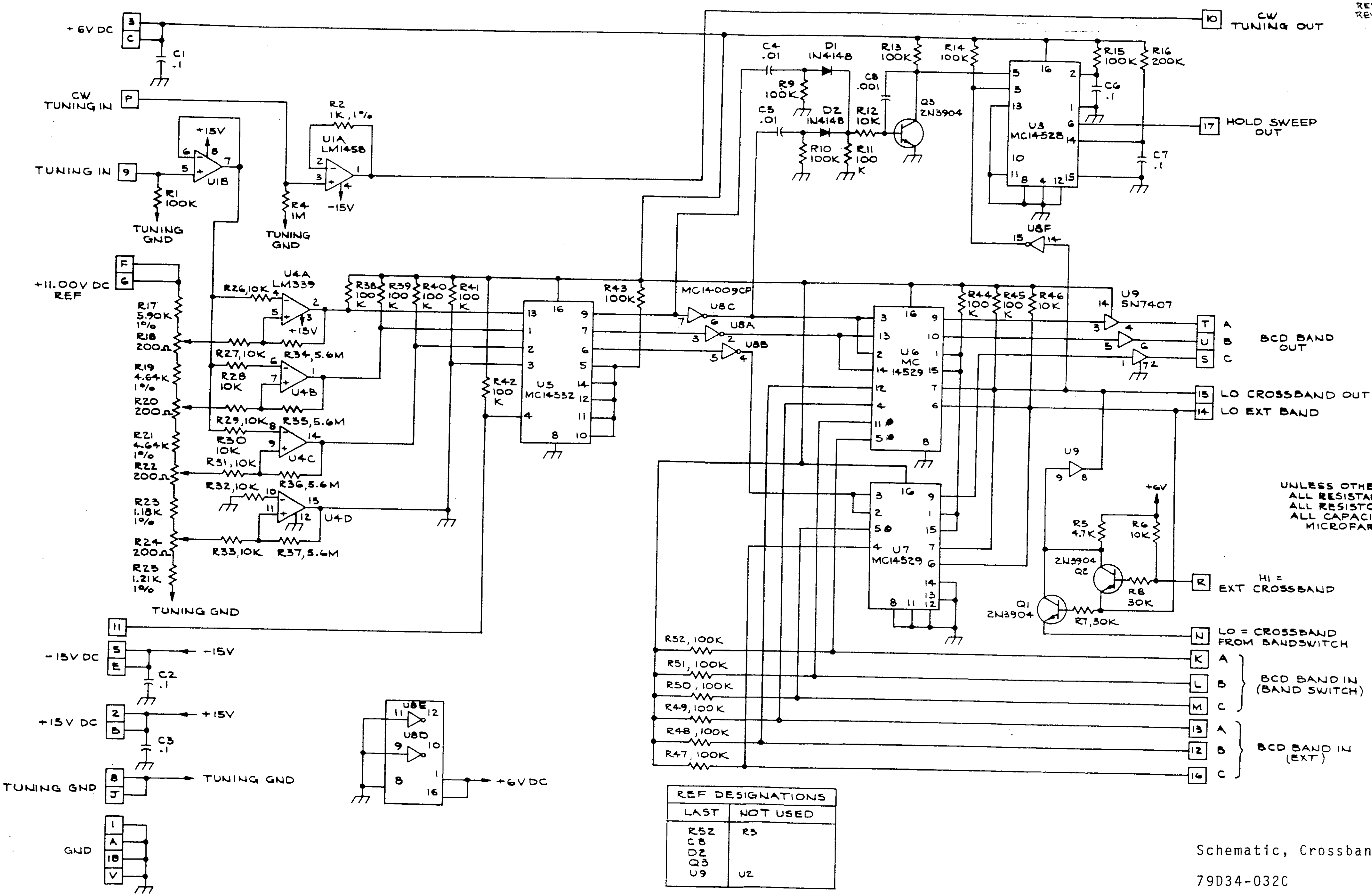
REF DESIGNATIONS	
LAST	NOT USED
C6	C5
D1	
U14	U10
R106	R15, 19, 20, 25, 30, 35, 40, 45, 48, 50, 51, 55, 60, 65, 70, 73, 75, 77, 80, 85, 90, 95, 100, 105

Schematic, Marker/Sweep Generator

79D33-029A (A3B3)

Figure 7.6

REV A - C.O. #8 RS 6/1/7
REV B - C.O. #19 PS 6/1/7
REV C - C.O. #32 PS 6/1/7



UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4W
ALL CAPACITORS ARE IN MICROFARADS

REF DESIGNATIONS

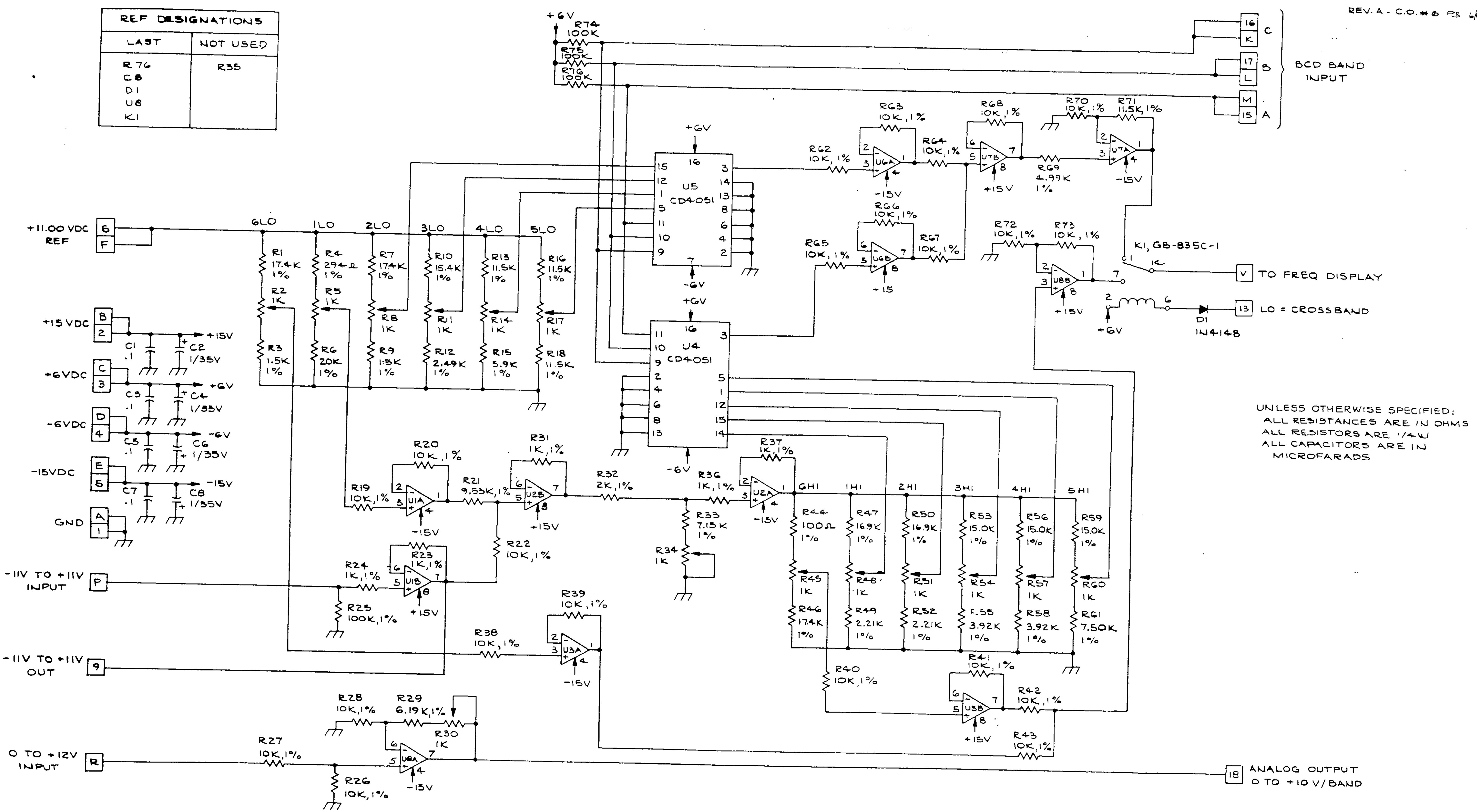
LAST	NOT USED
R52	R3
C8	
D2	
Q3	
U9	U2

Schematic, Crossband Logic Board

79D34-032C (A3B4)

Figure 7.7

REF DESIGNATIONS	
LAST	NOT USED
R76	R35
C8	
D1	
U8	
K1	

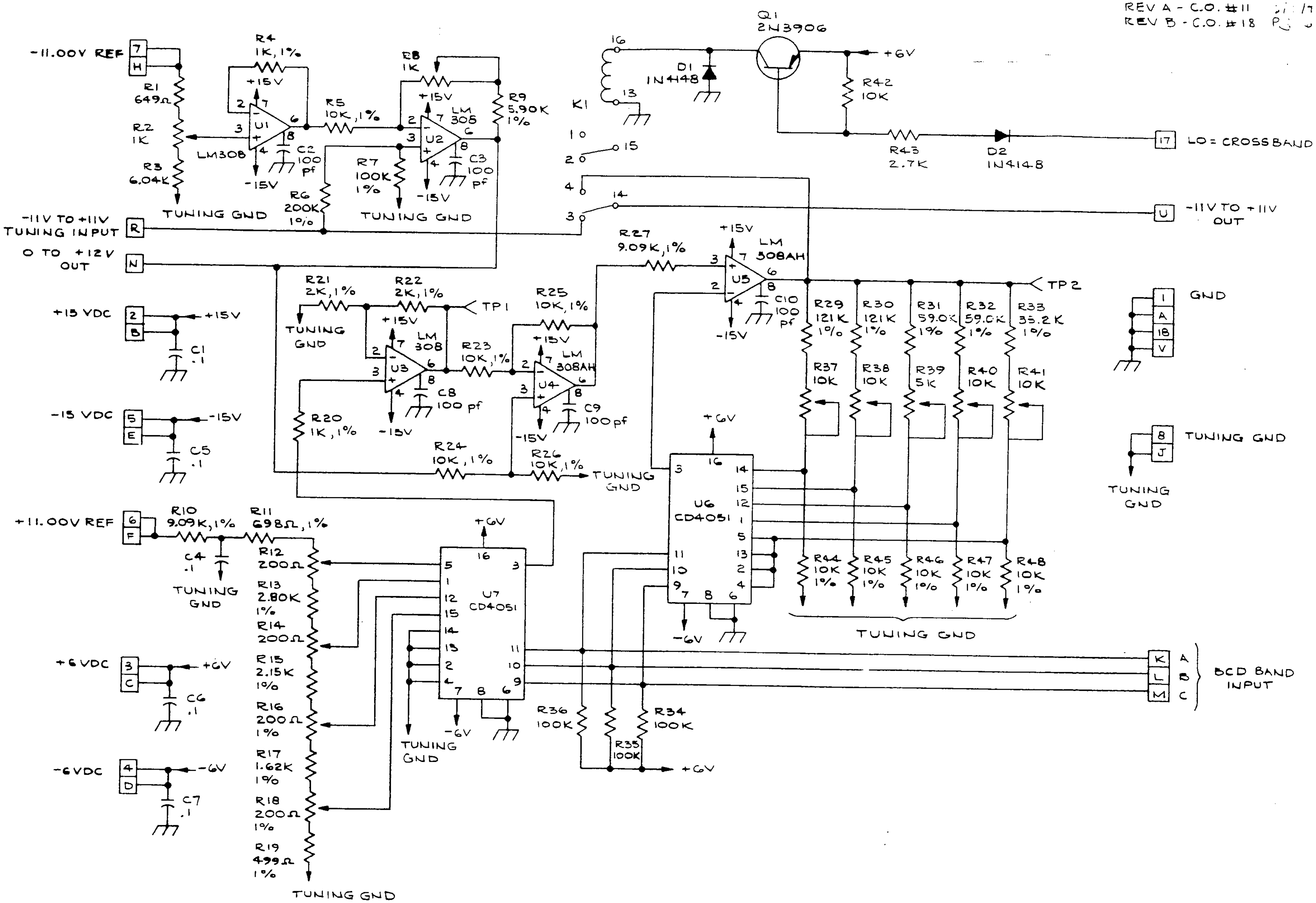


Schematic, Meter/Analog
Tracking Board

79D35-034A (A3B5)

Figure 7.8

REV A - C.O. #11
REV B - C.O. #18



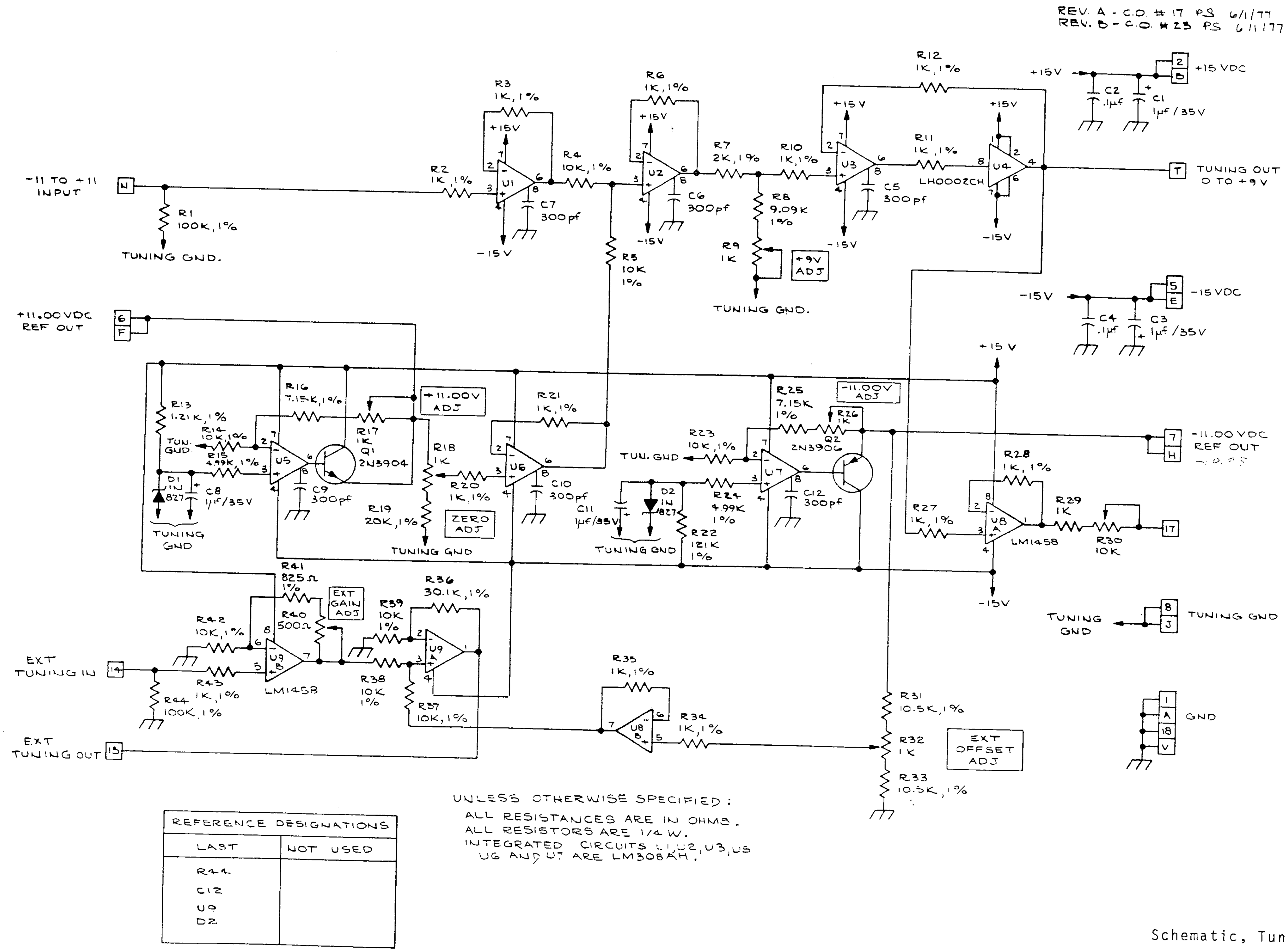
REF DESIGNATIONS	
LAST	NOT USED
R48	R28
C10	
D2	
Q1	
U7	
K1	

UNLESS OTHERWISE SPECIFIED
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W
ALL CAPACITORS ARE IN MICROFARADS

Schematic, Crossband Tuning Generator

79C36-038B (A3B6)

Figure 7.9

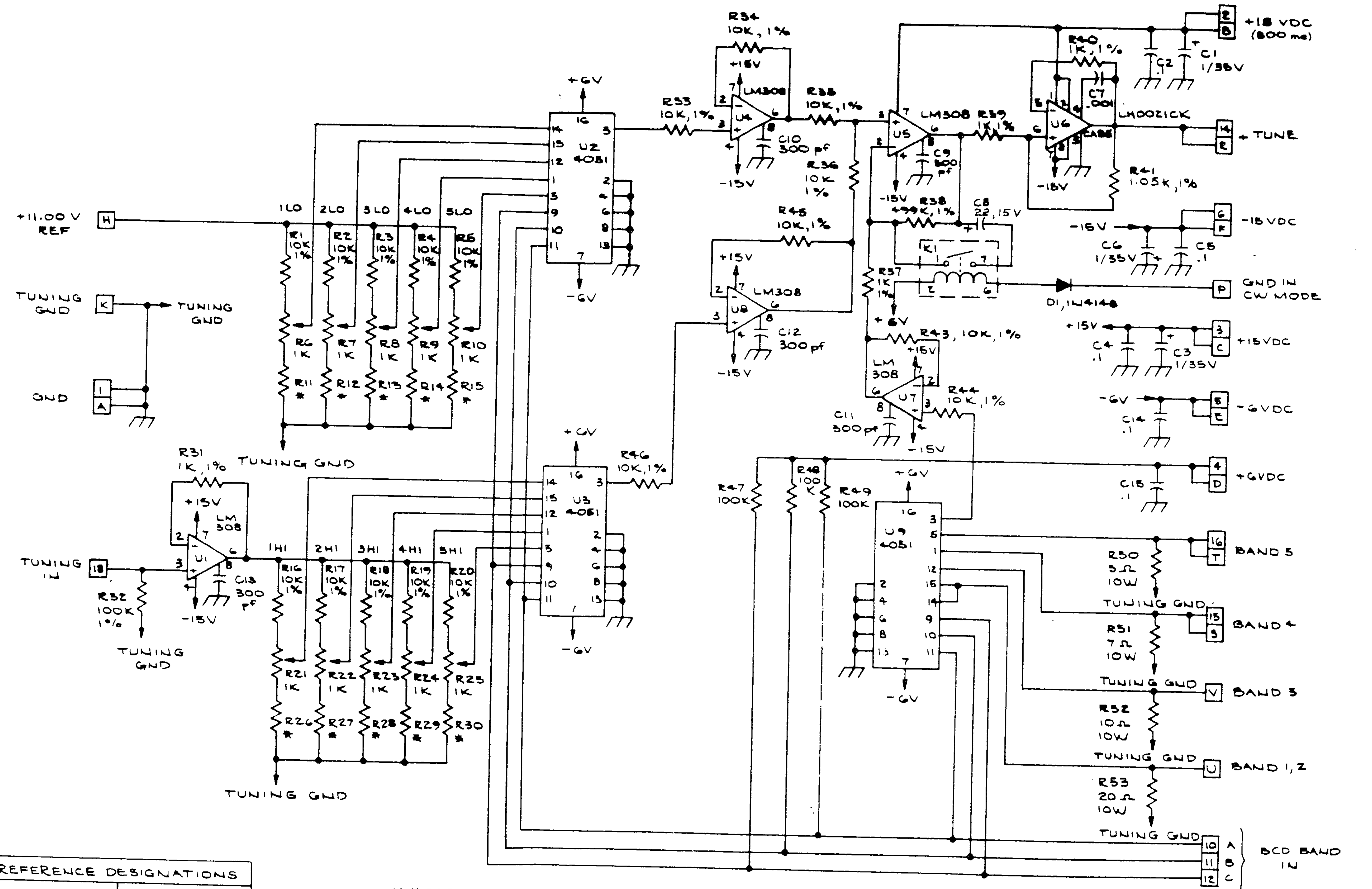


Schematic, Tuning Generator

79C37-041B (A3B7)

Figure 7.10

REV A - C.O. #24 PB 6/1/77



REFERENCE DESIGNATIONS	
LAST	NOT USED
R53	R42
C15	
U9	
K1	
D1	

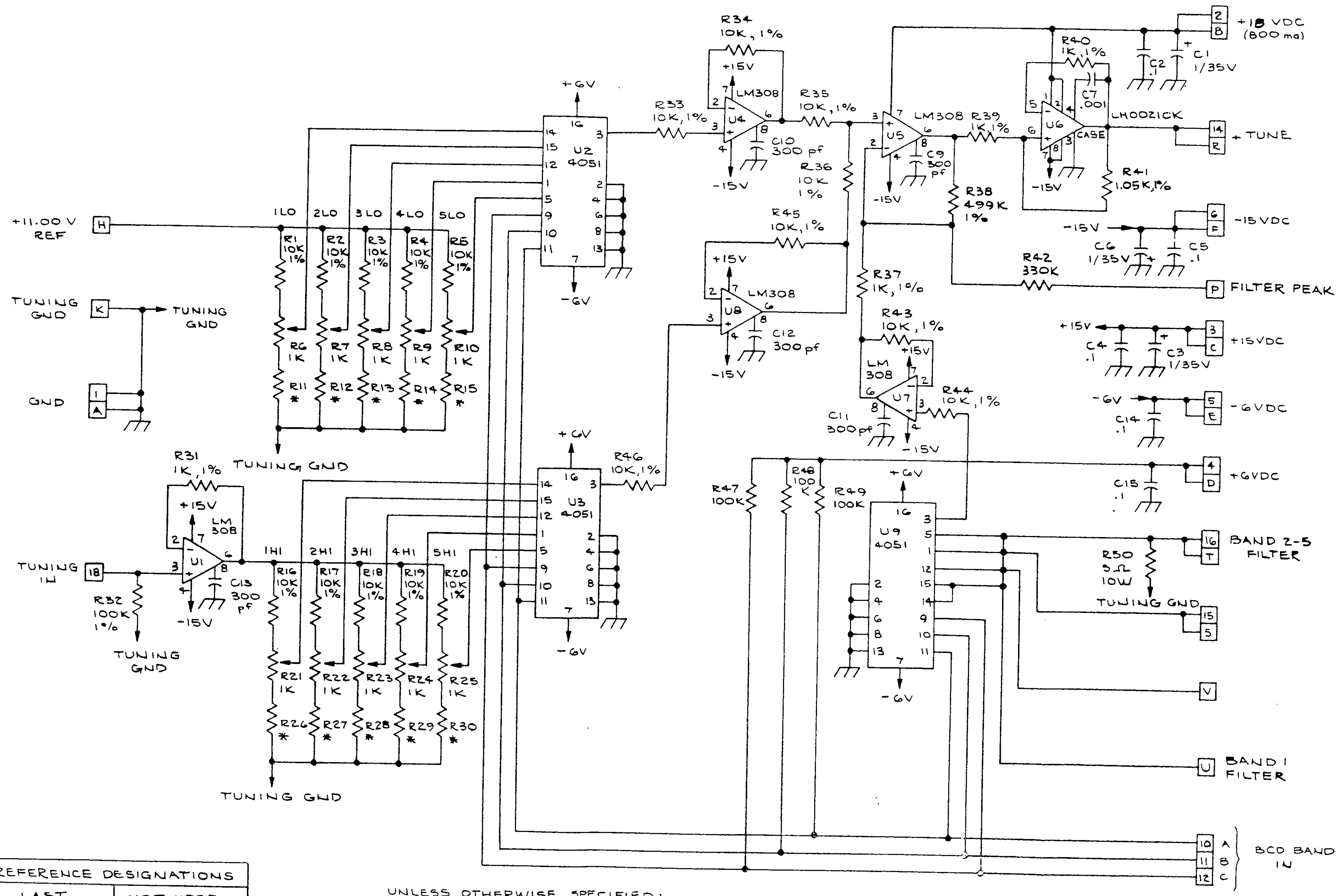
UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W
ALL CAPACITORS ARE IN MICROFARADS
* SELECTED VALUE RN55C 1%

Schematic, Oscillator Tracking/Driver

79C38-044A (A3B8)

Figure 7.11

REV. A - C.O. # 26 PS 6/1/77



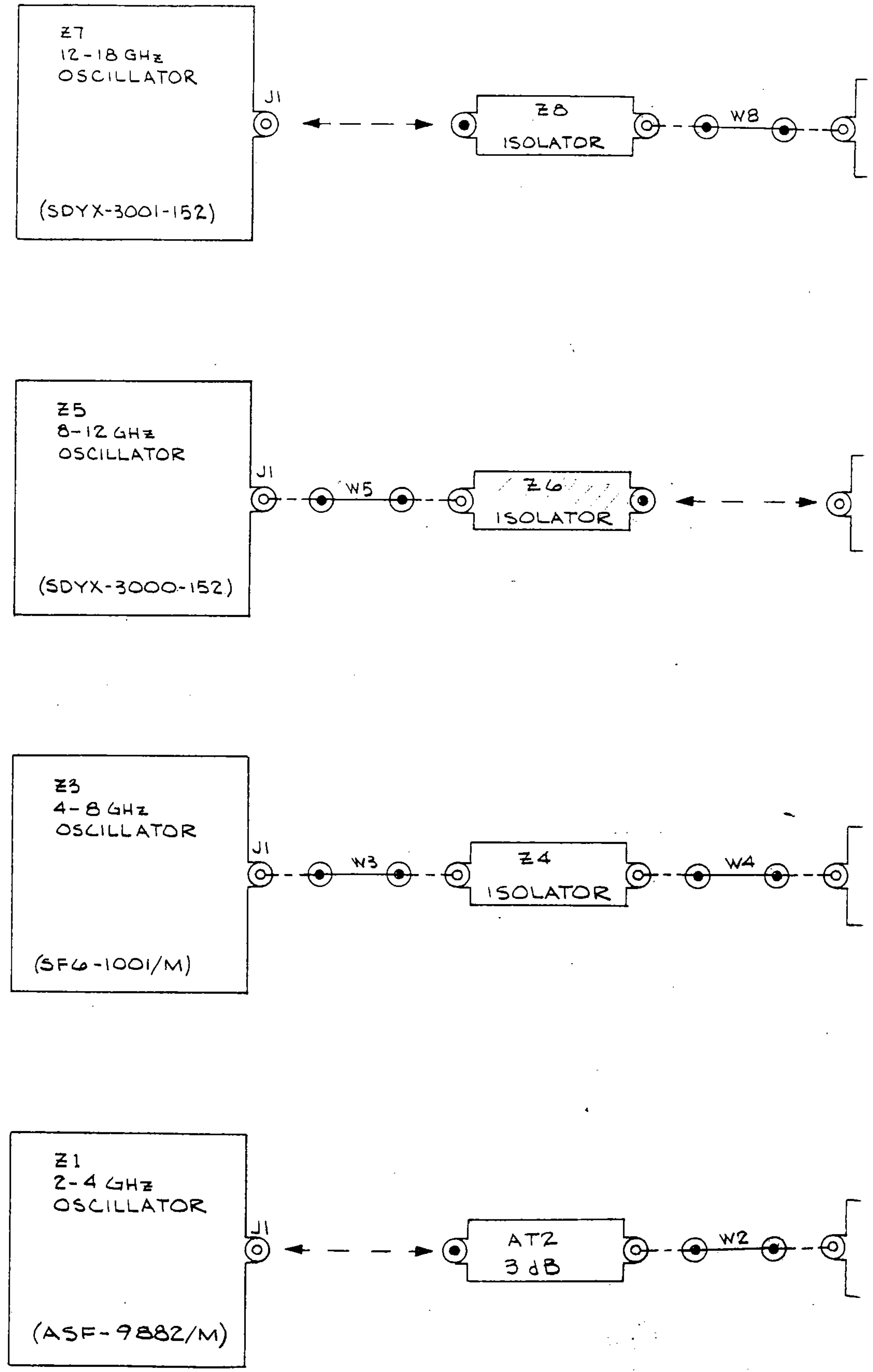
REFERENCE DESIGNATIONS	
LAST	NOT USED
R50	
C15	C8
U9	

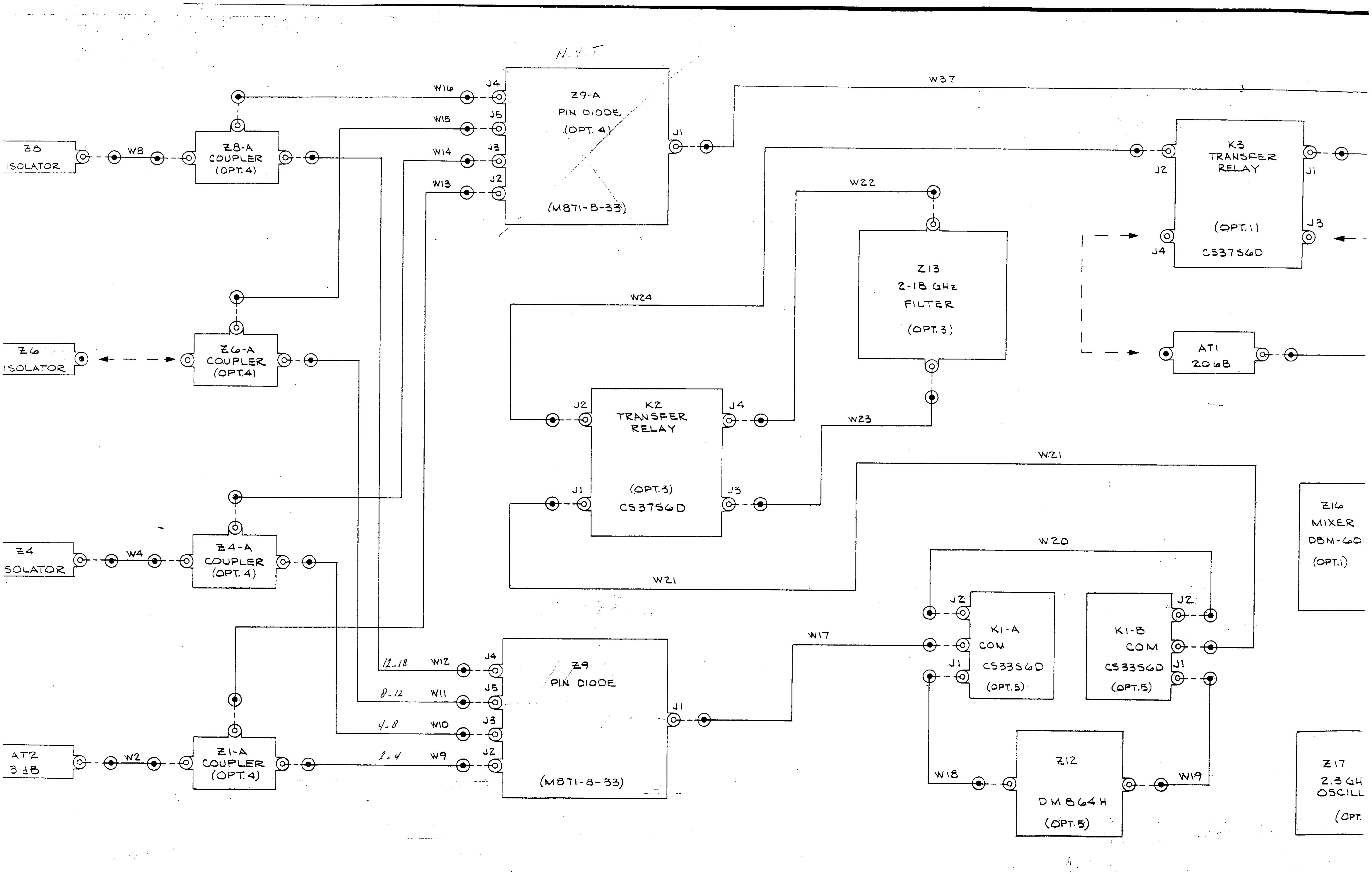
UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W
ALL CAPACITORS ARE IN MICROFARADS
* SELECTED VALUE RN55C 1%

Schematic, Filter Tracking/Driver

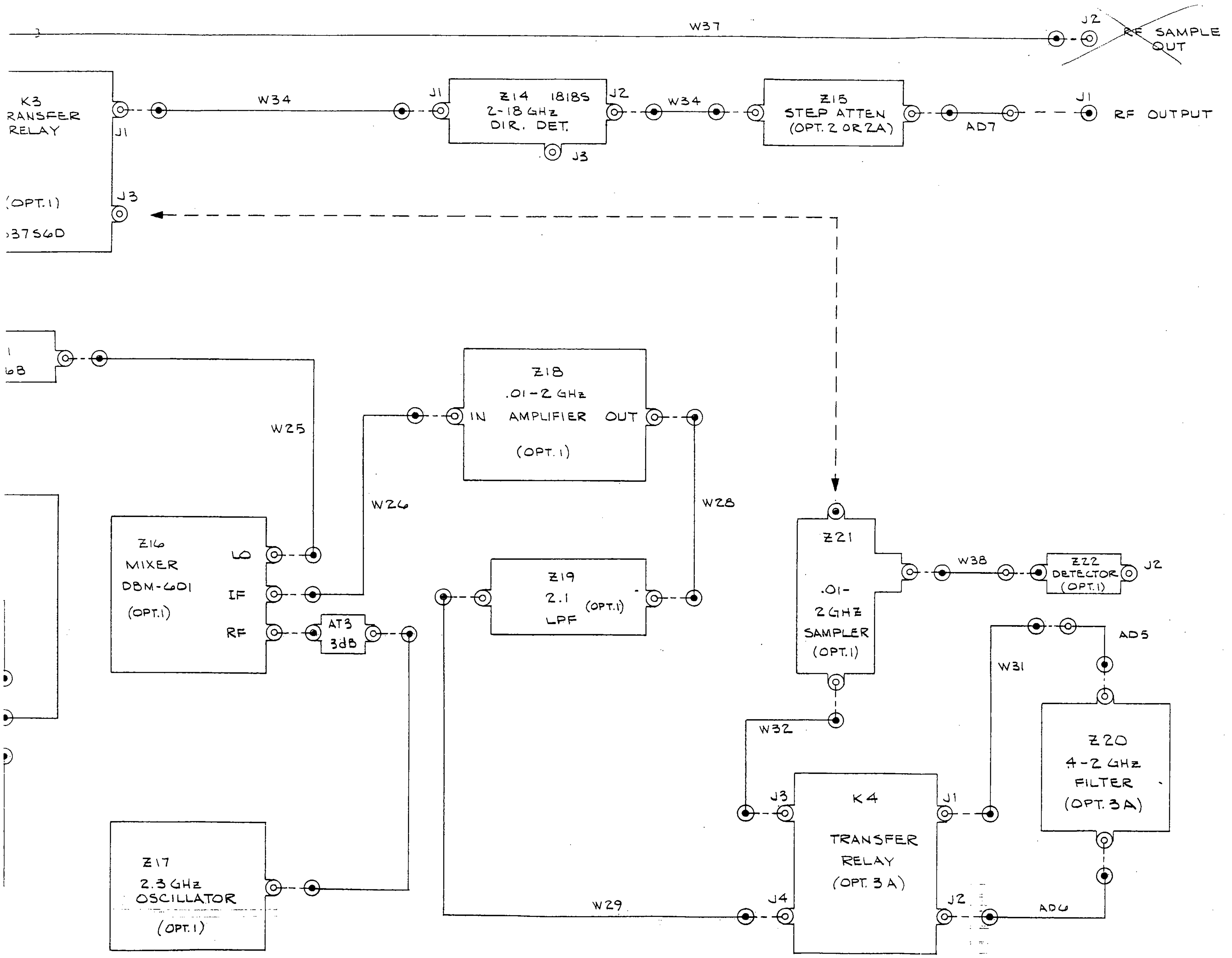
79C39-046A (A3B9

Figure 7.12


Z7
12-18 GHz
OSCILLATOR
(SDYX-3001-152)
J1
Z8
ISOLATOR
W8
Z5
8-12 GHz
OSCILLATOR
(SDYX-3000-152)
J1
W5
Z6
ISOLATOR
Z3
4-8 GHz
OSCILLATOR
(SF6-1001/M)
J1
W3
Z4
ISOLATOR
W4
Z1
2-4 GHz
OSCILLATOR
(ASF-9882/M)
J1
AT2
3 dB
W2



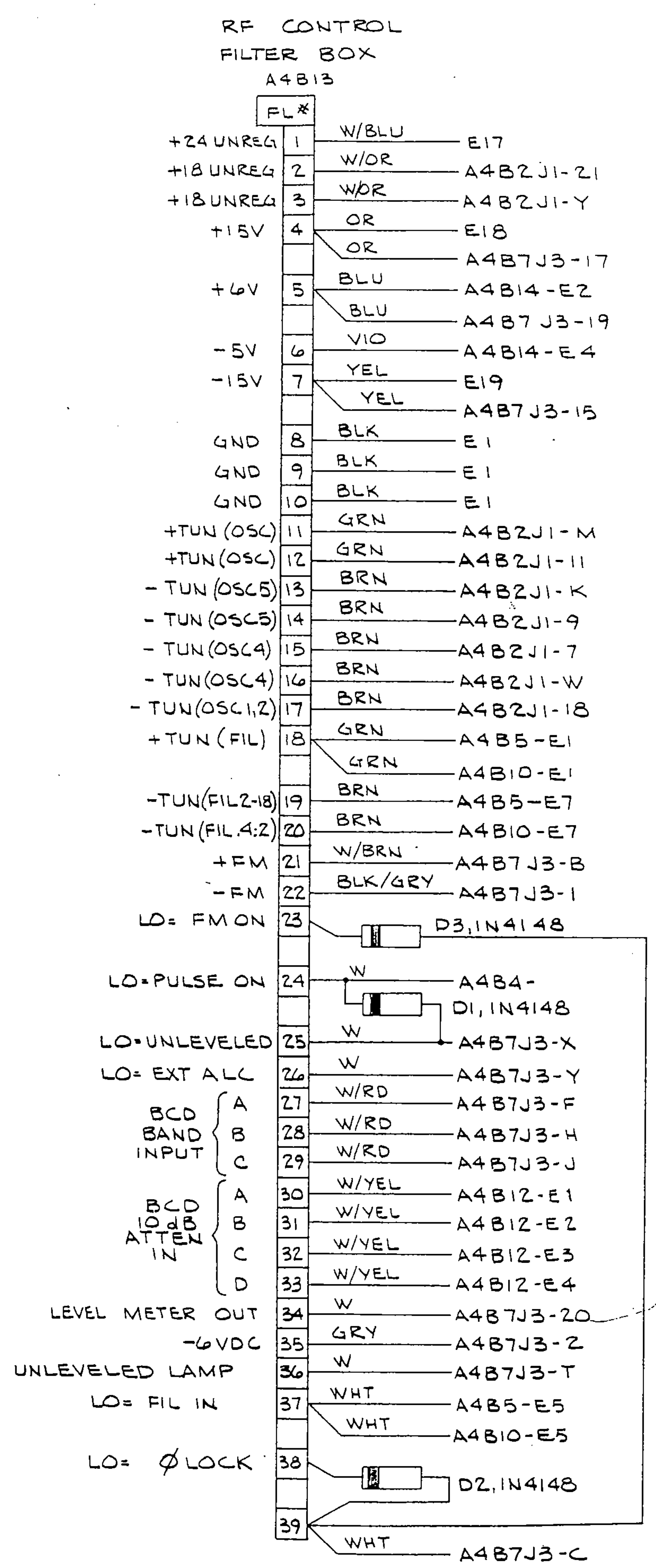
Z8
ISOLATOR
W8
Z8-A
COUPLER
(OPT. 4)
Z6
ISOLATOR
Z6-A
COUPLER
(OPT.4)
Z4
SOLATOR
W4
Z4-A
COUPLER
(OPT. 4)
AT2
3 dB
W2
Z1-A
COUPLER
(OPT. 4)
W16
W15
W14
W13
J4
J5
J3
J2
Z9-A
PIN DIODE
(OPT. 4)
(M871-8-33)
J1
W37
K3
TRANSFER
RELAY
(OPT. 1)
CS37S6D
J2
J1
J4
J3
W22
Z13
2-18 GHz
FILTER
(OPT. 3)
AT1
2068
W24
K2
TRANSFER
RELAY
(OPT.3)
CS37S6D
J2
J4
J1
J3
W23
W21
W21
W20
Z16
MIXER
DBM-601
(OPT.1)
12-18
W12
8-12
W11
4-8
W10
2-4
W9
Z9
PIN DIODE
(M871-8-33)
W17
K1-A
COM
CS33S6D
(OPT.5)
K1-B
COM
CS33S6D
(OPT.5)
W18
Z12
DM864H
(OPT.5)
W19
Z17
2.3 GH
OSCILL
(OPT.

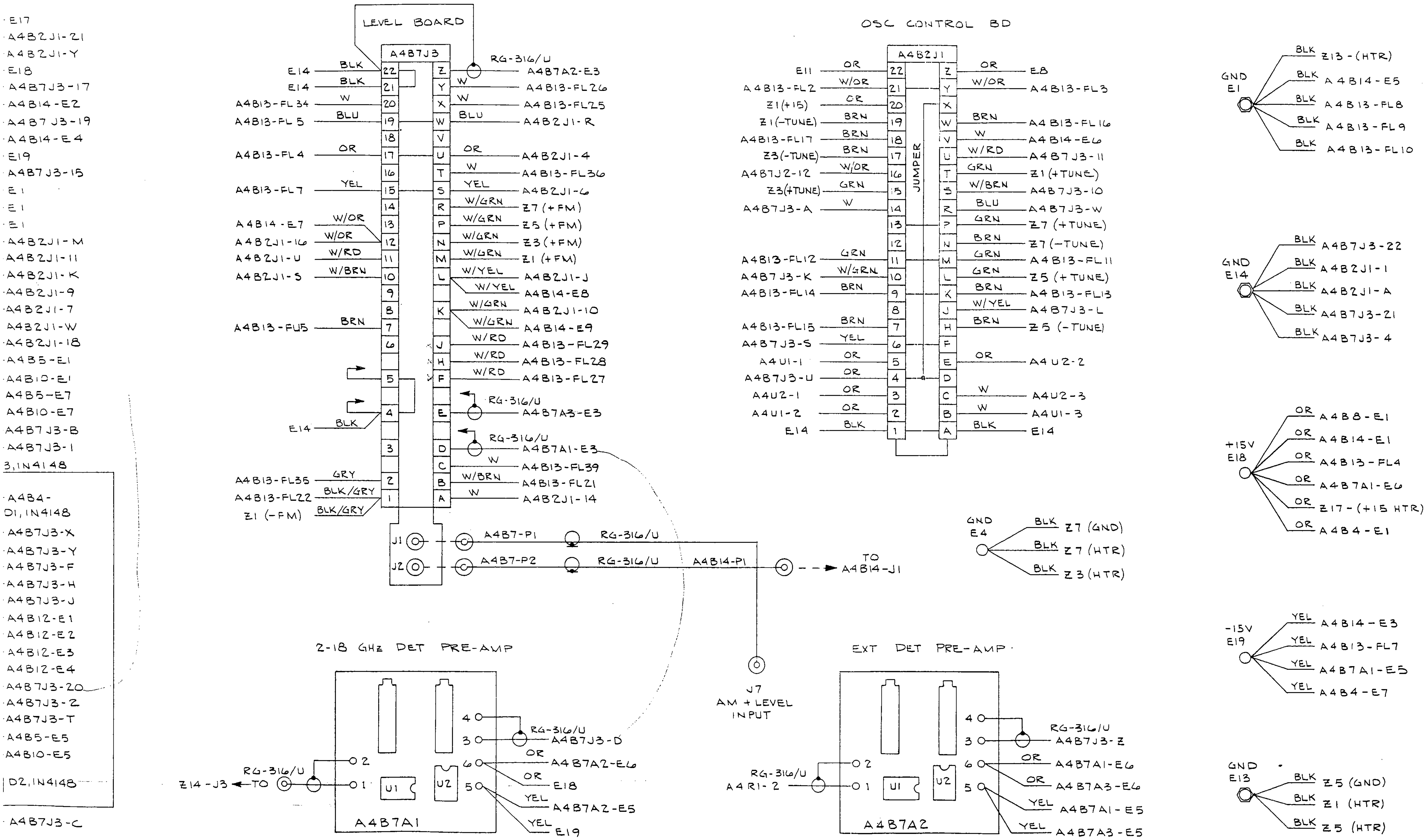


Wiring Diagram, RF Unit

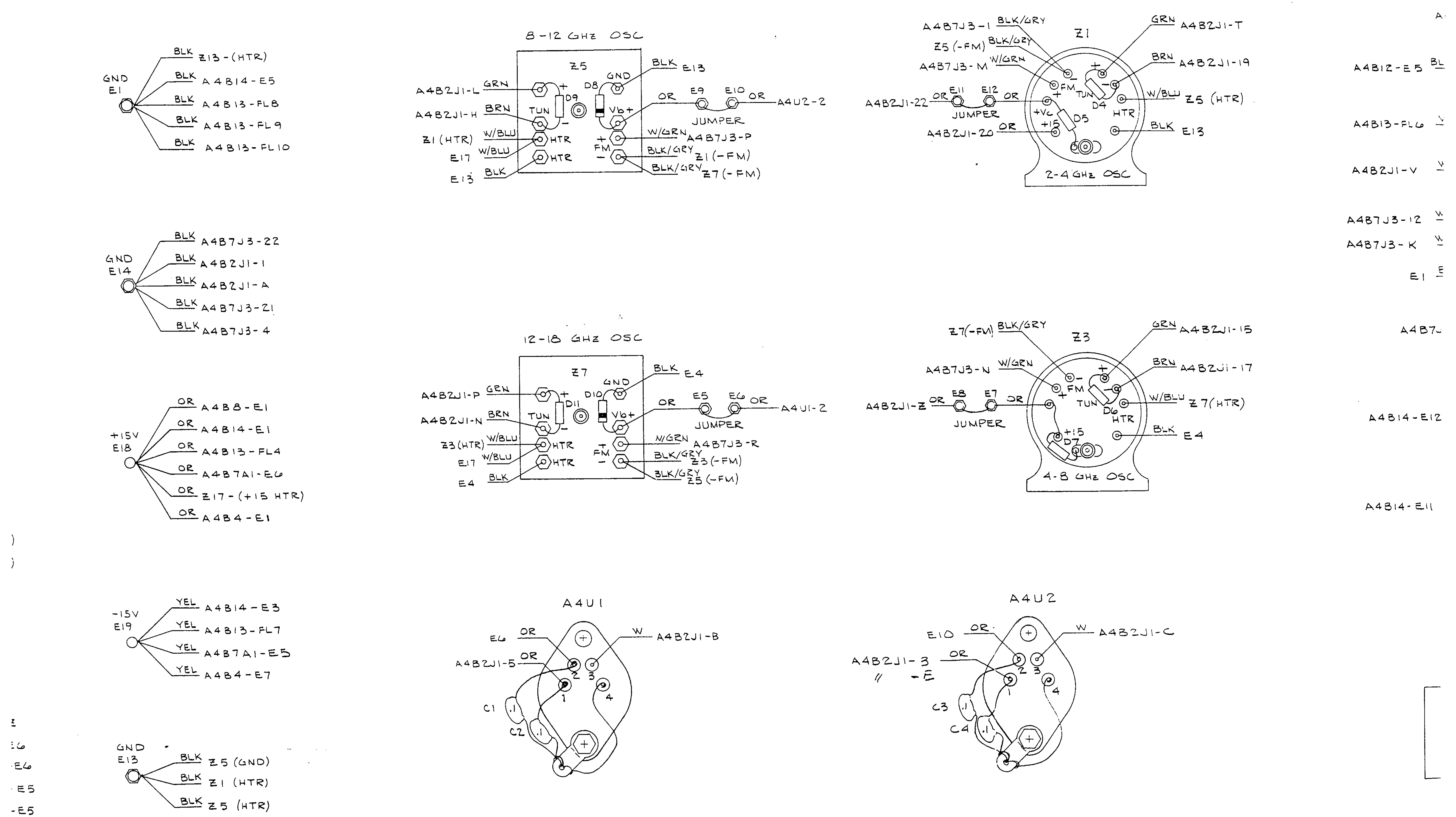
79R40-334 (A4)
Sheet 1 of 2

Figure 7.13

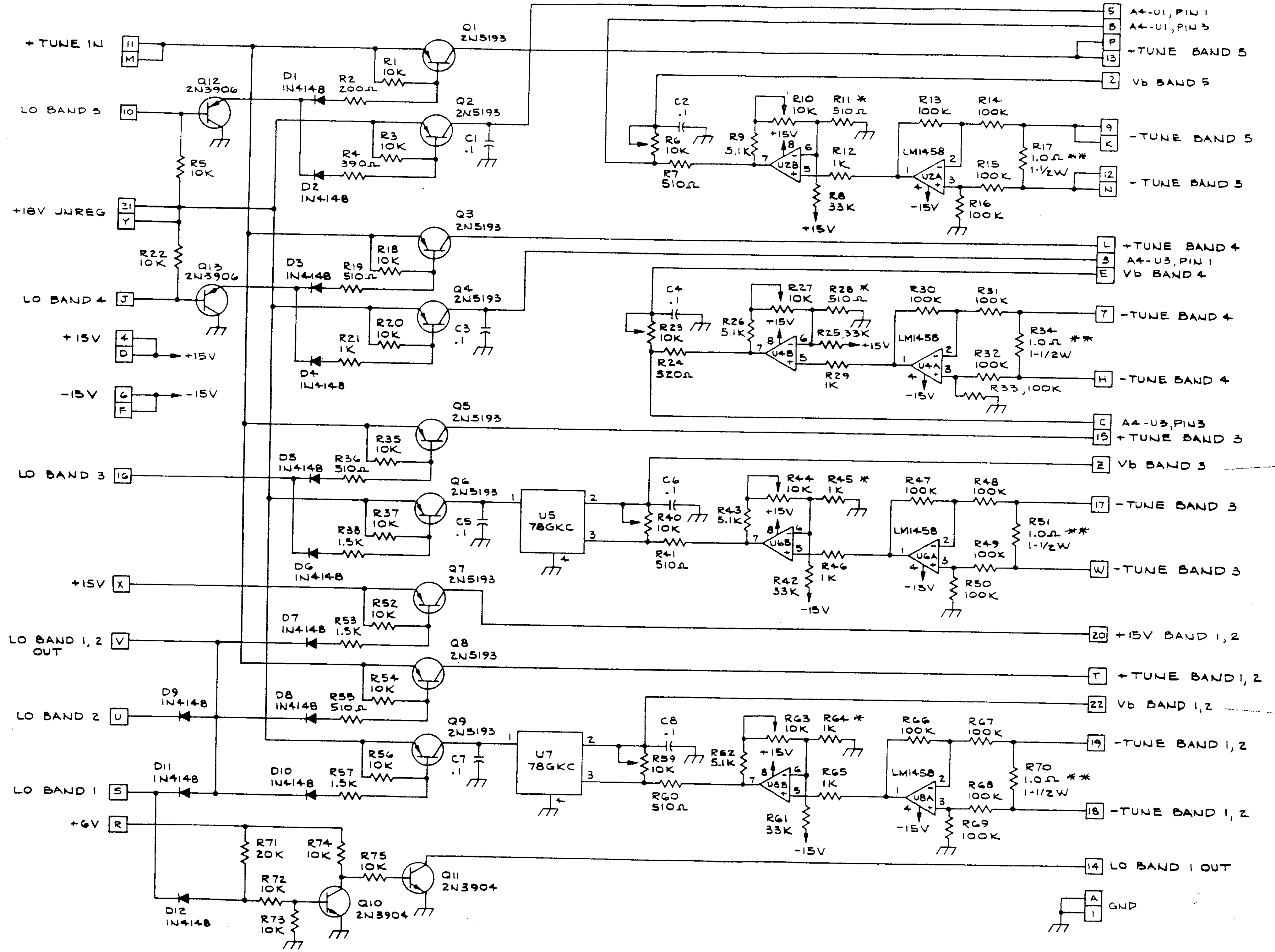

RF CONTROL
FILTER BOX
A4B13
FL*
+24 UNREG 1 W/BLU E17
+18 UNREG 2 W/OR A4B2J1-21
+18 UNREG 3 W/OR A4B2J1-Y
+15V 4 OR E18
OR A4B7J3-17
+6V 5 BLU A4B14-E2
BLU A4B7J3-19
-5V 6 VIO A4B14-E4
-15V 7 YEL E19
YEL A4B7J3-15
GND 8 BLK E1
GND 9 BLK E1
GND 10 BLK E1
+TUN (OSC) 11 GRN A4B2J1-M
+TUN (OSC) 12 GRN A4B2J1-11
- TUN (OSC5) 13 BRN A4B2J1-K
- TUN (OSC5) 14 BRN A4B2J1-9
- TUN (OSC4) 15 BRN A4B2J1-7
- TUN (OSC4) 16 BRN A4B2J1-W
- TUN (OSC1,2) 17 BRN A4B2J1-18
+TUN (FIL) 18 GRN A4B5-E1
GRN A4B10-E1
-TUN (FIL2-18) 19 BRN A4B5-E7
-TUN (FIL .4:2) 20 BRN A4B10-E7
+FM 21 W/BRN A4B7J3-B
-FM 22 BLK/GRY A4B7J3-1
LO= FM ON 23 D3, IN4148
LO= PULSE ON 24 W A4B4-
D1, IN4148
LO= UNLEVELED 25 W A4B7J3-X
LO= EXT ALC 26 W A4B7J3-Y
BCD BAND INPUT
A 27 W/RD A4B7J3-F
B 28 W/RD A4B7J3-H
C 29 W/RD A4B7J3-J
BCD 10dB ATTEN IN
A 30 W/YEL A4B12-E1
B 31 W/YEL A4B12-E2
C 32 W/YEL A4B12-E3
D 33 W/YEL A4B12-E4
LEVEL METER OUT 34 W A4B7J3-20
-6VDC 35 GRY A4B7J3-2
UNLEVELED LAMP 36 W A4B7J3-T
LO= FIL IN 37 WHT A4B5-E5
WHT A4B10-E5
LO= ØLOCK 38 D2, IN4148
39 WHT A4B7J3-C



LEVEL BOARD
A4B7J3
RG-316/U
OSC CONTROL BD
A4B2J1
JUMPER
GND E1
GND E14
+15V E18
GND E4
-15V E19
GND E13
A4B7-P1
A4B7-P2
A4B14-P1
TO A4B14-J1
2-18 GHz DET PRE-AMP
EXT DET PRE-AMP
J7 AM + LEVEL INPUT
A4B7A1
A4B7A2
U1
U2
Z14-J3 TO
A4R1-2
Z13-(HTR)
A4B14-E5
A4B13-FL8
A4B13-FL9
A4B13-FL10
A4B7J3-22
A4B2J1-1
A4B2J1-A
A4B7J3-21
A4B7J3-4
A4B8-E1
A4B14-E1
A4B13-FL4
A4B7A1-E6
Z17-(+15 HTR)
A4B4-E1
Z7 (GND)
Z7 (HTR)
Z3 (HTR)
A4B14-E3
A4B13-FL7
A4B7A1-E5
A4B4-E7
Z5 (GND)
Z1 (HTR)
Z5 (HTR)
A4B7J3-D
A4B7A2-E6
E18
A4B7A2-E5
E19
A4B7J3-Z
A4B7A1-E6
A4B7A3-E6
A4B7A1-E5
A4B7A3-E5



GND E1
BLK Z13-(HTR)
BLK A4B14-E5
BLK A4B13-FL8
BLK A4B13-FL9
BLK A4B13-FL10
GND E14
BLK A4B7J3-22
BLK A4B2J1-1
BLK A4B2J1-A
BLK A4B7J3-21
BLK A4B7J3-4
+15V E18
OR A4B8-E1
OR A4B14-E1
OR A4B13-FL4
OR A4B7A1-E6
OR Z17-(+15 HTR)
OR A4B4-E1
-15V E19
YEL A4B14-E3
YEL A4B13-FL7
YEL A4B7A1-E5
YEL A4B4-E7
GND E13
BLK Z5 (GND)
BLK Z1 (HTR)
BLK Z5 (HTR)
8-12 GHz OSC
Z5
A4B2J1-L GRN
A4B2J1-H BRN
Z1 (HTR) W/BLU
E17 W/BLU
E13 BLK
TUN
HTR
HTR
D9
D8
GND
Vb+
FM
BLK E13
OR E9 E10 OR A4U2-2
JUMPER
W/GRN A4B7J3-P
BLK/GRY Z1 (-FM)
BLK/GRY Z7 (-FM)
12-18 GHz OSC
Z7
A4B2J1-P GRN
A4B2J1-N BRN
Z3 (HTR) W/BLU
E17 W/BLU
E4 BLK
TUN
HTR
HTR
D11
D10
GND
Vb+
FM
BLK E4
OR E5 E6 OR A4U1-2
JUMPER
W/GRN A4B7J3-R
BLK/GRY Z3 (-FM)
BLK/GRY Z5 (-FM)
A4B7J3-1 BLK/GRY
Z5 (-FM) BLK/GRY
A4B7J3-M W/GRN
A4B2J1-22 OR E11 E12 OR
JUMPER
A4B2J1-20 OR
Z1
GRN A4B2J1-T
BRN A4B2J1-19
W/BLU Z5 (HTR)
BLK E13
FM
TUN
D4
HTR
+Vc
+15
D5
2-4 GHz OSC
Z7 (-FM) BLK/GRY
A4B7J3-N W/GRN
A4B2J1-Z OR E8 E7 OR
JUMPER
Z3
GRN A4B2J1-15
BRN A4B2J1-17
W/BLU Z7 (HTR)
BLK E4
FM
TUN
D6
HTR
+15
D7
4-8 GHz OSC
A4U1
E6 OR
A4B2J1-5 OR
W A4B2J1-B
1 2 3 4
C1
C2
.1
A4U2
E10 OR
A4B2J1-3 OR
" -E
W A4B2J1-C
1 2 3 4
C3
C4
.1
A4B12-E5
A4B13-FL6
A4B2J1-V
A4B7J3-12
A4B7J3-K
E1
A4B14-E12
A4B14-E11



NOTE:
* TYPICAL VALUE
** MAY BE REPLACED WITH JUMPER

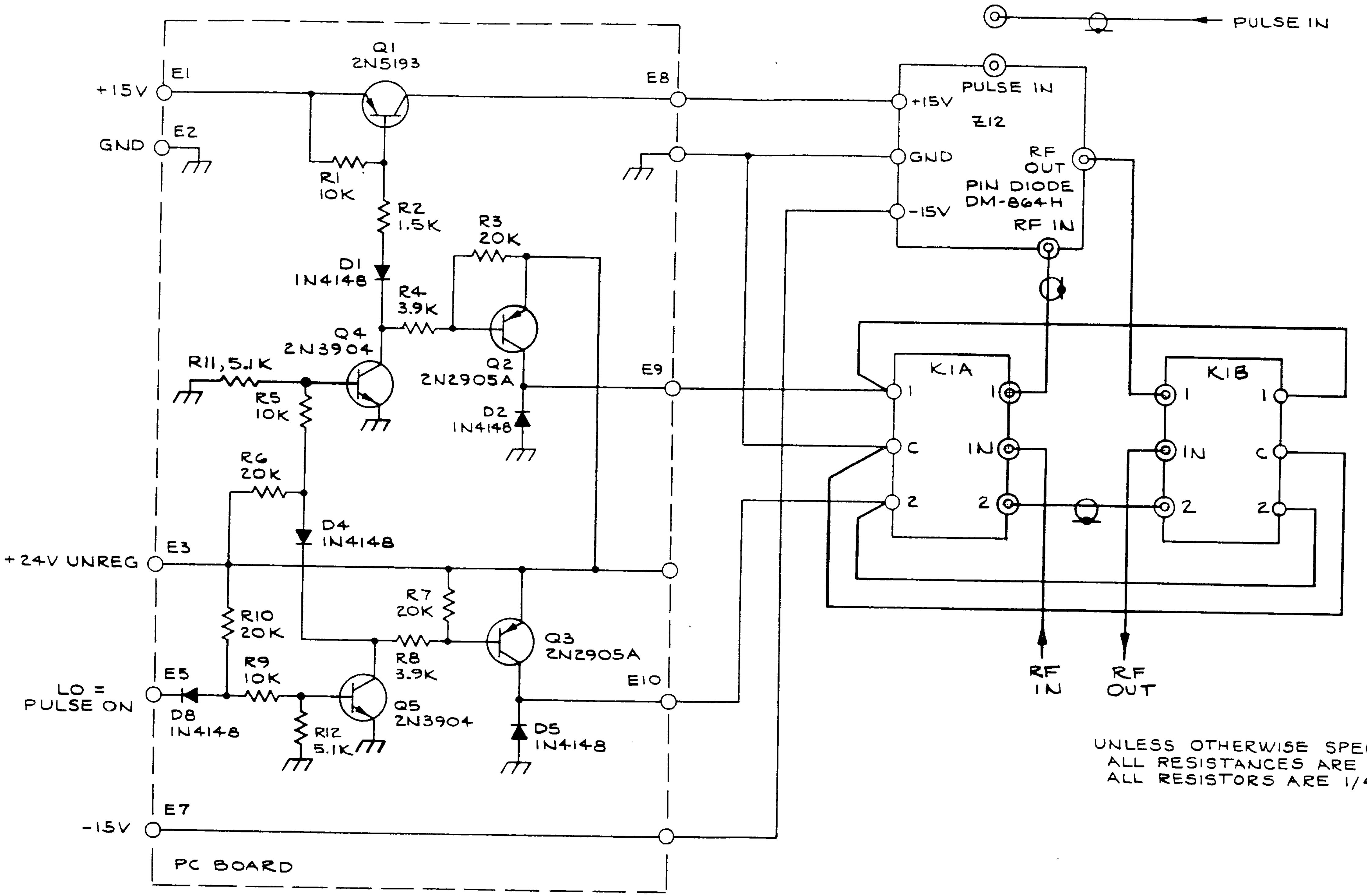
UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W
ALL CAPACITORS ARE IN MICROFARADS

REF DESIGNATIONS	
LAST	NOT USED
Q13 U8 D12 C8 R75	R39, 58

Schematic, Oscillator Contro
Board

79D42-332 (A4B2

Figure 7.14



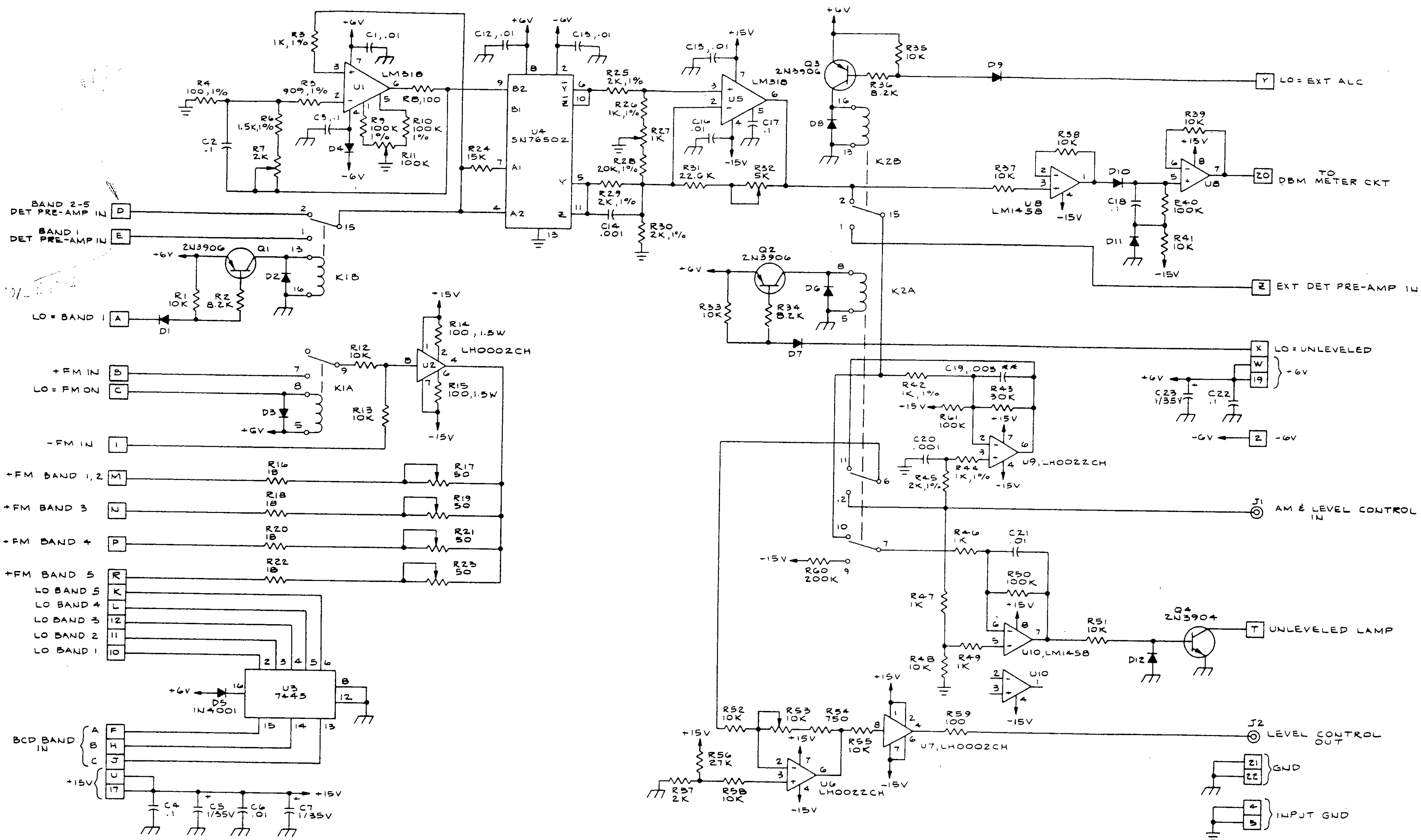
UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W

REF DESIGNATIONS	
LAST	NOT USED
R12 D8 Q5 Z12 K1	D7, 6 & 3 Z1 THRU 11

Schematic, Pulse Modulator
Relay Driver

79B44-325 (A4B4)
SG-811 Option 5

Figure 7.15



* TYPICAL VALUE

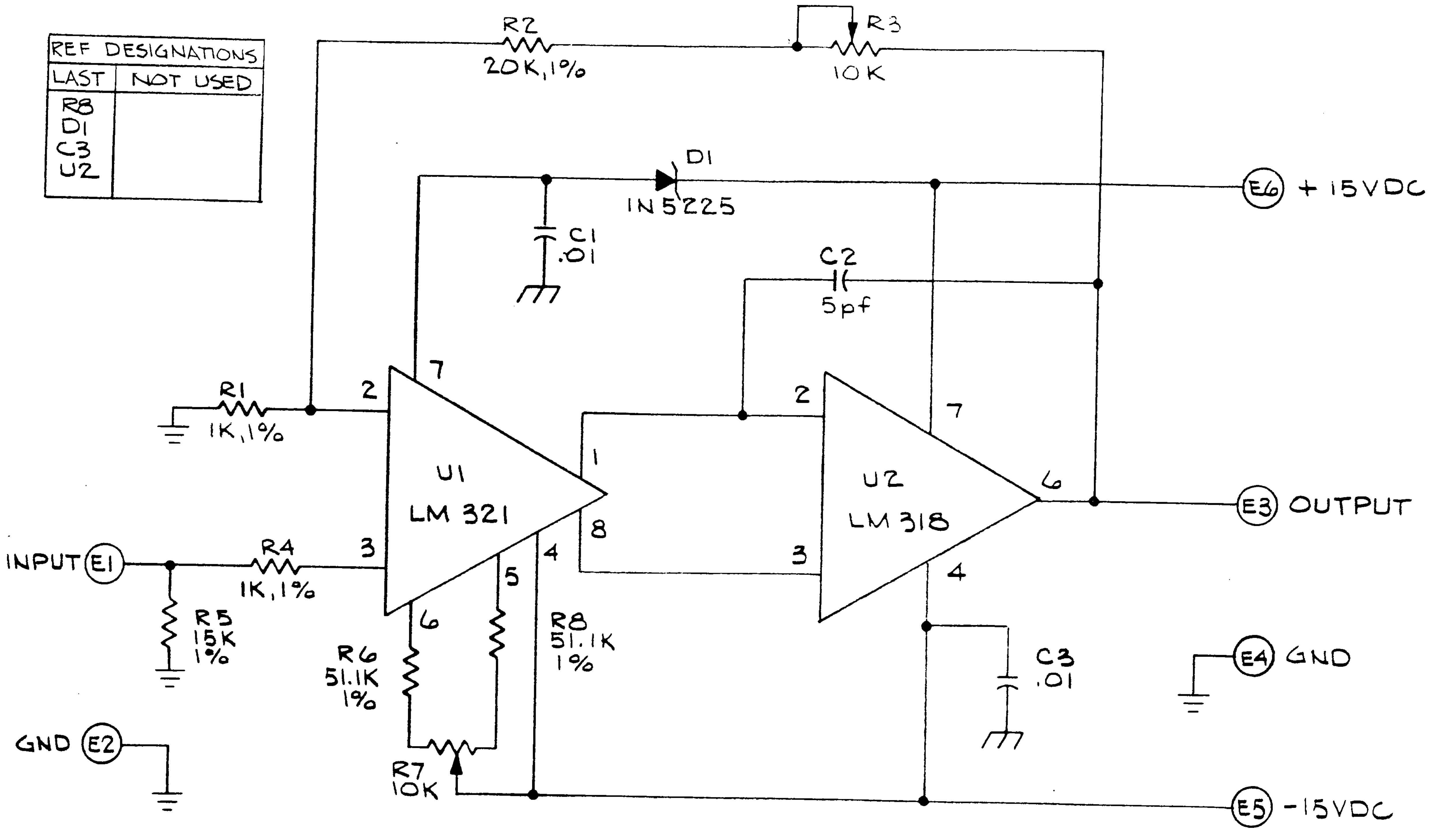
REF DESIGNATIONS	
LAST	NOT USED
C23 D12 J2 K2 Q4 R61	

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W
ALL CAPACITORS ARE IN MICROFARADS
ALL DIODES ARE P/N 1N4148

Schematic, Level Board

79D471-321 (A4B7)

Figure 7.17

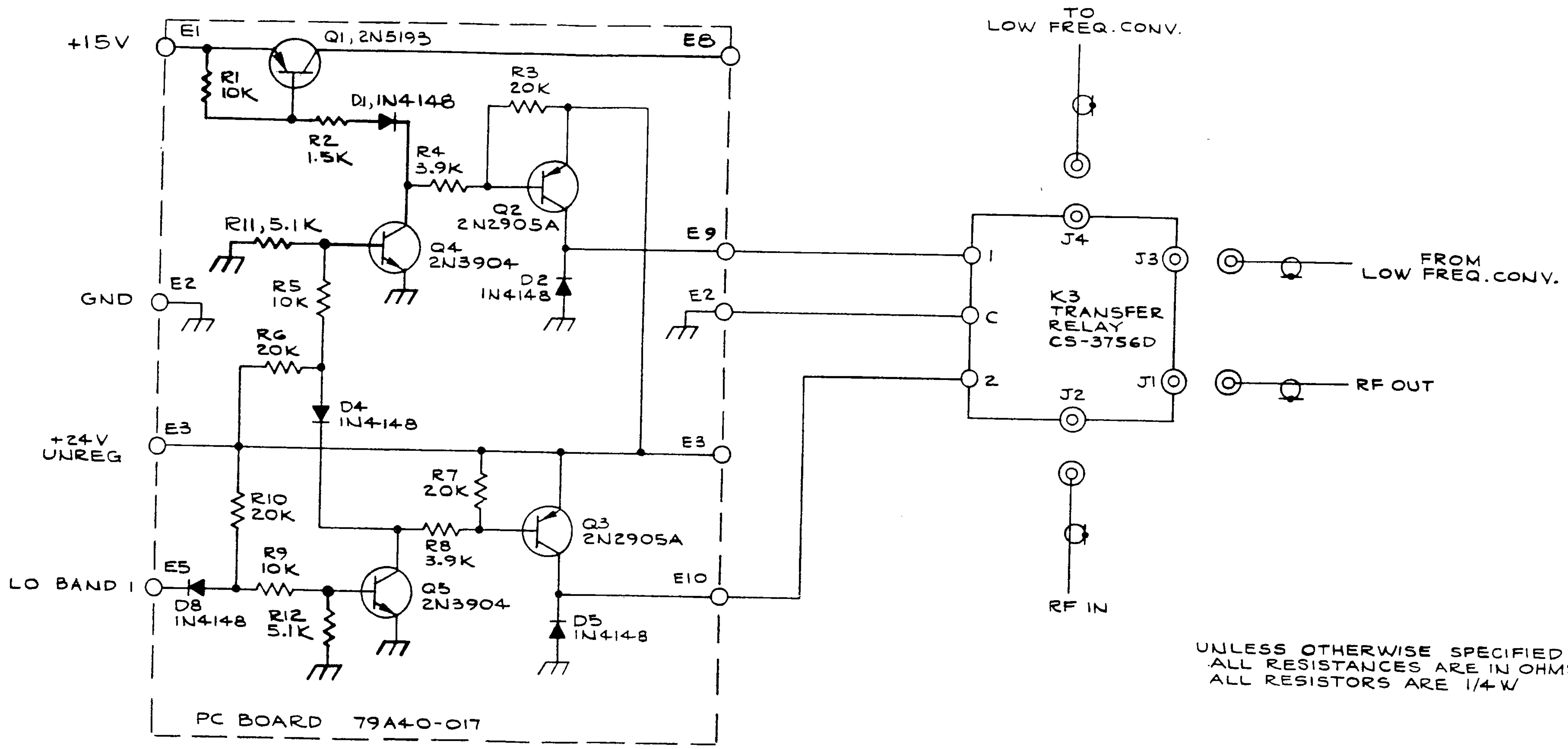


UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W
ALL CAPACITORS ARE IN MICROFARADS

Schematic, 2-18 GHz Det Pre-Amp

79B471-287 (A4B7A1)

Figure 7.17-1



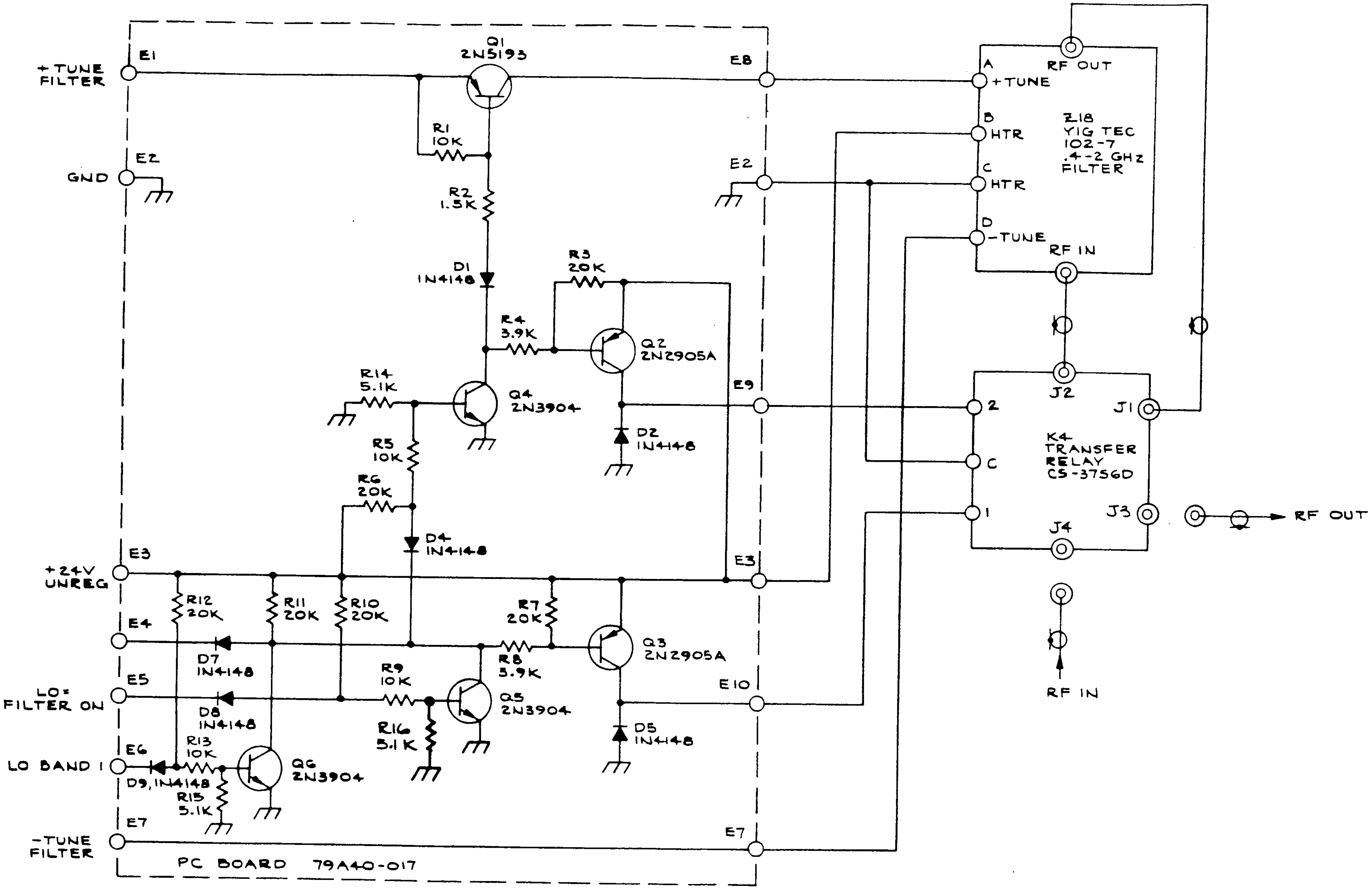
REF DESIGNATIONS	
LAST	NOT USED
R12 D8 Q5 K3	D3, 6 & 7 K1 & 2

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W

Schematic, Transfer Relay Driver

79B48-327 (A4B8)
SG-811 Option 1

Figure 7.18



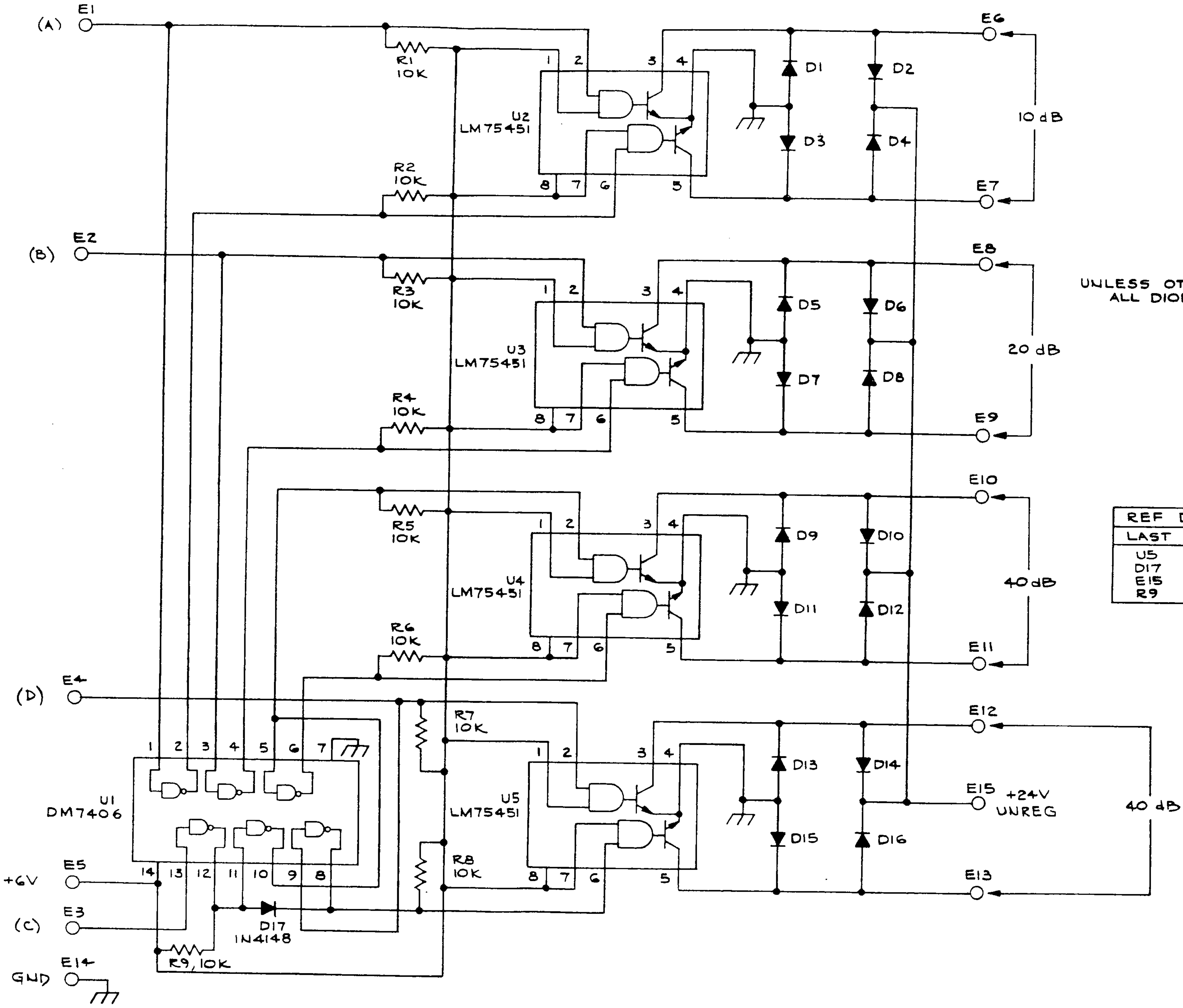
REF DESIGNATIONS	
LAST	NOT USED
R16 D9 Q6 Z18 K4	D3 & 6 Z1 THRU 17 K1 THRU 3

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4W

Schematic, .4-2 GHz Filter
Relay Driver

79B410-328 (A4B10)
SG-811 Option 3A

Figure 7.19



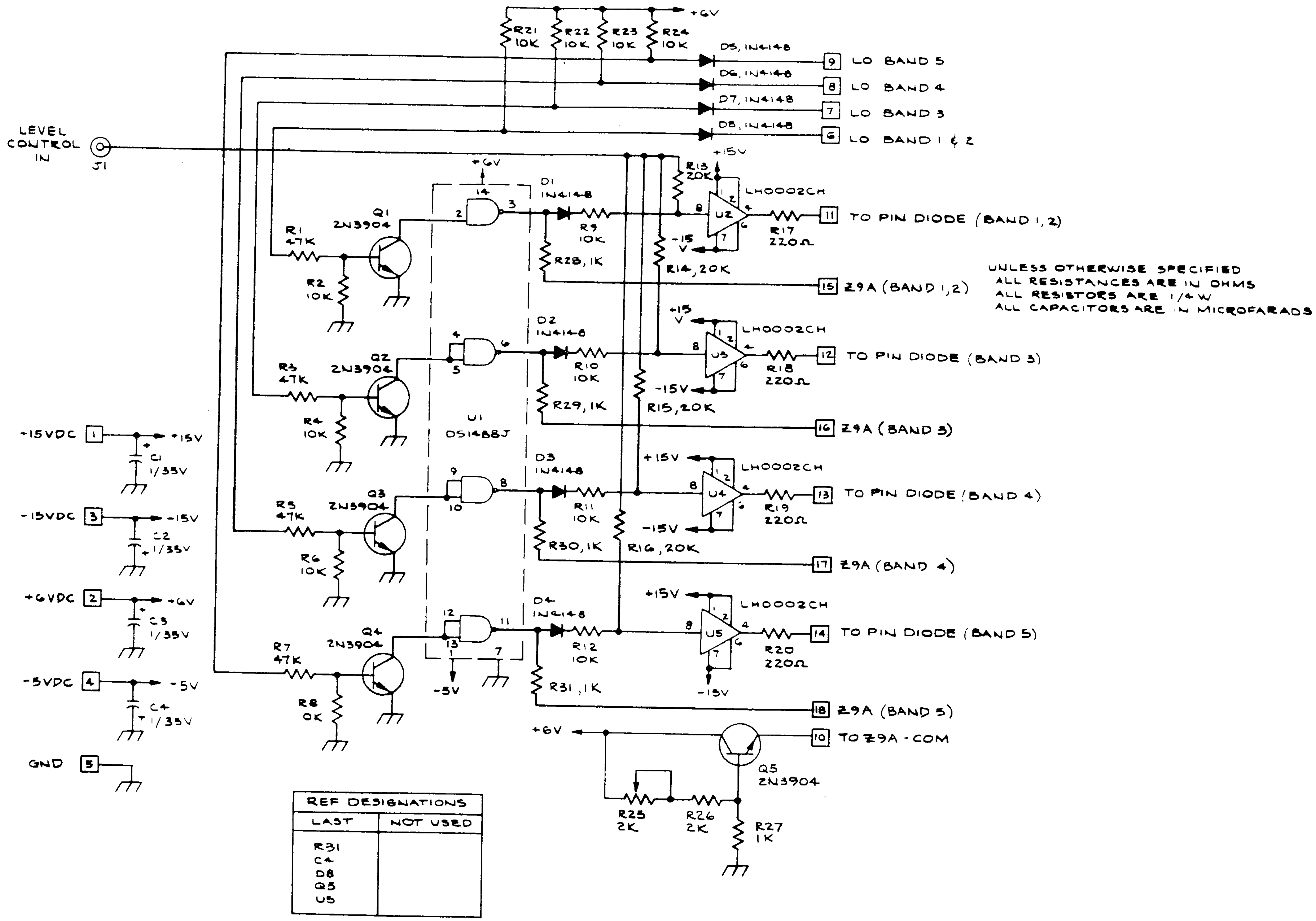
UNLESS OTHERWISE SPECIFIED: ALL DIODES ARE P.N. 1N4001

REF DESIGNATIONS	
LAST	NOT USED
U5 D17 E15 R9	

Schematic, Attenuator Driver Board

79C412-159 (A4B12)

Figure 7.20

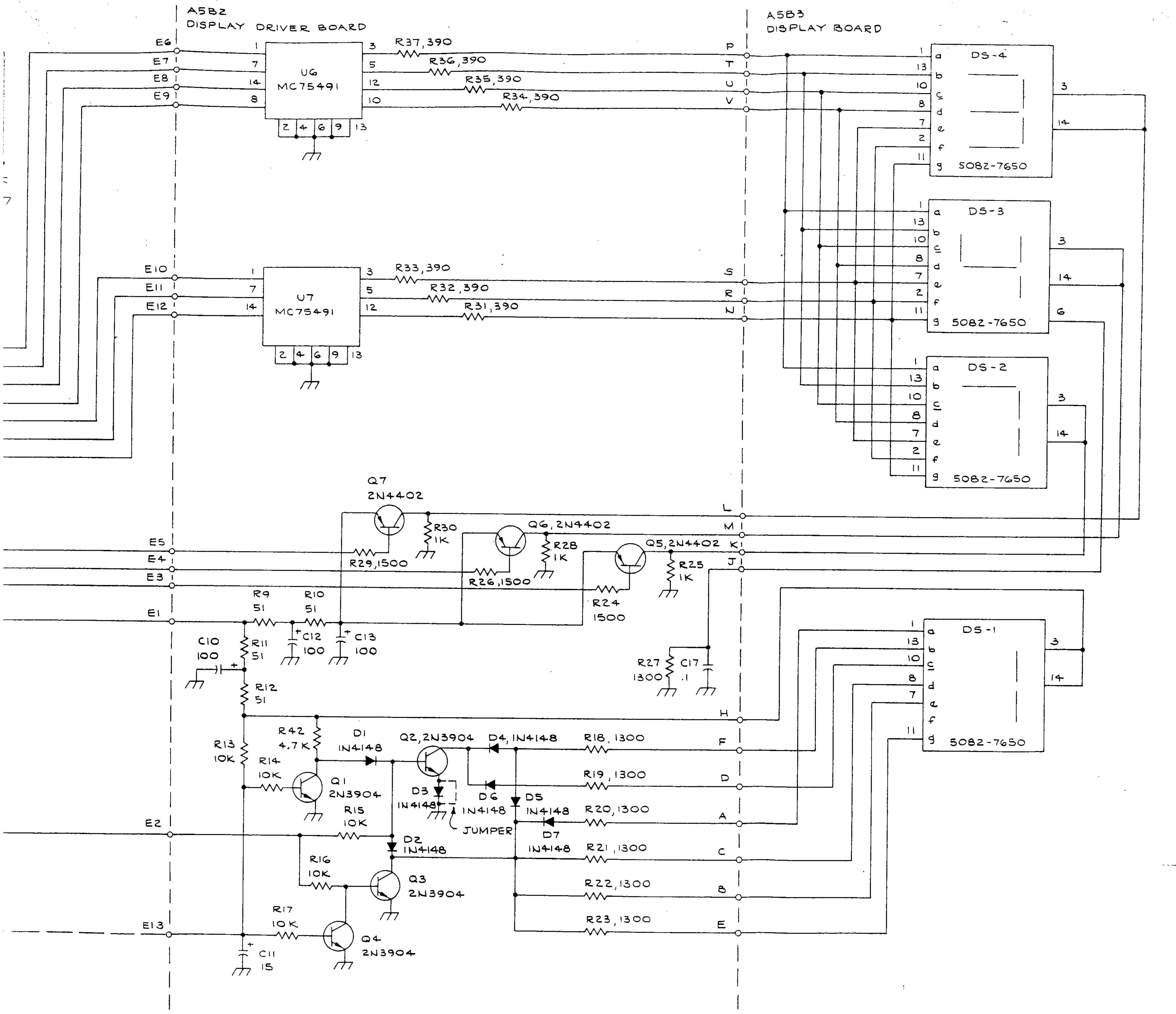


Schematic, Pin Diode Driv

79C414-323 (A4B1

Figure 7.21

REV A - C.O.# ... 6/1/77
REV B - C.O.#3 PS 6/1/77
REV C - C.O.# ...
REV.D - C.O.#44 PS 11/23/77



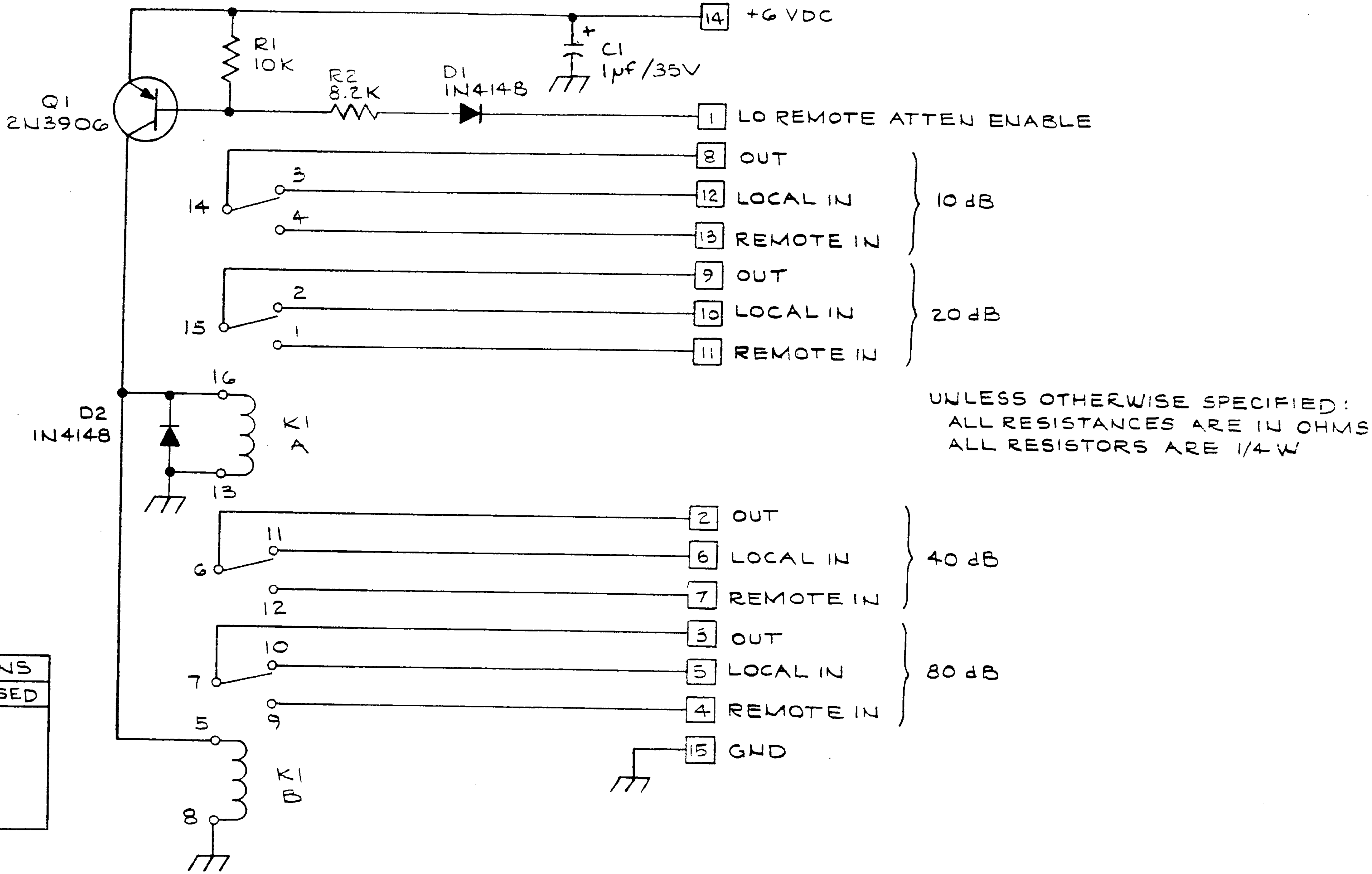
THE FOLLOWING COMPONENTS ARE FOR 18-26 GHz COVERAGE ONLY:
C11
D1, D2, D3, D5, D7
Q1, Q3, Q4
R13, R14, R16, R17, R21, R22, R23, R42

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W
ALL CAPACITORS ARE IN MICROFARADS

Schematic, Digital Frequency Display

79R50-156D (A5)

Figure 7.22

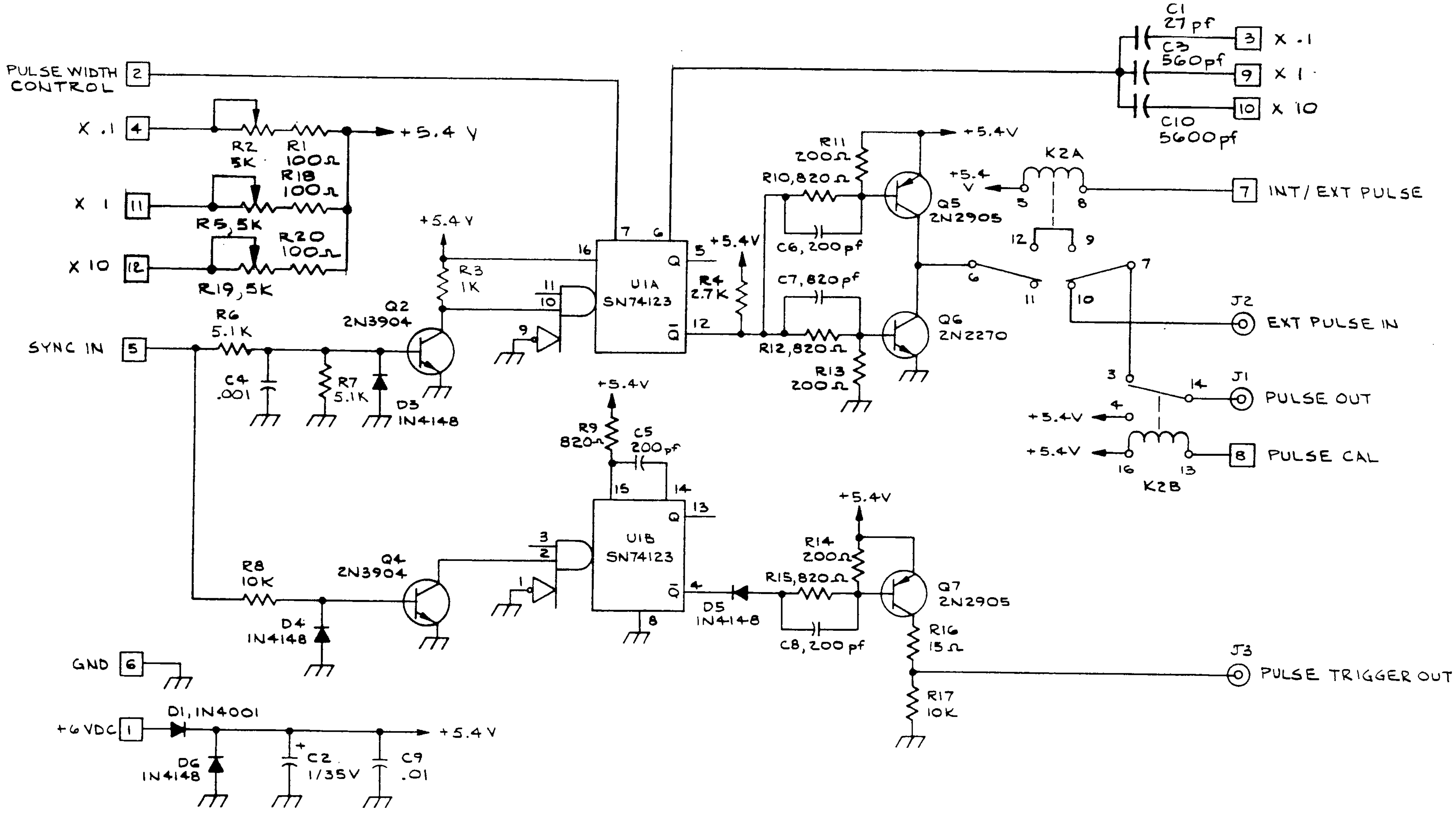


REF DESIGNATIONS	
LAST	NOT USED
R2	
C1	
D2	
K1	
Q1	

Schematic, Remote Attenuator Control

79B60-094 (A6)

Figure 7.23



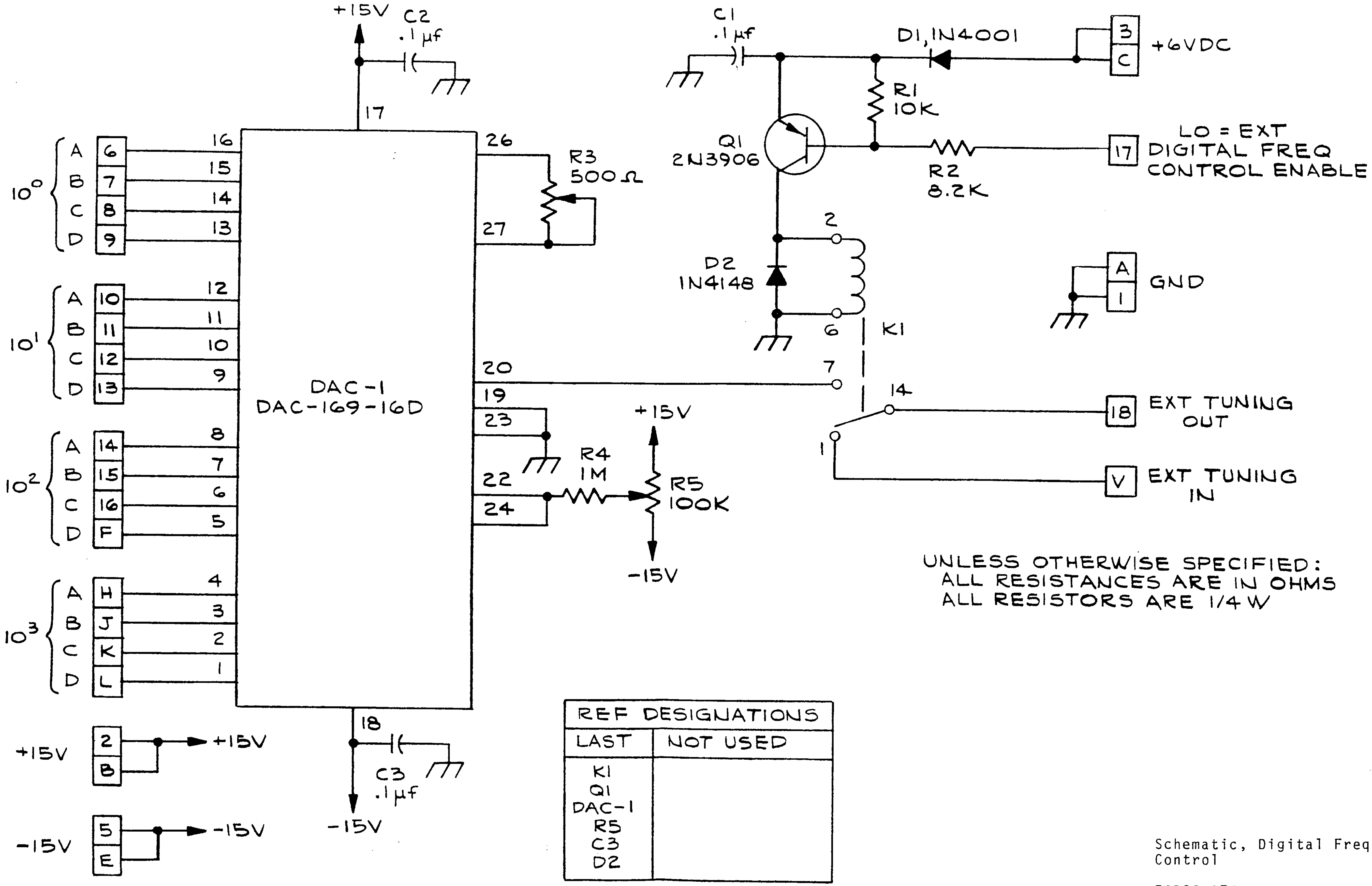
REF. DESIGNATIONS	
LAST	NOT USED
R20	
C10	
D6	D2
U1	
Q7	Q1, Q3
K2	

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4W
ALL CAPACITORS ARE IN MICROFARADS
* = SELECTED VALUE

Schematic, Internal Pulse Generator

79B70-324 (A7)

Figure 7.24



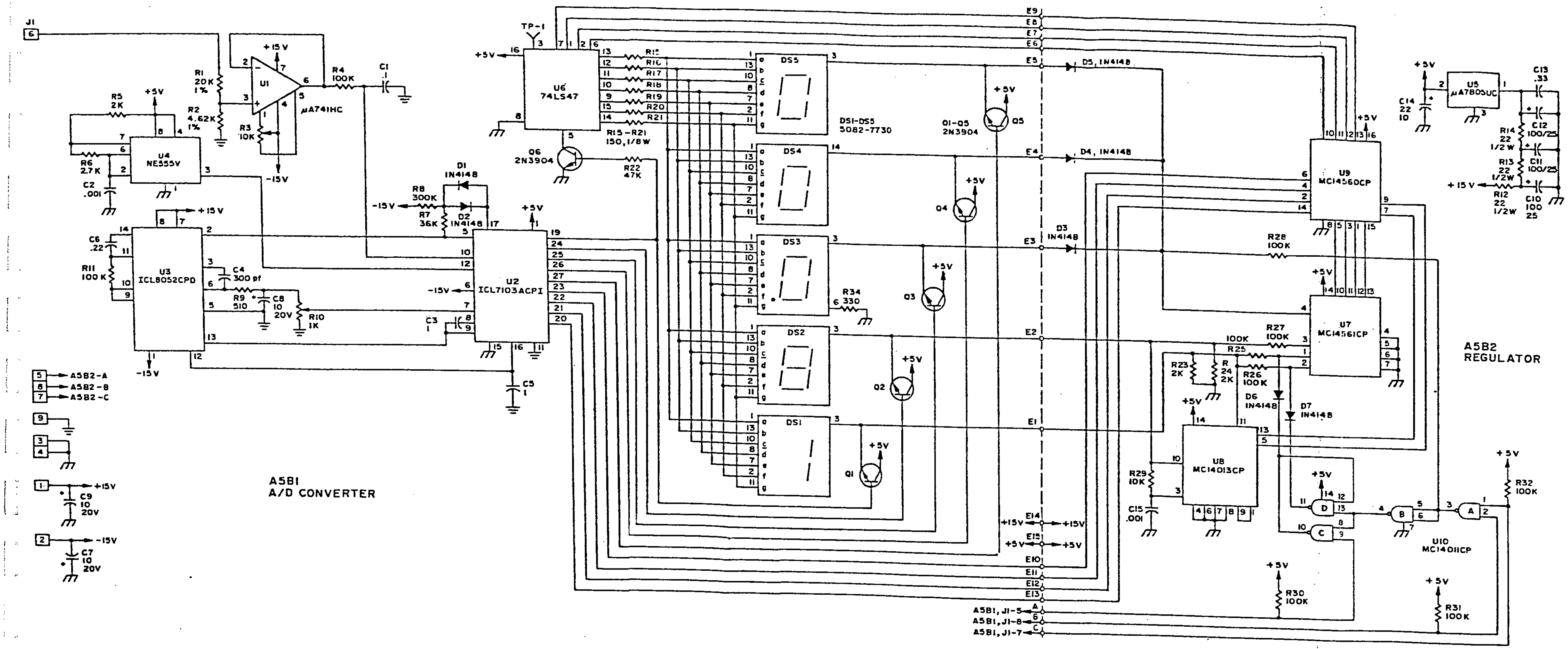
UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES ARE IN OHMS
ALL RESISTORS ARE 1/4 W

REF DESIGNATIONS	
LAST	NOT USED
K1 Q1 DAC-1 R5 C3 D2	

Schematic, Digital Frequency Control

79B80-176 (A8)

Figure 7.25



UNLESS OTHERWISE SPECIFIED
ALL RESISTOR VALUES ARE IN OHMS A
ALL CAPACITOR VALUES ARE IN MICRO

REF DESIGNATIONS	
LAST USED	NOT USED
C	
E15	
J1	
TP1	
C15	
D7	
DS5	
Q6	
R34	
U10	R33

Figure 7.22

SG-811
A5-SCHEMATIC,
FREQUENCY DISPLAY
79R50-424