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INSTRUCTION MANUAL

FOR THE

WJ 9040 SDU101 SPECTRUM DISPLAY UNIT

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WATKINS-JOHNSON COMPANY
700 Quince Orchard Road
Gaithersburg, MD 20878

September 1987

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WARNING

This equipment employs dangerous voltages which may be fatal if contacted. Exercise extreme caution in working with this equipment with any of the protective covers removed.

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EQUIPMENT MALFUNCTIONS

This unit was thoroughly inspected and factory adjusted for optimum performance prior to shipment. If an apparent malfunction is encountered after installation, verify that the correct input signals are present at the proper connectors. Prior to taking any corrective maintenance action or breaking any seals, contact your Watkins-Johnson representative, or the Watkins-Johnson Company Service Department to prevent the possibility of voiding the terms of the warranty. Contact the Watkins-Johnson Company via mail, telephone, wire, or cable at:

Watkins-Johnson Company
Company Service Department
700 Quince Orchard Road
Gaithersburg, Maryland 20878-1794

Toll Call: (301) 948-7550 Ext. 7201
TELEX: 89-8402
TWX: 710-828-0546
TELEFAX: (301) 921-9479
EASYLINK: 62928185

If reshipment is necessary, follow the instructions in the following paragraph (Preparation for Reshipment or Storage). Do not return the equipment until a Return for Maintenance Authorization (RMA) number has been obtained from the Watkins-Johnson Company's Customer Service Department. See Item 10 in the **General Terms and Conditions of Sale** paper (WJ Form # WJ-151-X) for more information on equipment returns.

PREPARATION FOR RESHIPMENT OR STORAGE

If the unit must be prepared for reshipment, the packaging method should follow the pattern established in the original shipment. Use the best packaging materials available to protect the unit during reshipment or storage. When possible, use the original packing container and cushioning materials. If the original packing materials are not available, use the following procedure:

1. Wrap the unit in sturdy paper or plastic.

2. Place the wrapped unit in a strong shipping container and place a layer of shock-absorbing material (3/4-inch minimum thickness) around all sides of the unit to provide a firm cushion and to prevent movement inside the container.

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3. If shipping the unit for service, fill out all information on the 5x6 PRODUCT DISCREPANCY REPORT card (WJ Form # WJC-QA55-0) that was provided with the original shipment. Also ensure that the Return for Maintenance Authorization (RMA) number is recorded on the card. If this card is not available, attach a tag to the unit containing the following information:

   a. Return for Maintenance Authorization (RMA) number.
   b. The Watkins-Johnson Type/Model number of the equipment.
   c. Serial number.
   d. Date received.
   e. Date placed in service.
   f. Date of failure.
   g. Warranty adjustment requested, yes or no.
   h. A brief description of the discrepant conditions.
   i. Customer name and return address.
   j. Original Purchase Order/Contract number.

4. Thoroughly seal the shipping container and mark it **FRAGILE.**

5. Ship to:

   Watkins-Johnson Company
   700 Quince Orchard Road
   Gaithersburg, Maryland 20878-1794
   U.S.A

When storing the equipment for extended periods, follow the above packing instructions to prevent damage to the equipment. The safe limits for storage environment are:

Temperature: -40 to +70°C
Humidity: less than 95%

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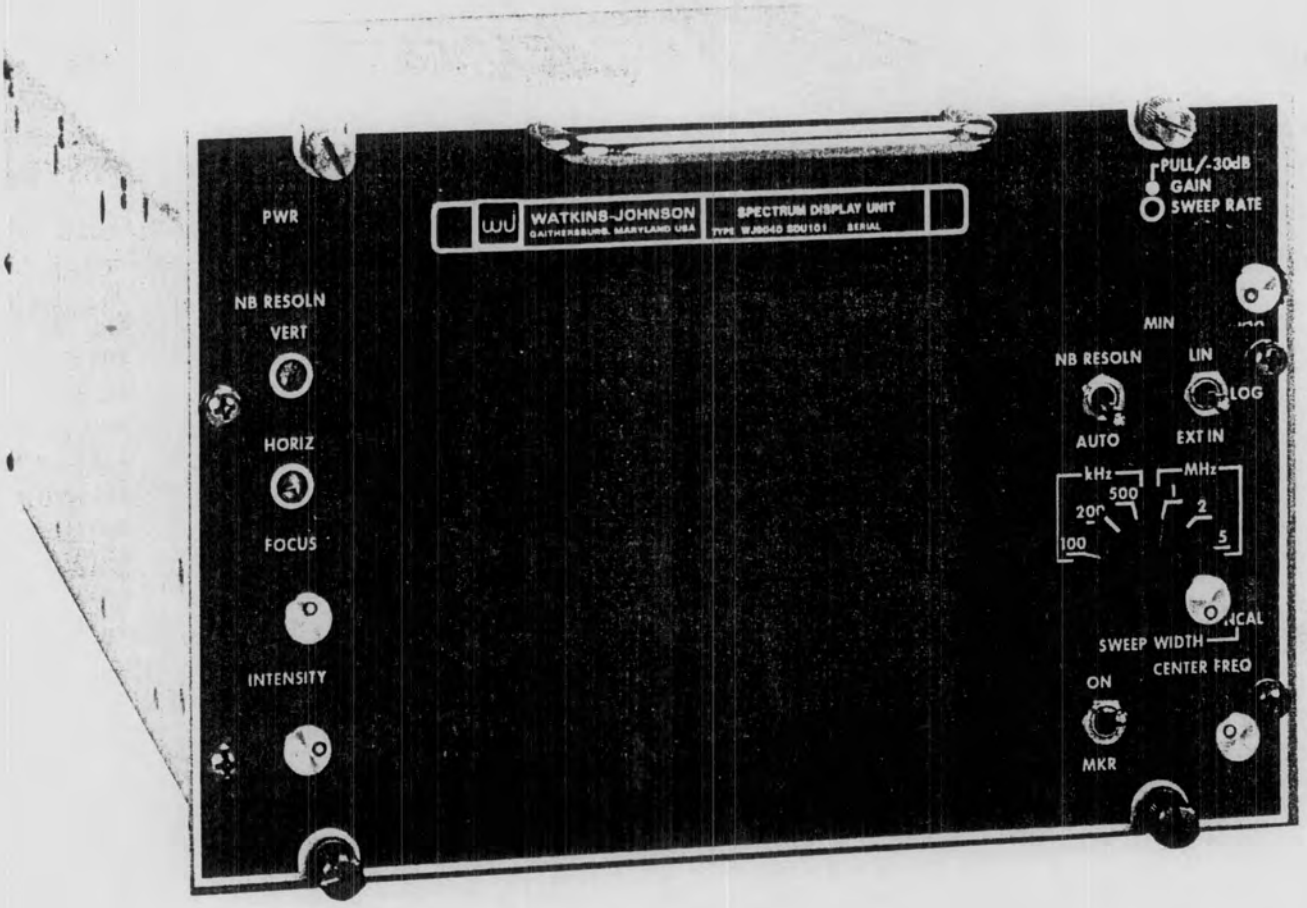

Figure 1-1. WJ 9040 SDU101 Spectrum Display Unit

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SECTION I

GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

The WJ 9040 SDU101 (**Figure 1-1**) is a general purpose spectrum display unit designed to present VHF/UHF signal activity on a large 5-inch diagonal Cathode Ray Tube. The SDU101 is fully compatible with the WJ 9040 Receiving System Family and shares the WJ 9040 system characteristics of low power consumption, modular construction and high performance. The unit accepts a 21.4 MHz IF input signal and is thus ideally suited for operation with the WJ 8628-X VHF/UHF series of receivers. In typical monitoring applications, the SDU101 functions as both a tuning aid and signal identifier for any receiver or demodulator with a 21.4 MHz signal monitor output. High Third Order Intercept Point and wide dynamic range enhance the unit's monitoring capabilities.

The SDU101 is operated manually via front panel controls. The unit offers both linear and logarithmic response with a log dynamic range of 60 dB. Switch selectable sweep widths are available in the range of 100 kHz to 5 MHz. The sweep rate is continuously variable from 5 to 25 Hz. Signal resolutions of 6 kHz (NB) and 20 kHz (WB) have been incorporated specifically for analysis of signals found in the VHF/UHF spectrum. The unit has an internal 21.4 MHz marker and controls for center frequency and gain setting.

1.2 MECHANICAL CHARACTERISTICS

The SDU101 is normally mounted in a 19-inch wide WJ 9040 System Equipment Frame (EFR100) and occupies one-half the width of the frame. The main deck and chassis, front, side, rear and top panels are constructed of aluminum. All operating controls and indicators are on the front panel, while all input and output lines are routed through the rear panel. The front panel is a 0.19 inch thick aluminum plate overlaid with a 0.032 inch black bezel etched with control markings.

The rear panel mounts all input and output connectors. A 25-pin D series connector interfaces the DC supply voltages and any required control I/O and Polled I/O signals between the SDU101 and the EFR100 Equipment Frame backplane. Seven SMA connectors provide signal interconnection between the SDU101 and ancillary equipment.

1.3 EQUIPMENT REQUIRED BUT NOT SUPPLIED

The following items are a minimum complement necessary to obtain use of the SDU101 if it is to be configured as a component in a WJ 9040 System.

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- EFR100 Equipment Frame
- EPS100 Power Supply
- Signal Source (Receiver SM out)

1.4 OPTIONAL EQUIPMENT

The following option is available for use with the Spectrum Display Unit. For additional information, contact the Watkins-Johnson Company, Gaithersburg, Maryland or your Watkins-Johnson Representative.

- Modular Power Supply WJ 8628/MPS

1.5 TABLE OF SPECIFICATIONS

See **Table 1-1** for WJ 9040 SDU101 Spectrum Display Unit specifications.

Courtesy of http://BlackRadios.terryo.org

Table 1-1. WJ 9040 SDU101 Spectrum Display Unit Specifications

Input Frequency	21.4 MHz
Input Impedance	50 ohms, nominal
Input Sensitivity	A 5 microvolt input signal will produce full scale deflection on the CRT display in Linear Mode
Dynamic Range	60 dB in LOG mode
Display Modes	Log or Linear
Center Frequency Adjustment Range	400 kHz nominal
Sweep Widths	100 kHz, 200 kHz, 500 kHz, 1 MHz, 2 MHz and 5 MHz
Resolution: Auto Mode	
100, 200 and 500 kHz Sweep Width	6.0 kHz
1, 2 and 5 MHz Sweep Width	20.0 kHz
Sweep Rate	5 Hz to 25 Hz
Sweep Linearity	Linear to Plus/Minus 5% of total sweep width
Response Flatness	Plus/Minus 1.0 dB
Internal Marker Frequency	21.4 MHz
Internal Marker Accuracy	Plus/Minus 0.005%
Gain Control Range	40 dB with variable control -30 dB switched
Front Panel Controls	Intensity, Focus, Horizontal, Vertical, Center Frequency, Sweep Width, Sweep Rate, Gain, -30 dB Attenuator, LIN/LOG/EXT IN, Marker On, Resolution Select
Horizontal (X) Output Level	Minus 0.5 VDC to Plus 0.5 VDC, Nominal
Vertical (Y) Output Level	Minus 0.5 VDC to Plus 0.5 VDC, Nominal
Blanking (Z) Output Level	0 VDC - full intensity, Plus 5.0 VDC - blanked
Horizontal (X) External Input Level	Minus 0.5 VDC to Plus 0.5 VDC, Nominal
Vertical (Y) External Input Level	Minus 0.5 VDC to Plus 0.5 VDC, Nominal
Blanking (Z) External Input Level	0 VDC - full intensity, Plus 5.0 VDC - Blanked
Power Requirements	+18.3 V, -18.3 V, + 8.2 V and +29V supplied by EFR100 Equipment Frame and associated power supply
Power Consumption	13 Watts approximately
Size	5.25 inches (132 mm) high 8 inches (200 mm) wide 14.38 inches (365 mm) deep
Weight	Approximately 12 lbs.
Operating Temperature Range	0^{o} C to Plus 50^{o} C

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SECTION II

INSTALLATION AND OPERATION

2.1 UNPACKING AND INSPECTION

Examine the shipping carton for damage prior to unpacking the equipment. If the carton appears to be damaged, have the carrier's agent present when the equipment is unpacked. If this is not possible, retain all packaging material and shipping containers for the carrier's inspection to verify damage to the equipment after unpacking. Also verify that the equipment shipped corresponds to the packing slip. Contact the Watkins-Johnson Company, CEI Division, or your Watkins-Johnson representative for any discrepancies or shortages.

The unit was thoroughly inspected and factory adjusted for optimum performance prior to shipment. It is, therefore, ready for use upon receipt. After uncrating and checking contents against the packing slip, visually inspect all exterior surfaces for dents and scratches. If external damage is visible, remove the dust covers and inspect the internal components for apparent damage. Then check the internal cables for loose connections, and plug-in items such as printed wiring boards, which may have been loosened from their receptacles.

2.2 PREPARATION FOR RESHIPMENT AND STORAGE

If the equipment must be prepared for reshipment, the packing methods should follow the pattern established in the original shipment. If retained, the original materials can be reused to a large extent or at least provide guidance for the repackaging effort. Conditions during storage and shipment should be limited as follows:

Maximum humidity: 95% (no condensation)
Temperature range: $-40^{o}C$ to $+85^{o}C$

2.3 INSTALLATION PROCEDURES

The SDU101 is designed to mount in the EFR100 Equipment Frame. Specific installation procedures for the EFR100 are covered in the WJ 9040 EFR100 Operator's Manual. However, the following general guidelines should be observed when using the SDU101 in the WJ 9040 Operational Environment:

1. Operating temperature range should be from $0^{o}C$ to $+50^{o}C$.

2. Free air circulation should be allowed between equipment frames. Multiple stacking significantly increases ambient temperatures.

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3. Use only stable, properly grounded AC power for the WJ 9040 equipment.

2.3.1 PHYSICAL INSTALLATION

Implement the following steps to install a single SDU101 in the EFR100 Equipment Frame.

1. Ensure that a one-half frame width space is available for the spectrum display unit.

2. Holding the display unit horizontally in front of the frame, align the display unit with the space in the frame. Simultaneously, move the display unit rearward into the frame, aligning the display unit with the guide slots in the base of the frame.

3. Continue moving the display unit slowly rearward in the frame until the rear panel connector just contacts the connector in the backplane. Exert a little extra force at this point, seating the connector with the frame's connector.

4. Secure the display unit in the frame by rotating the front panel locking screws clockwise until tight.

2.3.2 INPUT/OUTPUT CONNECTORS

The SDU101 input/output connectors shown in **Figure 2-1** are physically mounted on the rear panel of the display unit. These connectors are described in the following paragraphs:

2.3.2.1 Power, Command/Control (J1)

This 25-pin D type connector mates with any one of connectors J1 through J8 on the EFR100 backplane to supply DC voltages and I/O command/control signals to the SDU101. Connector pins and associated functions are listed as follows:

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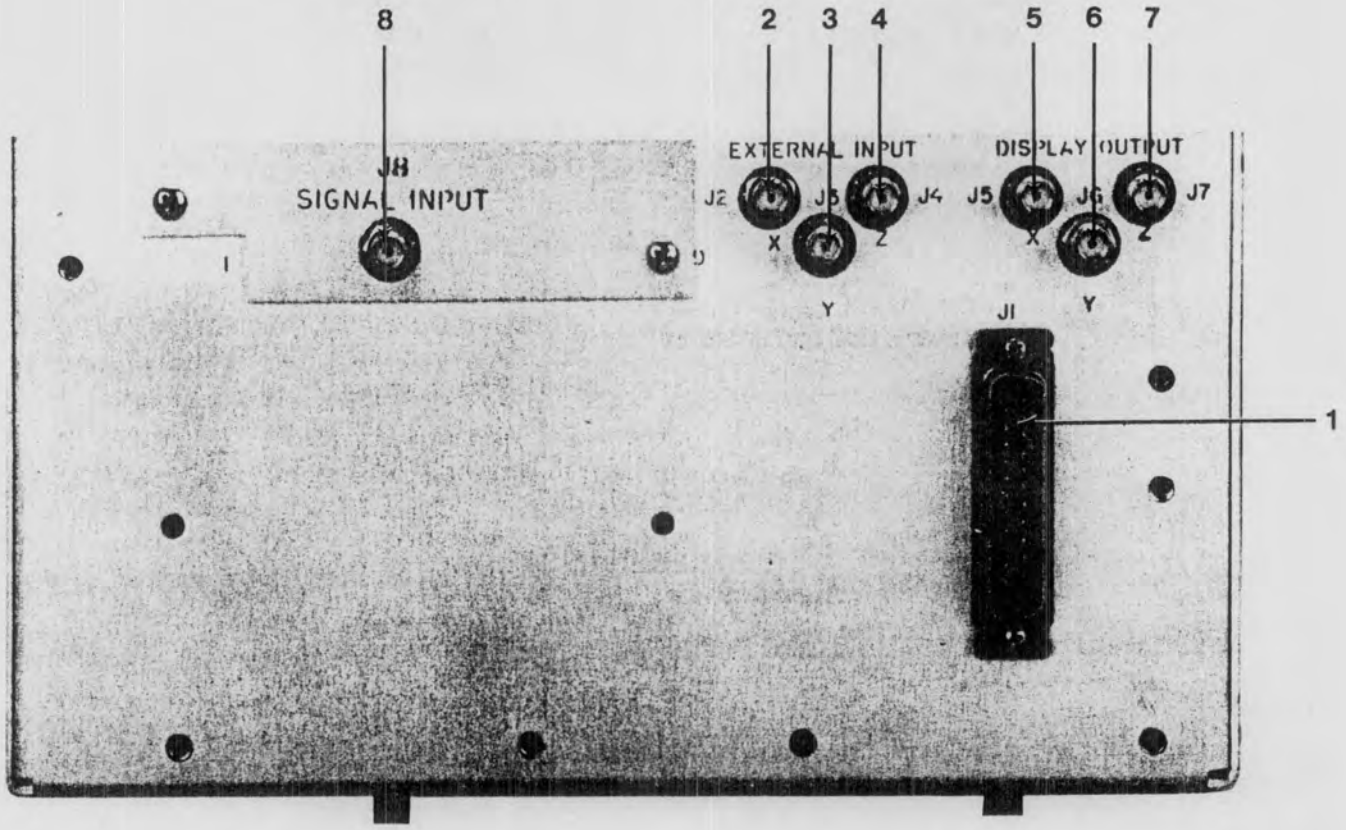
Pin #	Function	Pin #	Function
1	Addressed Enable B In	15	Report Data Out
2	Strobe In	16	Logic Ground
3	Clock In	18	Power Ground 2
5	Power Ground 1	19	-18.3 Vdc
6	+29 Vdc	20	+8.2 Vdc
7	+18.3 Vdc	21	
8	+8.2 Vdc	22	
9	Addressed Enable A In	23	
10	Polled I/O 8	24	
11		25	
12			
13			
14	Command/Control Data In		

Courtesy of http://BlackRadios.terryo.org



1. Power Command/Control (J1)
2. X-Input (J2)
3. Y-Input (J3)
4. Z-Input (J4)
5. X-Output (J5)
6. Y-Output (J6)
7. Z-Output (J7)
8. Signal Input (J8)

Figure 2-1. WJ 9040 SDU101 Rear Panel Connectors

Courtesy of http://BlackRadios.terryo.org

2.3.2.2 **X-Input (J2), Y-Input (J3) and Z-Input (J4)**

These three SMA connectors provide Horizontal (X), Vertical (Y) and Intensity modulation (Z) inputs from an external display generator (WJ 8628-4 with DRD option). Signal requirements are as follows:

X-Input:	A 1 V p/p input signal produces full-scale horizontal deflection.
Y-Input:	A 1 V p/p input signal produces full-scale vertical deflection.
Z-Input:	0 Vdc input equals full intensity; Plus 5 Vdc input equals fully blanked.

2.3.2.3 **X-Output (J5), Y-Output (J6) and Z-Output (J7)**

These three SMA connectors provide Horizontal (X), Vertical (Y) and Blanking (Z) outputs to drive an external display such as the WJ 9040 DXY100. Signal requirements are as follows:

X-Output:	-0.5 Vdc to +0.5 Vdc for full-scale horizontal deflection.
Y-Output:	-0.5 Vdc to +0.5 Vdc for full-scale vertical deflection.
Z-Output:	0 Vdc equals full intensity; +5 Vdc equals= fully blanked

2.3.2.4 **Signal Input (J8)** .

This SMA connector provides the 21.4 MHz SM signal input for the spectrum display unit from an external receiver or demodulator. Signal input requirement is 5 microvolts minimum from a 50 ohms source impedence.

2.4 OPERATION

The following paragraphs are a guide to familiarize the operator with the function and use of the SDU101 front panel controls and indicators. Refer to **Figure 3-2** for the location of each front panel control and indicator.

Courtesy of http://BlackRadios.terryo.org

2.4.1 PWR/NB RESOLUTION INDICATOR

The upper red indicator illuminates when DC power is applied to the unit via rear panel connector J1. The lower green indicator illuminates when narrow band resolution is selected. See **paragraphs 2.4.9** and **2.4.11** for details concerning narrow band resolution.

2.4.2 VERT CONTROL

This control sets the vertical centering of the trace on the CRT screen. The control is rotated clockwise to move the trace up on the screen.

2.4.3 HORIZ CONTROL

This control sets the horizontal centering of the trace on the CRT screen. The control is rotated clockwise to move the trace to the right on the screen.

2.4.4 FOCUS CONTROL

This control adjusts the focus of the trace on the CRT screen. The control is rotated CW or CCW as necessary to achieve satisfactory trace sharpness and focus.

2.4.5 INTENSITY CONTROL

This control adjusts the intensity of the trace on the CRT screen. The control is rotated clockwise to increase trace intensity. Adjust the control for minimum satisfactory intensity consistent with visibility and focus.

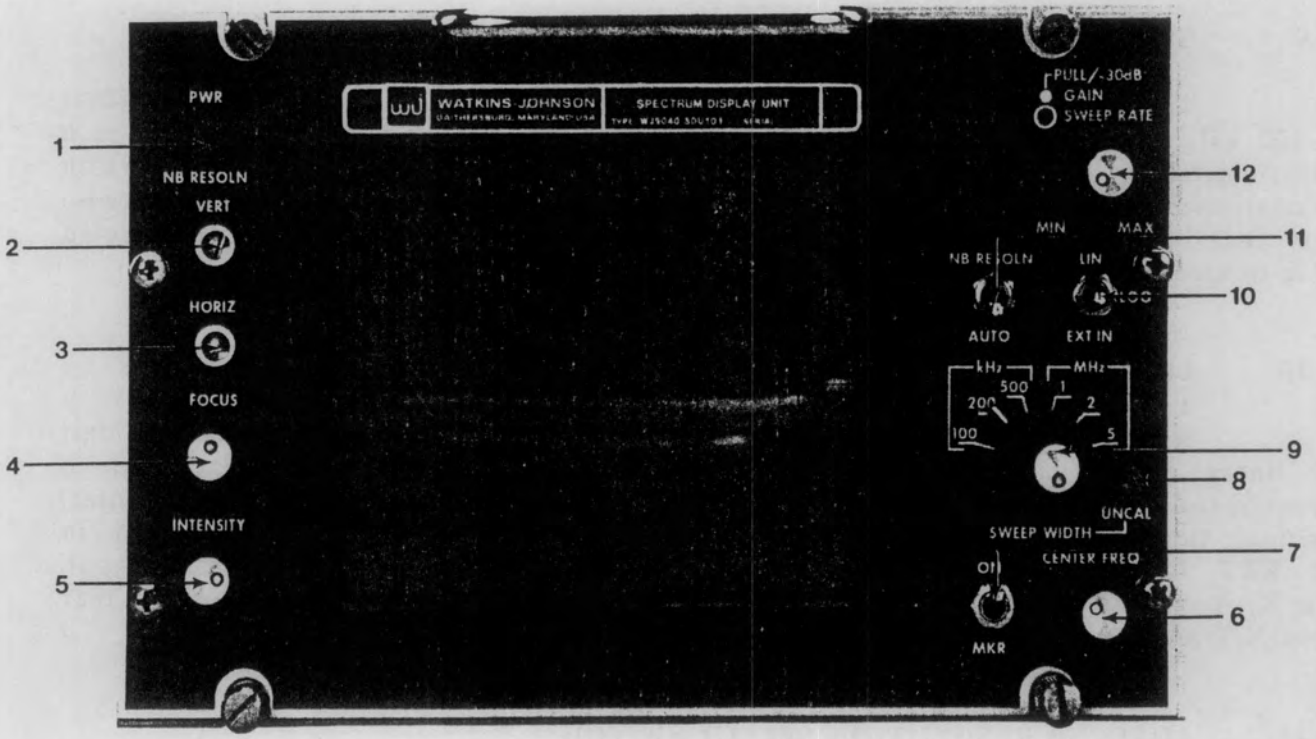
2.4.6 CENTER FREQ CONTROL

This control adjusts the center frequency of the display a nominal 400 kHz. Satisfactory center frequency calibration of the SDU101 may be achieved by turning the marker on (see **paragraph 2.4.7** for marker information) and rotating the center frequency control until the marker pip is aligned with the vertical line in the center of the screen.

2.4.7 MARKER ON CONTROL

This switch is used to turn the 21.4 MHz marker on or off. When turned on, the marker is displayed as a vertical pip on the CRT screen.

Courtesy of http://BlackRadios.terryo.org



1. PWR/NB Resolution Indicator
2. VERT Control
3. HORIZ Control
4. FOCUS Control
5. INTENSITY Control
6. CENTER FREQ Control
7. Marker On Switch
8. Sweep Width UNCAL Indicator
9. Sweep Width Control
10. LIN/LOG/EXT IN Select Switch
11. AUTO/NB RESOLN Select Switch
12. GAIN/SWEEP RATE Control

Figure 2-2. WJ 9040 SDU101 Front Panel Controls and Indicators

Courtesy of http://BlackRadios.terryo.org

2.4.8 SWEEP WIDTH UNCAL INDICATOR

This indicator illuminates when the Sweep Width Vernier (see **paragraph 2.4.9**) is rotated counterclockwise from the detent or calibrated sweep width position.

2.4.9 SWEEP WIDTH CONTROL

The outer control is a 6-position rotary switch selecting sweep widths of 100 kHz, 200 kHz, 500 kHz, 1 MHz, 2 MHz and 5 MHz. The inner control is a potentiometer. When rotated fully clockwise, spectrum display unit sweep width is controlled only by the outer rotary switch. When rotated counterclockwise from the detent, actual sweep width can be varied from the rotary switch selected value to zero (potentiometer at max. CCW).

2.4.10 LIN/LOG/EXT IN SELECT SWITCH

When placed in the LIN (upper) position, this switch programs the unit for linear display. Each major vertical division on the CRT screen is equal to approximately 16% of full scale deflection. When placed in the LOG (center) position, this switch programs the unit for logarithmic display. When placed in the EXT IN (lower) position, this switch programs the unit for external input. The X, Y and Z parameters of the CRT screen are controlled by inputs on the rear panel X,Y and Z input connectors.

2.4.11 AUTO/NB RESOLUTION SELECT SWITCH

When placed in the AUTO (lower) position, this switch automatically selects wide band (20 kHz) resolution in 1, 2 or 5 MHz sweep widths and selects narrow band (6 kHz) resolution in 100, 200 or 500 kHz sweep widths. When placed in the upper position, this switch places the unit in narrow band resolution for all sweep widths.

2.4.12 GAIN/SWEEP RATE CONTROL

The outer control is a potentiometer controlling the sweep rate. Sweep rate can be varied from 5 Hz (max. CCW) to 25 Hz (max. CW). The inner control is a combination potentiometer/pull switch. The potentiometer permits variable vernier reduction of displayed signal level on the CRT screen. When the control is at maximum CW rotation, displayed signal level is maximum. Pulling the control out automatically inserts a 30 dB attenuator in the SM input signal path, causing a corresponding reduction in displayed signal level on the CRT screen.

Courtesy of http://BlackRadios.terryo.org

SECTION III

CIRCUIT DESCRIPTION

3.1 INTRODUCTION

This section describes the theory of operation of the Spectrum Display Unit. A simplified block diagram is provided to show overall functional partitioning of the various modules in the unit. Detailed block diagrams and circuit level descriptions are provided for each of the unit's modules.

3.2 GENERAL DESCRIPTION

Figure 3-1 is a simplified block diagram of the unit. As shown in **Figure 3-1**, the display unit consists of the following major modules:

a. High Voltage/Deflection Amplifier, A1

b. Sweep Generator, A2

c. Input Filter/Converter, A4A1

d. Sweep/Marker Oscillator, A4A2

e. Output Amplifier, A4A4

f. Interface, A4A5

A general discussion of each section follows.

3.2.1 HIGH VOLTAGE/DEFLECTION AMPLIFIER (A1)

A general discussion of the High Voltage/Deflection Amplifier functions and signal interfaces is provided in the following paragraphs.

3.2.1.1 High Voltage/Deflection Amplifier (A1) Functions

The High Voltage/Deflection Amplifier performs the following functions:

a. High Voltage Generation -- A dc to dc converter develops the dc voltages necessary to operate the CRT display tube.

b. CRT Deflection -- Horizontal and Vertical deflection amplifiers amplify the horizontal and vertical signals to drive the CRT deflection plates.

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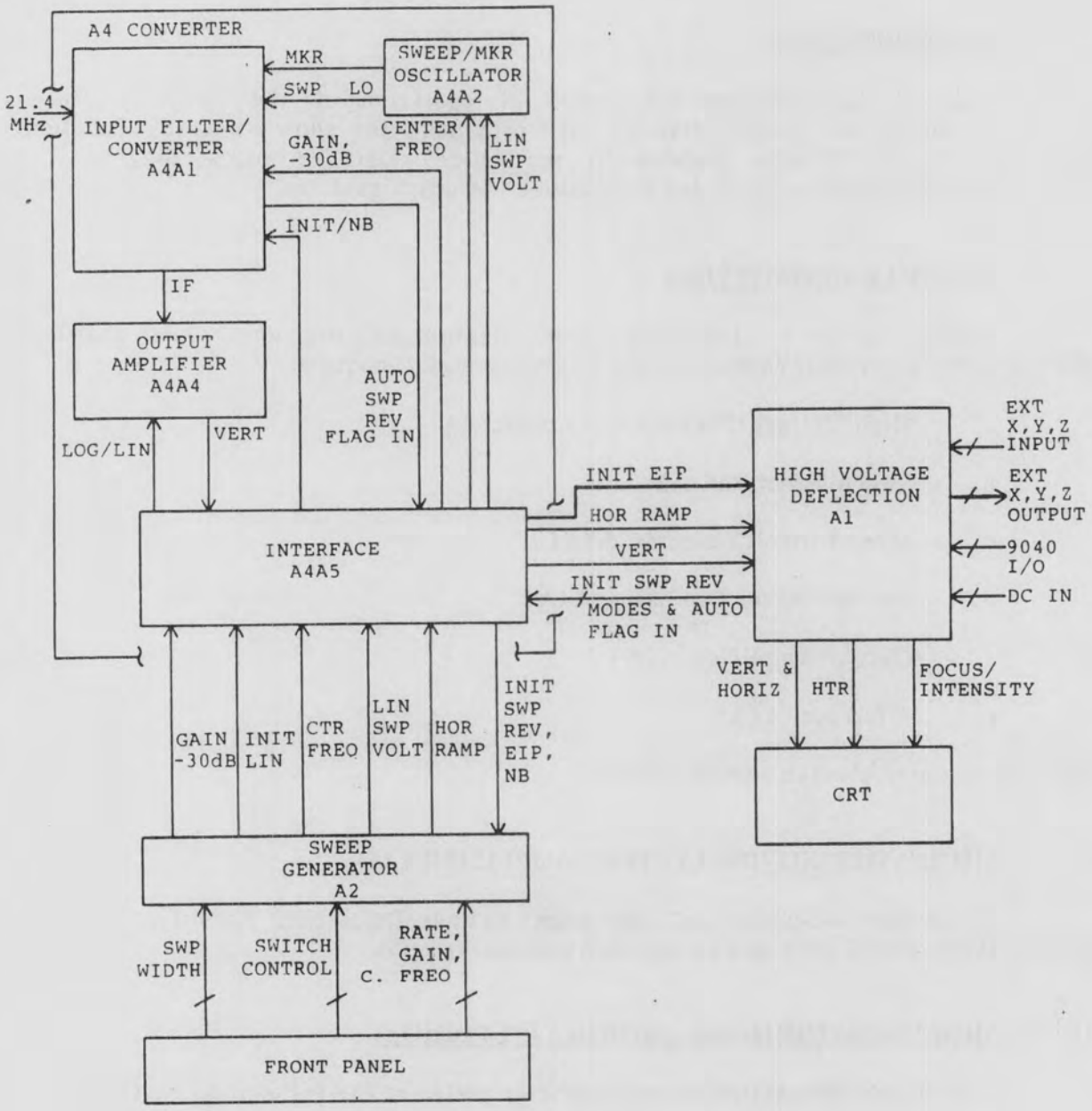

Figure 3-1. WJ 9040 SDU101 Spectrum Display Unit Block Diagram

Courtesy of http://BlackRadios.terryo.org

c. Input Signal Selection -- CMOS switches select either internal or external horizontal, vertical and blanking signals.

d. Option Selection -- A switch matrix allows programming the unit for Manual/Auto sweep reverse and HF Converter Option (if installed) selection.

3.2.1.2 **High Voltage/Deflection Amplifier (A1) Input/Output Signal Interfaces**

The following input/output signals interface with the High Voltage/Deflection Amplifier:

a. DC Input -- DC voltages of +29 V, +18.3 V, -18.3 V, and +8.2 V are input from the EFR100 Equipment Frame.

b. WJ 9040 I/O -- Clock, strobe and data signals for remote operation, when applicable, are input from the EFR100 Equipment Frame.

c. Ext X, Y and Z -- External horizontal, vertical and blanking signals are input from the display unit rear panel.

d. VERT and HORIZ -- Internal vertical and horizontal drive signals are input from the Interface Card, A4A5 and Sweep Generator Card, A2.

e. VERT OUT -- A high level (+200 V) vertical deflection signal drives the CRT vertical deflection plates.

f. HOR OUT -- A high level (+200 V) horizontal deflection signal drives the CRT horizontal deflection plates.

g. CRT High Voltage -- A -2 kV DC voltage drives the grid and heater of the CRT.

h. FOCUS and INTENSITY -- Focus and intensity voltages derived from the -2 kV output drive the CRT anode and cathode.

i. Heater -- A nominal +6.3 V dc voltage drives the CRT heater.

3.2.2 **SWEEP GENERATOR (A2)**

A general discussion of the Sweep Generator functions and signal interfaces is provided in the following paragraphs.

Courtesy of http://BlackRadios.terryo.org

3.2.2.1 **Sweep Generator (A2) Functions**

The Sweep Generator performs the following functions:

a. Horizontal Ramp Generation -- A sawtooth generator develops a nominal 0.8 Vpp ramp voltage for driving the CRT horizontal plates.

b. Linear Sweep Generation -- A sawtooth generator develops the linear sweep voltages to drive the Sweep Oscillator.

c. Sweep Selection -- A CMOS switch selects either VHF (normal, 21.4 MHz) or HF (optional, 455 kHz) sweep voltages.

d. Front Panel Interface -- Control lines from the front panel controls and indicators are interfaced through the Sweep Generator Card.

3.2.2.2 **Sweep Generator (A2) Input/Output Signal Interfaces**

The following input/output signals interface with the Sweep Generator:

a. Sweep Rate -- The front panel sweep rate control connects to the Sweep Generator to determine the sweep rate (5 to 25 Hz).

b. VHF Sweep -- The VHF sweep ramp is routed through the front panel sweep width rotary switch to select sweep widths from 100 kHz to 5 MHz.

c. Variable Sweep -- The switch selected sweep width ramp is routed through the front panel variable sweep width control to permit varying the actual sweep width from zero to maximum.

d. Linearized Sweep Voltage -- The linearized sweep voltage (-5 V to +4 V for 5 MHz sweep width) drives the Interface Card, A4A5.

e. Gain -- The front panel gain control is routed through the Sweep Generator Card to the Interface Card, A4A5.

f. LIN/LOG/EXT IN -- The front panel LIN/LOG/EXT IN switch is then routed through the Sweep Generator Card to the Interface Card, A4A5.

3.2.3 **CONVERTER (A4)**

A general discussion of the Converter functions and signal interfaces is provided in the following paragraphs.

Courtesy of http://BlackRadios.terryo.org

3.2.3.1 **Input Filter/Converter (A4A1) Functions**

The Input Filter/Converter performs the following functions:

a. Gain Control -- Fixed and variable gain control circuits provide gain adjustment for the Spectrum Display Unit.

b. Frequency Conversion -- The 21.4 MHz SM input is down converted to an 8.56 MHz IF.

c. Filtering -- Wide and Narrow band IF filters limit the resolution bandwidth to 20 kHz or 6 kHz.

3.2.3.2 **Input Filter/Converter (A4A1) Input/Output Signal Interfaces**

The following input/output signals interface with the Input Filter/Converter:

a. IF Input -- A 21.4 MHz SM input signal comes from the rear panel signal input connector.

b. Gain -- A gain control voltage is input from the front panel gain control via the Sweep Generator Card, A2.

c. WB/NB -- The wide band/narrow band select signal is input from the front panel resolution and sweep width switch control via the Sweep Generator Card, A2.

d. Sweep LO -- The Sweep LO signal is input from the Sweep Oscillator, A4A2. Frequency range is 27.46 to 32.46 MHz (5 MHz sweep width).

e. MARKER -- A fixed 21.4 MHz marker signal is input from the Sweep Oscillator, A4A2.

f. IF Out -- A filtered 8.56 MHz IF output signal is sent to the Output Amplifier, A4A4.

3.2.4 **SWEEP/MARKER OSCILLATOR, (A4A2)**

A general discussion of the Sweep/Marker Oscillator functions and signal interfaces is provided in the following paragraphs.

Courtesy of http://BlackRadios.terryo.org

3.2.4.1 Sweep/Marker Oscillator (A4A2) Functions

The Sweep/Marker Oscillator performs the following functions:

a. Sweep LO Signal Generation -- A voltage controlled oscillator generates the sweep LO signal of 29.96 MHz +/- 2.5 MHz.

b. Marker Generation -- A fixed crystal oscillator generates the 21.4 MHz marker signal.

3.2.4.2 Sweep/Marker Oscillator (A4A2) Input/Output Signal Interfaces

The following input/output signals interface with the Sweep/Marker Oscillator:

a. Center Frequency -- The center frequency control voltage is input from the front panel Center Frequency control via the Interface Card, A4A5.

b. Linear Sweep Voltage -- The linear sweep voltage is input from the Interface Card, A4A5.

c. Select Marker -- The select marker signal is input from the front panel Marker switch via the Interface Card, A4A5.

d. Sweep LO Out -- The sweep LO signal drives the Input Filter/Converter Card, A4A1.

e. Marker Out -- The 21.4 MHz marker signal drives the Input Filter/Converter Card, A4A1.

3.2.5 OUTPUT AMPLIFIER, (A4A4)

A general discussion of the Output Amplifier functions and signal interfaces is provided in the following paragraphs.

3.2.5.1 Output Amplifier (A4A4) Functions

The Output Amplifier performs the following functions:

a. LIN/LOG Gain Setting -- Gain setting circuits adjust the overall gain of the display unit for LIN and LOG display settings.

b. IF Detection -- A detector circuit converts the IF signal to a vertical dc signal.

Courtesy of http://BlackRadios.terryo.org

3.2.5.2 **Output Amplifier (A4A4) Input/Output Signal Interfaces**

The following input/output signals interface with the Output Amplifier:

a. IF Input -- An 8.56 MHz IF signal is input from the IF Filter/Converter Card,A4A1.

b. LIN GAIN Set -- This signal from the Interface Card, A4A5, sets the gain of the Output Amplifier in linear display mode.

c. LOG GAIN Set -- This signal from the Interface Card, A4A5, sets the gain of the Output Amplifier in log display mode.

d. VERT Out -- The detected vertical output signal drives the Interface Card, A4A5.

3.2.6 INTERFACE (A4A5)

A general discussion of the Interface functions and signal interfaces is provided in the following paragraphs.

3.2.6.1 **Interface (A4A5) Functions**

The Interface performs the following functions:

a. Vertical Signal Amplification -- A buffer amplifies and DC offsets the Vertical signal from the Output Amplifier.

b. LIN/LOG Switch Selection -- A CMOS switch routes the appropriate LIN or LOG gain select lines to the Output Amplifier Card, A4A4.

c. Sweep Reversal -- Appropriate logic circuits perform manual or automatic sweep reversal.

3.2.6.2 **Interface (A4A5) Input/Output Signal Interfaces**

The following input/output signals interface with the Interface:

a. VERT In -- The detected vertical input signal comes from the Output Amplifier Card, A4A4.

b. LIN/LOG In -- Control signals from the front panel LIN/LOG/EXT IN switch are input via the Sweep Generator Card, A2.

c. SWEEP REV -- Manual and automatic sweep reversal signals are input from the High Voltage/Deflection Card, A1.

Courtesy of http://BlackRadios.terryo.org

d. VERT Out -- The amplified and offset adjusted vertical signal drives the High Voltage/Deflection Card, A1.

e. LIN/LOG A and B -- These gain select lines drive the Output Amplifier Card, A4A4.

f. SWEEP REV OUT -- The sweep reverse signal goes to the Sweep Generator Card, A2.

3.3 THEORY OF OPERATION

The following paragraphs provide a detailed circuit description for each of the spectrum display unit's modules. Block diagrams are used throughout the text to clarify the description. These block diagrams should be used in conjunction with the schematic diagrams in Section VI.

3.3.1 HIGH VOLTAGE/DEFLECTION AMPLIFIER (A1)

Refer to **Figure 3-2**, High Voltage/Deflection Amplifier, A1, Block Diagram, and **Figure 6-1**, High Voltage/Deflection Amplifier, A1, Schematic Diagram, as aids in understanding the following description. As shown in **Figure 3-2**, the High Voltage/Deflection Amplifier, A1, consists of the following major assemblies:

a. High Voltage Generator

b. Vertical/Horizontal Input Switch

c. Vertical Amplifier/Driver

d. Horizontal Amplifier/Driver

e. Z-Detector/Blanking Driver

f. Switch Matrix

3.3.1.1 High Voltage Generator

The high voltage generator consists of push-pull oscillator Q1, Q2 and switching transformer T1. The oscillator is driven by +/- 15 VDC supplied by regulators U12 and U13. The transistors switch at approximately 15 kHz, developing square wave voltages in the secondary of T1. The output of T1-4 and 5 is rectified by CR6 and filtered by C12 to develop the +6.3 Vdc CRT heater voltage. The output of T1-7 and 10 is rectified by CR1-CR2 and filtered by C9 to develop the -2 kV CRT grid voltage. The output of T1-7, 8 and 9 is rectified by CR3 and CR4 and filtered by C11 to develop the +200 Vdc deflection voltage.

Courtesy of http://BlackRadios.terryo.org

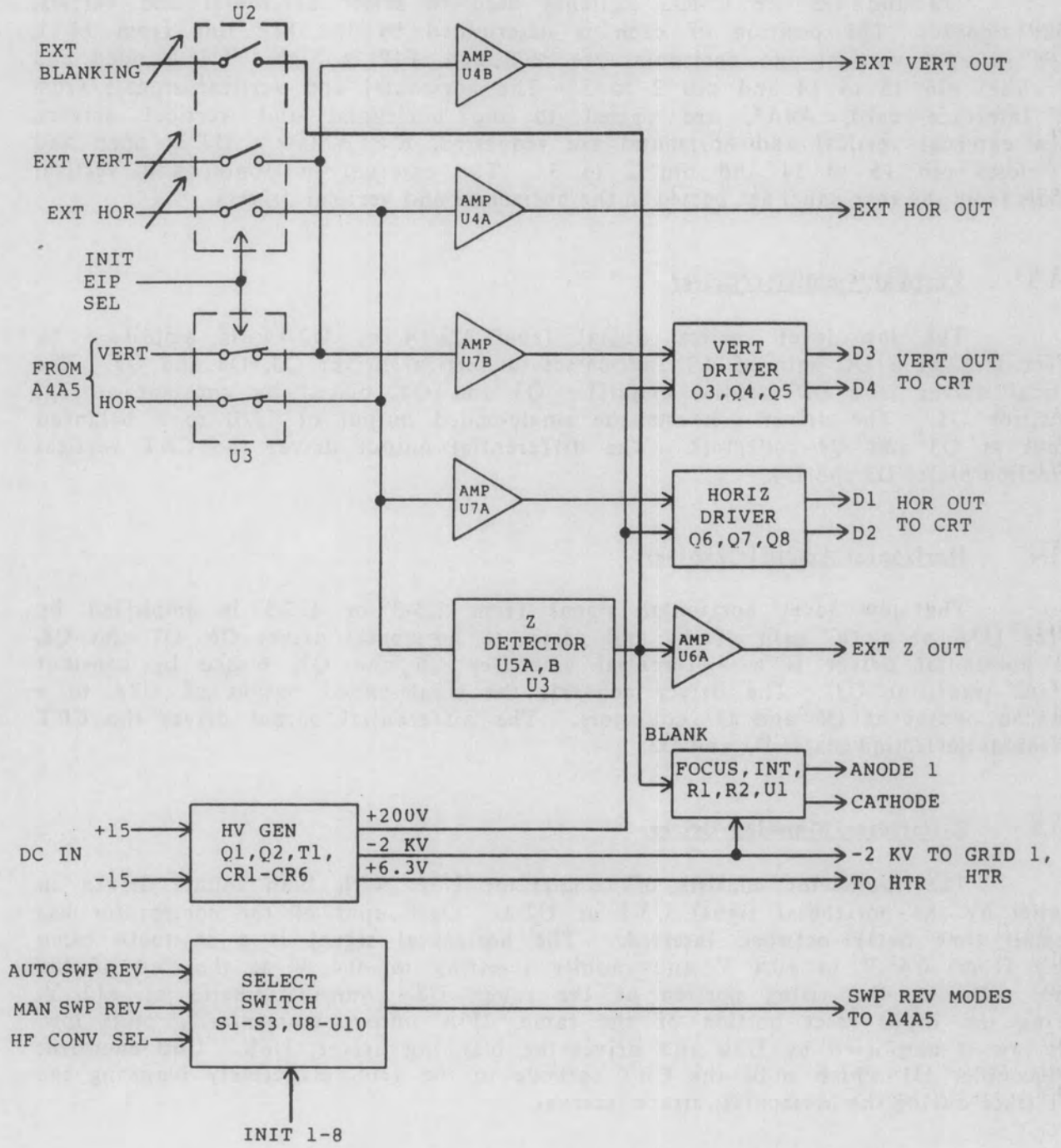

Figure 3-2. High Voltage/Deflection Amplifier Block Diagram

Courtesy of http://BlackRadios.terryo.org

3.3.1.2 Vertical/Horizontal Input Switch

U2 and U3 are CMOS switches used to select horizontal and vertical input signals. The position of each is determined by the EIP line from J4-11. When internal vertical and horizontal are requested, EIP is high. U2 is open and U3 closes pin 15 to 14 and pin 2 to 3. The horizontal and vertical signals from the Interface card, A4A5, are passed to the horizontal and vertical drivers. When external vertical and horizontal are requested, EIP is low. U3 is open and U2 closes pin 15 to 14 and pin 2 to 3. The external horizontal and vertical signals from the rear panel are passed to the horizontal and vertical drivers.

3.3.1.3 Vertical Amplifier/Driver

The low level vertical signal from U3-14 or U2-14 is amplified by buffer U7B at a DC gain of 4.3 and passes to vertical driver Q3, Q4 and Q5. The vertical driver is a differential amplifier Q3 and Q4, biased by constant current transistor Q5. The driver converts the single-ended output of U7B to a balanced output at Q3 and Q4 collectors. The differential output drives the CRT vertical deflection plates D3 and D4.

3.3.1.4 Horizontal Amplifier/Driver

The low level horizontal signal from U3-3 or U2-3 is amplified by buffer U7A at a DC gain of 4.3 and passes to horizontal driver Q6, Q7 and Q8. The horizontal driver is a differential amplifier Q6 and Q7, biased by constant current transistor Q8. The driver converts the single-ended output of U7A to a balanced output at Q6 and Q7 collectors. The differential output drives the CRT horizontal deflection plates D1 and D2.

3.3.1.5 Z-Detector/Blanking Driver

The Z-detector consists of comparator U5A with both inputs driven in parallel by the horizontal signal U3-3 or U2-3. One input of the comparator has a small time delay network inserted. The horizontal signal is a sawtooth ramp rising from -0.4 V to +0.4 V and rapidly resetting to -0.4 V at the end of the ramp. During the rising portion of the ramp, U5A output remains at +12 V. During the rapid reset portion of the ramp, U5A output momentarily pulls low. This low is amplified by U5B and drives the blanking driver, U6B. U6B energizes photocoupler U1 which pulls the CRT cathode to the grid, effectively blanking the CRT trace during the horizontal retrace interval.

3.3.1.6 Switch Matrix

The switch matrix, S1-S3 and U8-10, are used to select MANUAL SWEEP REV, AUTO SWEEP REV, and HF CONVERTER. In the SDU101, only S2 switch section 9 is closed.

Courtesy of http://BlackRadios.terryo.org

3.3.2 SWEEP GENERATOR (A2)

Refer to **Figure 3-3**, Sweep Generator, A2, Block Diagram, and **Figure 6-2**, Sweep Generator, A2 Schematic Diagram, as aids in understanding the following description. As shown in **Figure 3-3**, the Sweep Generator, A2 consists of the following major assemblies:

a. Ramp Generator

b. Sweep Width Calibration Pots

c. Sweep Select Switch

d. Horizontal Sweep Amplifier

e. Horizontal Sweep Linearizer

3.3.2.1 Ramp Generator

The ramp generator consists of Unijunction transistor Q1 and constant current transistor Q2 operating as a relaxation oscillator. Oscillating frequency is determined by C4,C5 and Q2 bias current as programmed by front panel sweep rate control. The sawtooth output is amplified by buffer U2B to +/- 10 V. This output is reduced through divider R23/R24 to +/- 0.4 Vdc to become the horizontal ramp signal.

3.3.2.2 Sweep Width Calibration Pots

The 20 Vpp ramp output from U2B drives the sweep width calibration pots R1-R7 in parallel. R7 is the HF SWP calibration pot and is not used in this configuration. R1-R6 reduce the U2B output to the level corresponding to the six front panel selectable sweep widths. The levels are as follows:

SWEEP WIDTH	PK-PK RAMP VOLTAGE (NOMINAL)
5 MHz	10 volts (R6)
2 MHz	4 volts (R5)
1 MHz	2 volts (R4)
500 kHz	1 volt (R3)
200 kHz	0.4 volt (R2)
100 kHz	0.2 volt (R1)

The outputs from the six calibration pots go to the front panel rotary Sweep Width control which selects the voltage corresponding to the indicated sweep width and sends the voltage back to the Sweep Generator board.

Courtesy of http://BlackRadios.terryo.org

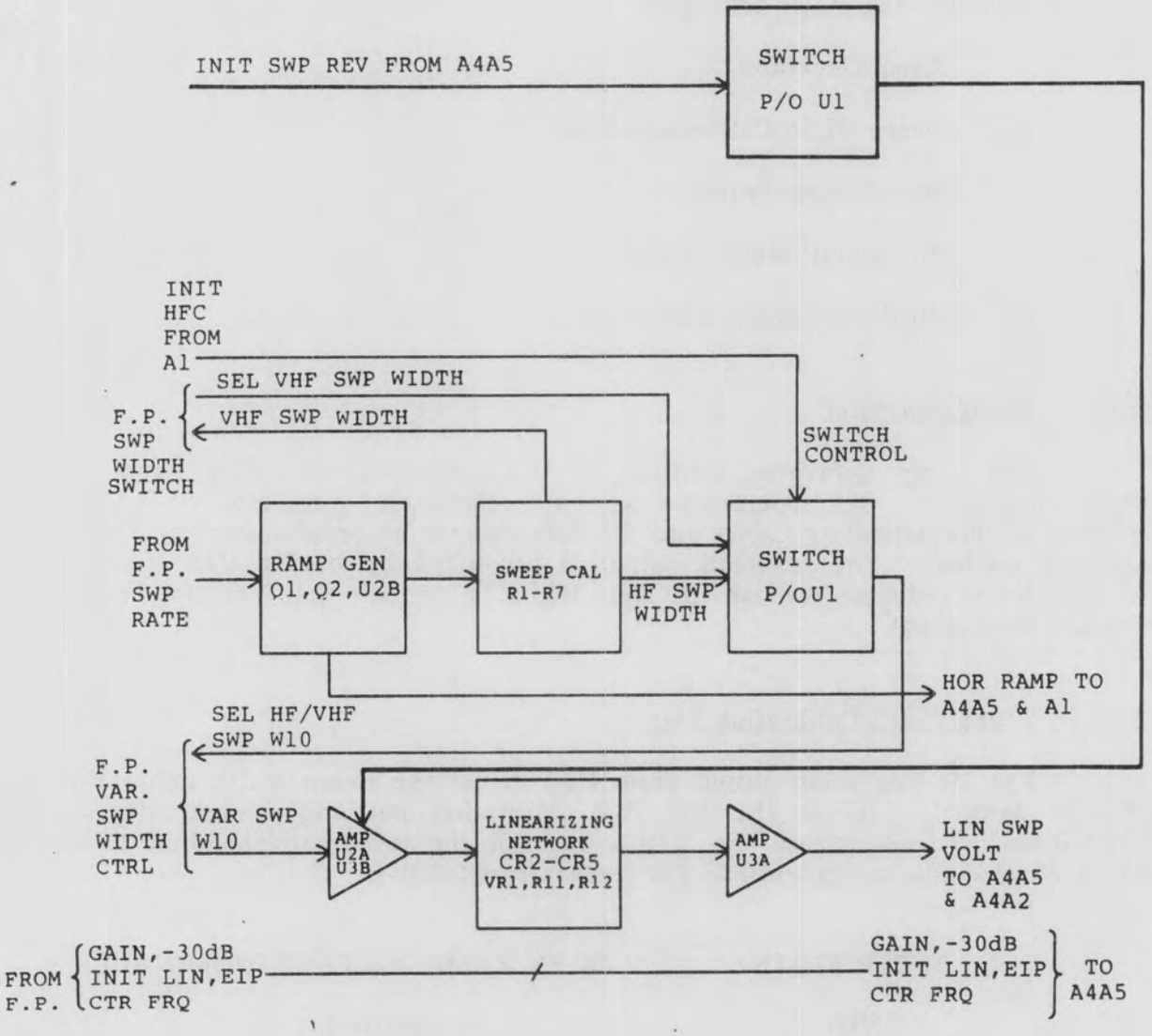

Figure 3-3. Sweep Generator Block Diagram

Courtesy of http://BlackRadios.terryo.org

3.3.2.3 Sweep Select Switch

Sweep select switch U1 is operated by the HF Converter select command from A1. When the HF converter is installed, U1 permits selection of either the HF Sweep Width from R7 through U1-S3, or the VHF Sweep Width from the front panel Sweep Width control through U1-S1. The output, U1-D1 or D3 goes through the front panel variable sweep control potentiometer and back into the Sweep Generator board.

3.3.2.4 Horizontal Sweep Amplifier

The horizontal sweep ramp from the front panel variable sweep control is amplified by buffer U2A and drives switchable amplifier U3B. U3B operates either in an inverting or non-inverting mode, as selected by switch U1-D4. During normal sweep, U1-D4 is floating and U3B operates as a non-inverting amplifier with gain of +1. During reverse sweep, U1-D4 is grounded and U3B operates as an inverting amplifier with gain of -1.

3.3.2.5 Horizontal Sweep Linearizer

The horizontal sweep output of U3B is a straight line ramp. The linearity of the Sweep Local Oscillator requires a modified or curved ramp due to the characteristic of the varactor diode. To achieve this, ramp linearizer CR2-CR5 and VR1 is inserted across the U3B output. The action of these diodes, along with R11 and R12 is to curve the ramp and Sweep Local Oscillator to nearly a linear frequency output. The ramp is then passed through unity gain buffer U3A whose output goes to Interface, A4A5.

3.3.3 INPUT FILTER/CONVERTER (A4A1)

Refer to **Figure 3-4**, Input Filter/Converter, A4A1, Block Diagram, and **Figure 6-5**, Input Filter/Converter, A4A1 Schematic Diagram, as aids in understanding the following description. As shown in **Figure 3-4**, the Input Filter/Converter, A4A1 consists of the following major assemblies:

a. Input Attenuator Switch

b. Voltage Controlled Bandpass Amplifier

c. Mixer, U3

d. IF Bandpass Amplifier

e. Wideband/Narrow Band Switch

f. Output Amplifier

Courtesy of http://BlackRadios.terryo.org

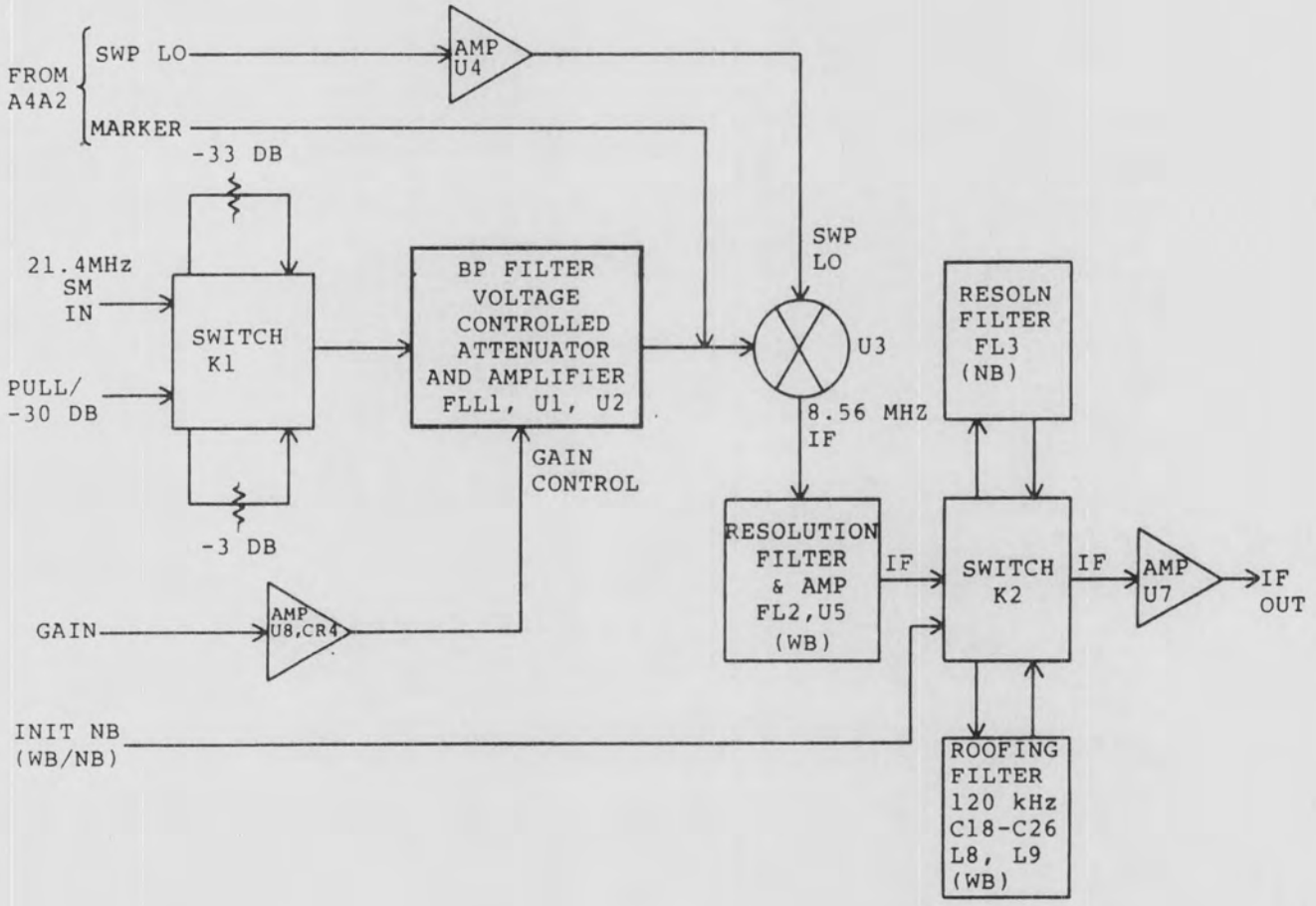

Figure 3-4. Input Filter/Converter Block Diagram

Courtesy of http://BlackRadios.terryo.org

3.3.3.1 **Input Attenuator Switch**

The 21.4 MHz SM input from the rear panel drives the input to the attenuator switch, K1-2. When the -30 dB switch is pushed in, K1 routes the SM signal through a -3 dB attenuator R3-R5. When the -30 dB switch is pulled, K1 routes the SM signal through a -33 dB attenuator R6-R10. The switch output, K1-8 drives the input to the bandpass filter.

3.3.3.2 **Bandpass Filter, Voltage Controlled Attenuator and Amplifier**

The SM signal from K1 passes through filter FL1, which is centered at 21.4 MHz with a 6 MHz bandwidth. The signal then passes through voltage controlled attenuator U1. The control pin of U1 is driven by gain amplifier, U8A/B. When the front panel variable gain control is maximum CW, the input to U8A is +6V and the output of U8A is +12 V. This voltage is buffered by U8B and through the control pin of U1 sets the loss of U1 at -1 dB. When the front panel variable gain control is maximum CCW, the input to U8A is +0.5V and the output of U8A is +1 V. This voltage is buffered by U8B and through the control pin of U1 sets the loss of U1 at -41 dB. U1 output is amplified by +15 dB by Low Noise Amplifier U2.

3.3.3.3 **Mixer, U3**

Low Noise Amplifier U2 output is combined with the marker input from the Sweep Oscillator and drives the input to mixer U3. U3 combines the SM and marker input with the sweep LO signal (27.46 to 32.46 MHz maximum in 5 MHz sweep width) from the Sweep Oscillator to produce an 8.56 MHz IF output. Mixer U3 operates at approximately -6 dB loss. U3 output drives the first bandpass/resolution filter/amplifier.

3.3.3.4 **IF Bandpass Amplifier**

The 8.56 MHz IF output from U3 passes through FL2 which is centered at 8.56 MHz and has a 20 kHz bandwidth. The FL2 output is amplified by +20 dB by buffer U5 and drives WB/NB switch, K2.

3.3.3.5 **Wideband/Narrow Band Switch**

U5 IF output drives the WB/NB switch input, K2-8. If wideband resolution is selected, K2 routes the IF signal through the wideband filter, which has approximately a 120 kHz bandwidth. Effective signal bandwidth or resolution is limited to 20 kHz by FL2. If narrowband resolution is selected, K2 routes the IF signal through the narrowband filter, FL3, which has 6 kHz bandwidth. The switch output, K2-2, is amplified by +17 dB by buffer U7. The U7 IF output drives the Output Amplifier Card, A4A4.

Courtesy of http://BlackRadios.terryo.org

3.3.4 SWEEP/MARKER OSCILLATOR, (A4A2)

Refer to **Figure 3-5**, Sweep/Marker Oscillator, A4A2, Block Diagram, and **Figure 6-6**, Sweep/Marker Oscillator, A4A2 Schematic Diagram, as aids in understanding the following description. As shown in **Figure 3-5**, the Sweep Oscillator, A4A2, consists of the following major assemblies:

a. Voltage Controlled Oscillator (VCO)

b. LO Buffer

c. Marker Oscillator

3.3.4.1 Voltage Controlled Oscillator (VCO)

The VCO consists of oscillator transistor Q1 whose tuned frequency is determined by L1, L3, C3-C5, C13, C14 and varactor diode CR1. DC bias on CR1 comes from two sources: a fixed dc voltage set by front panel Center Freq control, and the linearized sweep voltage from the Sweep Generator Card, A2. The output frequency of Q1 is centered at 29.96 MHz by the Center Freq control and varies to a maximum of +/- 2.5 MHz by the linearized sweep voltage.

3.3.4.2 LO Buffer

The VCO output is amplified by buffer Q2/Q3 operating at a gain of 2. Q3 collector passes through impedance matching transformer T1/C16/C21. The sweep LO output from the transformer operates at approximately +4 dBm and drives the Input Filter/Converter Card, A4A1.

3.3.4.3 Marker Oscillator

Marker oscillator consists of transistor Q4 whose oscillation frequency is determined by crystal Y1. Q4 is energized by the SEL MKR line coming from the front panel MARKER switch. The 21.4 MHz marker signal is tapped from the Q4 emitter and drives the Input Filter/Converter Card, A4A1.

3.3.5 OUTPUT AMPLIFIER, (A4A4)

Refer to **Figure 3-6**, Output Amplifier, A4A4, Block Diagram, and **Figure 6-7**, Output Amplifier, A4A4, Schematic Diagram, as aids in understanding the following description. As shown in **Figure 3-6**, the Output Amplifier, A4A4, consists of the following major assemblies:

a. Gain Controlled Amplifier

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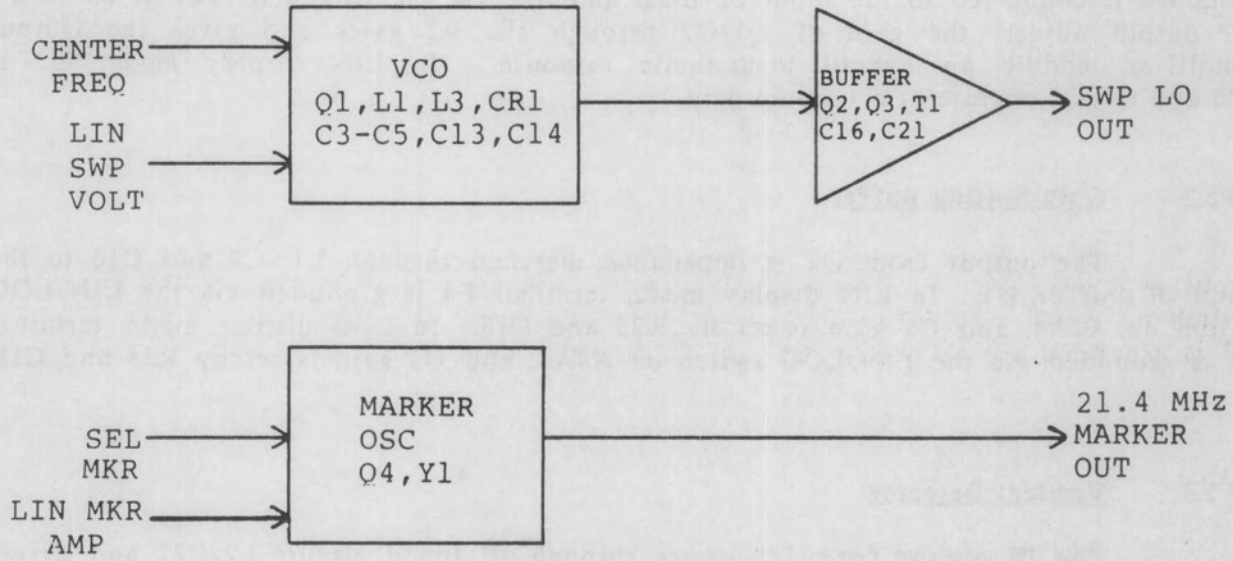

Figure 3-5. Sweep Oscillator Block Diagram

Courtesy of http://BlackRadios.terryo.org

b. Gain Setting Buffer

c. Vertical Detector

d. Vertical Output Amplifier

3.3.5.1 **Gain Controlled Amplifier**

The IF input signal from the Input Filter/Converter is amplified by gain controlled amplifier Q1/Q2. Q1 and Q2 are dual gate FET's with each #2 gate driven by LOG buffer amplifier, U2. In LOG display mode, the DC vertical output from U3 is connected to the input of LOG amp U2 via the LIN/LOG switch on A4A4. U2 output adjusts the gain of Q1/Q2 through the #2 gates and gives the Output Amplifier module an overall logarithmic response. In LIN display mode, U2 is idle and Q1/Q2 operate at maximum gain.

3.3.5.2 **Gain Setting Buffer**

The output from Q2 is impedance matched through L1, C9 and C10 to the input of buffer U1. In LIN display mode, terminal E4 is grounded via the LIN/LOG switch on A4A4, and U1 gain is set by R25 and C18. In LOG display mode, terminal E3 is grounded via the LIN/LOG switch on A4A4, and U1 gain is set by R24 and C18.

3.3.5.3 **Vertical Detector**

The IF output from U1 passes through IF tuned circuit L2/C22 and drives detector CR8. The DC output from CR8 varies from approximately 0 Vdc for no IF signal input to a maximum of +12 Vdc.

3.3.5.4 **Vertical Output Amplifier**

The DC output from CR8 is amplified by non-inverting buffer U3. U3 operates at unity gain with slight positive bias on the inverting input. This forward bias level biases diode CR8 via the non-inverting input, increasing the weak signal sensitivity of CR8. U3 output is filtered by R46/C28 to reduce noise and passes through vertical level control R47 to the vertical output terminal, E9.

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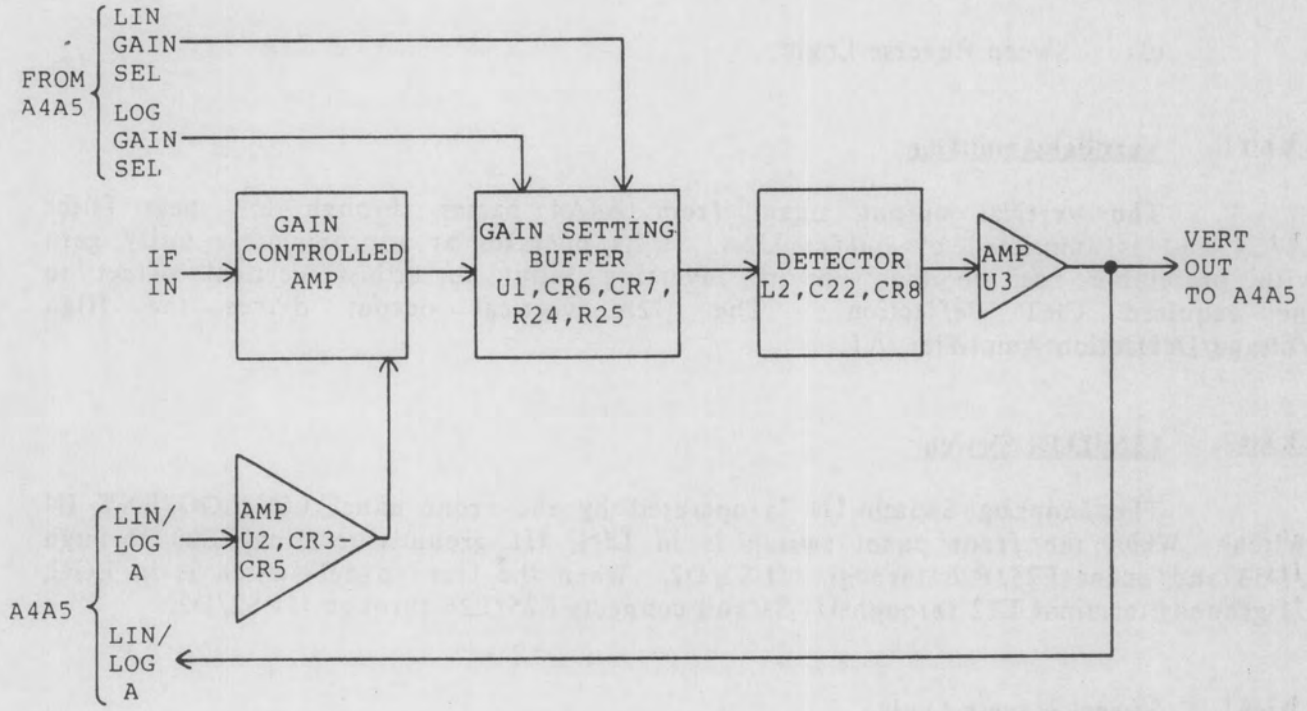

Figure 3-6. Output Amplifier Block Diagram

Courtesy of http://BlackRadios.terryo.org

3.3.6 INTERFACE (A4A5)

Refer to **Figure 3-7**, Interface, A4A5, Block Diagram, and **Figure 6-8**, Interface, A4A5, Schematic Diagram, as aids in understanding the following description. As shown in **Figure 3-7**, the Interface, A4A5, consists of the following major assemblies:

a. Vertical Amplifier

b. Lin/Log Switch

c. Sweep Reverse Logic

3.3.6.1 Vertical Amplifier

The vertical output signal from A4A4 passes through low pass filter L1/C4 and is amplified by buffer U2A. U2A operates at approximately unity gain with presetable positive bias on its inverting input to adjust vertical offset to the required CRT deflection. The U2A vertical output drives the High Voltage/Deflection Amplifier, A1.

3.3.6.2 LIN/LOG Switch

The Lin/Log Switch U1 is operated by the front panel LIN/LOG/EXT IN switch. When the front panel switch is in LIN, U1 grounds terminal E23 through U1-S3 and opens E25/E26 through U1-S2/D2. When the front panel switch is in LOG, U1 grounds terminal E22 through U1-S1 and connects E25/E26 through U1-S2/D2.

3.3.6.3 Sweep Reverse Logic

The sweep reverse logic consists of buffer U2B and gates U3 and U4. The sweep reverse logic generates a SWP REV signal at U4C output when a MAN SWP REV MODE 1 (J1-6), MAN SWP REV MODE 2 (J1-7) or AUTO SWP REV FLAG (J1-9) is present.

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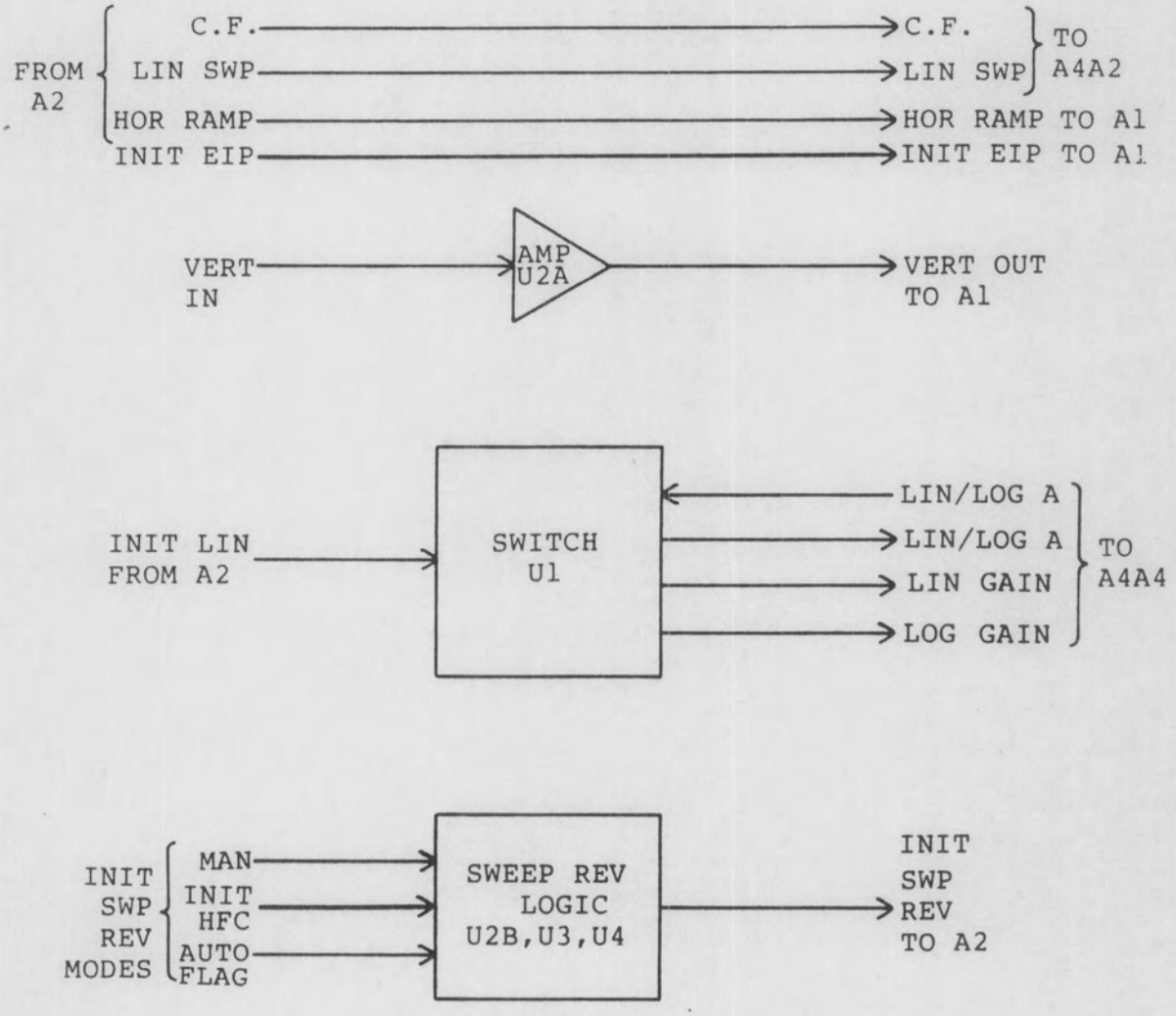

Figure 3-7. Interface Block Diagram

Courtesy of http://BlackRadios.terryo.org

SECTION IV

MAINTENANCE

4.1 GENERAL

This section provides detailed procedures to perform preventive and corrective maintenance on the WJ 9040 SDU101 Spectrum Display Unit. Preventive maintenance helps prevent malfunctions or breakdowns. Corrective maintenance includes procedures for returning a malfunctioning display unit to operating condition.

4.2 MODULE ACCESS

The display unit is a highly compact unit consisting of small printed circuit assemblies, interconnecting cabling and chassis mounted components. Physical access to all display unit assemblies is obtained by removing the top cover. Access to front panel components is obtained by removing the front panel which is secured to the display unit side panels.

4.3 PREVENTIVE MAINTENANCE

Preventive maintenance consists of visual inspection, cleaning and lubrication. Although the WJ 9040 SDU101 Spectrum Display Unit is designed for extended operation with little or no routine servicing, optimum long-term performance can only be achieved by a periodic preventive maintenance schedule. Table 4-1 is a recommended schedule for performing preventive procedures.

Table 4-1. Preventive Maintenance Schedule

Procedure	Interval	Comments
Cleaning	60 days	Interval variable depending on the operating environment.
Inspection for damage	60 days	Interval variable depending on operating environment and equipment use.

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Table 4.1. Preventive Maintenance Schedule (Cont'd)

Procedure	Interval	Comments
Performance Tests	180 days	Interval variable depending on operating environment and equipment use.
Adjustment/Alignment	---	Adjustment/Alignment keyed to results of Performance Tests.

4.3.1 VISUAL INSPECTION

A visual inspection of the Spectrum Display Unit should be performed every 1200 hours of operation or less. The inspection should be performed thoroughly to uncover existing or potential component malfunctions. At a minimum, the following items should be checked.

1. Inspect the equipment covers and front panel for condition of finish and panel markings.
2. Inspect for dents, punctures, or warped areas.
3. Inspect quarter-turn fasteners and receptacles.
4. Inspect the external surfaces for loose or missing screws or washers.
5. Inspect the receptacles for conditions of pins, contacts, and mountings.
6. Inspect the internal components for signs of deterioration, discoloration, or charring. Check for melted insulation and damaged, cracked, or broken components.
7. Inspect the printed circuit boards for damaged tracks, loose connections, corrosion, or other signs of deterioration.
8. Inspect the PC connectors, interface connectors, and chassis wiring for excessive wear, looseness, misalignment, corrosion, or other signs of deterioration.

4.3.2 CLEANING

Complete removal of dust, grease and other contamination is of prime importance in maintaining the reliability and useful life of the display unit.

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CAUTION

Avoid the use of chemical cleaning agents containing benzene, toluene, xylene, acetone, or similar solvents. These chemicals may damage the plastics used in this display unit.

1. Exterior - Dust the cabinet off with a soft cloth. Dust the front panel controls with a small soft-bristled paint brush. Dirt clinging to the cabinet may be removed with a clean, lint-free cloth dampened with a mild detergent and water solution. Avoid using abrasive cleaners. They will scratch the front panel.

2. Interior - Dust in the interior of the unit should be removed before it builds up enough to cause arcing and short circuits during periods of high humidity. Dust is best removed by dry, low-pressure air. Dirt clinging to surfaces may be removed with a soft-bristled paint brush or a clean, lint-free cloth dampened with a mild detergent and water solution. Use a cotton-tipped applicator for cleaning in narrow spaces and on the circuit boards.

3. Switch Contacts - When maintenance is necessary due to accumulated dirt and dust on the contacts, observe the following precautions: Clean the switch contacts with isopropyl alcohol or a mild detergent solution. Avoid cleaning solutions containing benzene, acetone, or similar solvents.

4.3.3 LUBRICATION

Lubrication is not required for the WJ 9040 SDU101 Spectrum Display Unit.

4.4 SPECTRUM DISPLAY UNIT CHECKOUT PROCEDURE

4.4.1 GENERAL

The checkout procedure outlined in this paragraph defines the minimum performance standards which ensure adequate display unit functioning under all normal operating modes. The tests should be used for initial display unit inspection, for preventive maintenance checks, for troubleshooting or to verify display unit performance after repairs have been made.

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4.4.2 TEST EQUIPMENT REQUIRED

Table 4-2 lists the test equipment required for corrective maintenance of the WJ 9040 SDU101 Spectrum Display unit. Equivalent equipment may be used.

Table 4-2. Test Equipment Required

Instrument Type	Required Characteristics	Recommended Instrument
Signal Generator	CW RF output, from -111 dBm to 0 dBm	HP8640B
Oscilloscope	DC to 50 MHz	HP180C
Digital Voltmeter	DC ranges; 1% or better	Fluke 8100A
Frequency Counter	DC to 50 MHz; 1 Hz resolution	HP5303A

4.4.3 SPECTRUM DISPLAY UNIT CHECKOUT PROCEDURE GUIDELINES

1. Read each test procedure thoroughly before attempting to perform the test.
2. Configure test equipment as shown in the test setup figures (where applicable) for each test.
3. Set the test equipment and display unit controls as directed for each test.
4. Allow a minimum of 30 minutes warm-up time for test equipment prior to performing any of the tests.
5. Unless otherwise indicated, acceptable tolerances are +/- 3 dB for signal levels and +/- 15% for AC/DC supply voltages.
6. The tests should be performed in the sequence given. If a malfunction is noted, refer to **paragraph 4.5** for troubleshooting.

4.4.4 FRONT PANEL CONTROL/DISPLAY FUNCTION TEST

1. Connect the spectrum display unit to a DC power source such as the EPS100 power supply in the EFR100 Equipment Frame.

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2. Set the display unit front panel controls as follows:

   a. SWEEP RATE-- Max. CW
   b. RESOLN -- AUTO
   c. SWEEP WIDTH-- 100 kHz
   d. MARKER -- OFF

3. Energize the DC power source. The red power indicator and green NB indicators should illuminate.

4. After a short warmup, the trace should be visible near the bottom of the CRT screen. Adjust the VERT, HORIZ, FOCUS and INTENSITY controls to achieve a clear, sharp trace at the baseline of the CRT screen.

5. Slowly rotate the SWEEP RATE control from maximum CW to maximum CCW and back again to maximum CW. The scan rate of the CRT trace should be observed to slow down to approximately 5 times/second as the control approaches maximum CCW.

6. Rotate the SWEEP WIDTH control slowly to the 5 MHz position. The green NB indicator should be illuminated for 100, 200 and 500 kHz, and should be extinguished for 1, 2 and 5 MHz. Lift the NB switch to the up position. The green NB indicator should illuminate.

7. This completes the front panel control/indicator test. Deenergize the DC power source unless other tests are to be performed.

4.4.5 SPECTRUM DISPLAY UNIT TEST

1. Connect the spectrum display unit as shown in **Figure 4-1.**

2. Set the display unit front panel controls as follows:

   a. SWEEP RATE -- Max. CW
   b. RESOLN -- AUTO
   c. SWEEP WIDTH -- 5 MHz
   d. MARKER -- OFF
   e. CENTER FREQ -- Mid Range
   f. GAIN -- Max. CW
   g. LIN/LOG/EXT IN -- LOG

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3. Set the signal generator parameters as follows:

   a. RF ON/OFF -- OFF
   b. Frequency -- 21.4000 MHz
   c. Output Level -- -28 dBm
   d. Modulation -- None

4. Energize the DC power source. The red power indicator should illuminate.

5. After a short warmup, the trace should be visible near the bottom of the CRT screen. Adjust the VERT, HORIZ, FOCUS and INTENSITY controls to achieve a clear, easily viewable trace at the baseline of the CRT screen.

6. Place the MARKER switch in the ON position. The marker pip should be clearly visible on the screen. Adjust the CENTER FREQ control as necessary to center the marker in the center of the CRT screen. Place the MARKER switch in the OFF position.

7. Place the signal generator RF ON/OFF switch to the ON position. The generator signal should display as approximately a full height pip in the center of the CRT screen. Adjust the generator output level slightly to achieve full height deflection of the signal on the screen.

8. Pull the -30 dB switch out. The signal deflection on the screen should drop approximately 30 dB. Push the switch back to the in position.

9. Rotate the GAIN control to maximum CCW. The signal deflection should drop approximately -40 dB. Rotate the control back to maximum CW.

10. Change the signal generator frequency to 23.9 MHz. The signal should move to the extreme left of the display screen. Display amplitude should not vary more than +/- 3 dB.

11. Change the signal generator frequency to 18.9 MHz. The signal should move to the extreme right of the display screen. Display amplitude should not vary more than +/- 3 dB.

12. Repeat steps 10 and 11 for sweep widths of 2 MHz, 1 MHz, 500 kHz, 200 kHz and 100 kHz. For each sweep width position, refer to **Table 4-3** to determine the signal generator lower and upper frequency settings.

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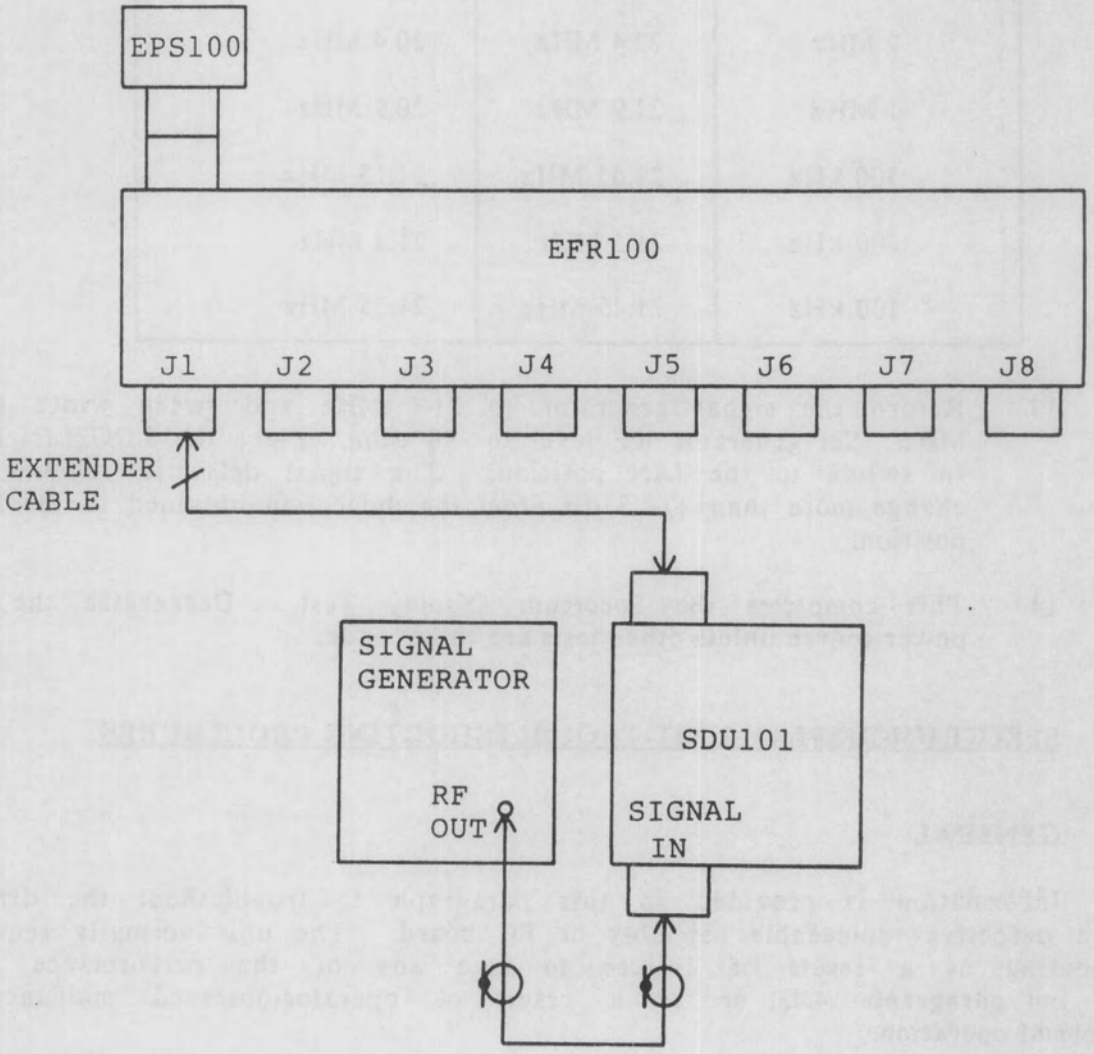

Figure 4-1. WJ 9040 SDU101 Spectrum Display Unit Test Setup

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Table 4-3. Sweep Width Upper/Lower Frequency Settings

Sweep Width	Upper Freq	Lower Freq
5 MHz	23.9 MHz	18.9 MHz
2 MHz	22.4 MHz	20.4 MHz
1 MHz	21.9 MHz	20.9 MHz
500 kHz	21.65 MHz	21.15 MHz
200 kHz	21.5 MHz	21.3 MHz
100 kHz	21.45 MHz	21.35 MHz

13. Return the signal generator to 21.4 MHz and sweep width to 5 MHz. Set generator RF level to -90 dBm. Place the LOG/LIN/EXT In switch to the LIN position. The signal deflection should not change more than +/- 3 dB from the deflection obtained in the LOG position.

14. This completes the Spectrum Display Test. Deenergize the DC power source unless other tests are to be made.

4.5 SPECTRUM DISPLAY UNIT TROUBLESHOOTING PROCEDURES

4.5.1 GENERAL

Information is provided in this paragraph to troubleshoot the display unit to a defective replaceable assembly or PC board. The unit normally requires troubleshooting as a result of failure to pass any of the performance tests outlined in **paragraph 4.4**, or as a result of operator-observed malfunctions during normal operation.

4.5.2 TROUBLESHOOTING GUIDELINES

Table 4-4, WJ 9040 SDU101 Spectrum Display Unit Troubleshooting Procedures and Chart is provided as an aid in locating defective assemblies and PC boards within the unit. The chart is designed to be used in conjunction with the display unit performance tests outlined in **paragraph 4.4**. The troubleshooting procedures provide a listing of specific fault symptoms that could occur for each of the performance tests outlined in **paragraph 4.4**. Probable causes of the fault and suggested corrective actions are also listed. The following guidelines should be applied when using **Table 4-4**.

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1. Perform each of the performance tests in **paragraph 4.4.** Note any failures to achieve the expected test result or results.

2. Refer to **Table 4-4.** Locate the performance test and fault symptom noted in step 1.

3. Perform the corrective action associated with the fault symptom. If a module is replaced requiring alignment, refer to **paragraph 4.8** and perform the indicated alignment.

4. Repeat the performance test in **paragraph 4.4** that resulted in the fault symptom to confirm the corrective action.

5. Defective modules removed in step 3 above may be repaired by referring to **paragraph 4.6.**

6. The display unit may be returned to service if it successfully passes all the performance tests in **paragraph 4.4.**

7. **Table 4-4** is intended as a general troubleshooting guide and is not a substitute for standard signal tracing/fault isolation techniques performed by skilled technicians familiar with the display unit circuitry.

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Table 4-4. WJ 9040 SDU101 Spectrum Display Unit Troubleshooting Procedures.

Test	Fault	Probable Cause	Corrective Action
FRONT PANEL CONTROL/ DISPLAY FUNCTION	Red and Green indicators do not light	Defective A3	Replace A3
		No dc power	Check dc power from equipment frame. If good, replace A1.
	No CRT trace	Defective high voltage or focusing circuit.	Replace A1
		Defective CRT	Replace CRT
	Trace not wide enough.	Defective horizontal ramp generator.	Check horiz ramp signal at A2J2-12. Should be 0.8 Vpp. If not, replace A2. If OK, replace A1.
SWEEP RATE CONTROL	Control not effective.	Defective horizontal sweep generator.	Replace A2
	Green NB indicator lights continuously	Defective Sweep Width switch.	Check or replace switch. If OK, replace A2, then A1.
SPECTRUM DISPLAY TEST	Marker not visible on CRT screen.	Defective marker oscillator.	Check marker signal at A4A2-E8. If OK, replace A4A1. If not good, replace A4A2, then marker switch.
	Generator signal not visible.	Defective A4A1.	Check IF output at A4A1-E6. If OK, replace A4A4, then replace A1.

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Table 4-4. WJ 9040 SDU101 Spectrum Display Unit Troubleshooting Procedures (Cont'd)

Test	Fault	Probable Cause	Corrective Action
SPECTRUM DISPLAY TEST (Cont'd)		Defective A4A2.	Check Sweep LO at A4A1-E4. If OK, replace A4A1. If not OK, replace A4A2 then A2.
	PULL/-30 dB switch not effective.	Defective A4A1.	Check A4A1-E9 for low when switch is out. If OK, then replace A4A1. If not replace S6.
	Variable gain pot not effective.	Defective A4A1.	Check A4A1-E10 for swing of 0 to +6 V. If OK, replace A4A1. If not, replace R3.
	Upper and lower trace frequency limits incorrect.	Defective A2.	Perform Sweep Generator alignment. If not OK, replace A2.
		Defective A4A2.	Perform Sweep Generator alignment. If OK, replace A4A2.
	Display amplitude incorrect.	Defective A4A1.	Perform A4A1 alignment. If not OK, replace A4A1. If OK, replace A4A4.
	LIN display not correct.	Defective A4A4.	Check A4A4-E4 for low in LIN mode. If OK, replace A4A4. If not OK, replace A4A5, then S4.

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4.6 MODULE TESTING AND REPAIR

4.6.1 GENERAL

This paragraph provides the testing, troubleshooting and repair information necessary to restore a malfunctioning module to normal operation. The information provided consists of the following categories:

1. Module test and troubleshooting procedures to assist signal tracing and localize faulty circuit areas.

2. Fault isolation tables to assist isolating defective components in faulty circuit areas.

3. Parts Replacement Guidelines, **paragraph 4.7**, are provided to assist in repairing a defective module.

4.6.2 PROCEDURE GUIDELINES

The module testing and troubleshooting procedures are defined using an EFR100 Equipment Frame, an EPS100 Power Supply and a functional WJ 9040 SDU101 Spectrum Display Unit as a test bed. **Figure 4-2** is a block diagram showing the test bed configuration which will be used in each of the module testing and troubleshooting procedures. When testing and troubleshooting a defective module, observe the following guidelines:

1. Allow the test equipment a 30 minute warm up before any test is performed.

2. Refer to the testing and troubleshooting paragraph for the desired module. Configure the display unit and test equipment as indicated in the test procedure for the module.

3. Perform the testing and troubleshooting procedure in the sequence given. If any failure is encountered or any desired result is not obtained, the Fault Isolation Table lists which key components would most likely cause the failure.

4. Refer to **paragraph 4.7**, Parts Replacement Guidelines, and replace the key components indicated in step 3 above. Repeat the Testing and Troubleshooting Procedure to confirm the corrective action.

5. If the module still fails, additional troubleshooting and signal tracing is required. Refer to the circuit descriptions in Section III and schematic diagrams in Section VI as aids in performing additional troubleshooting.

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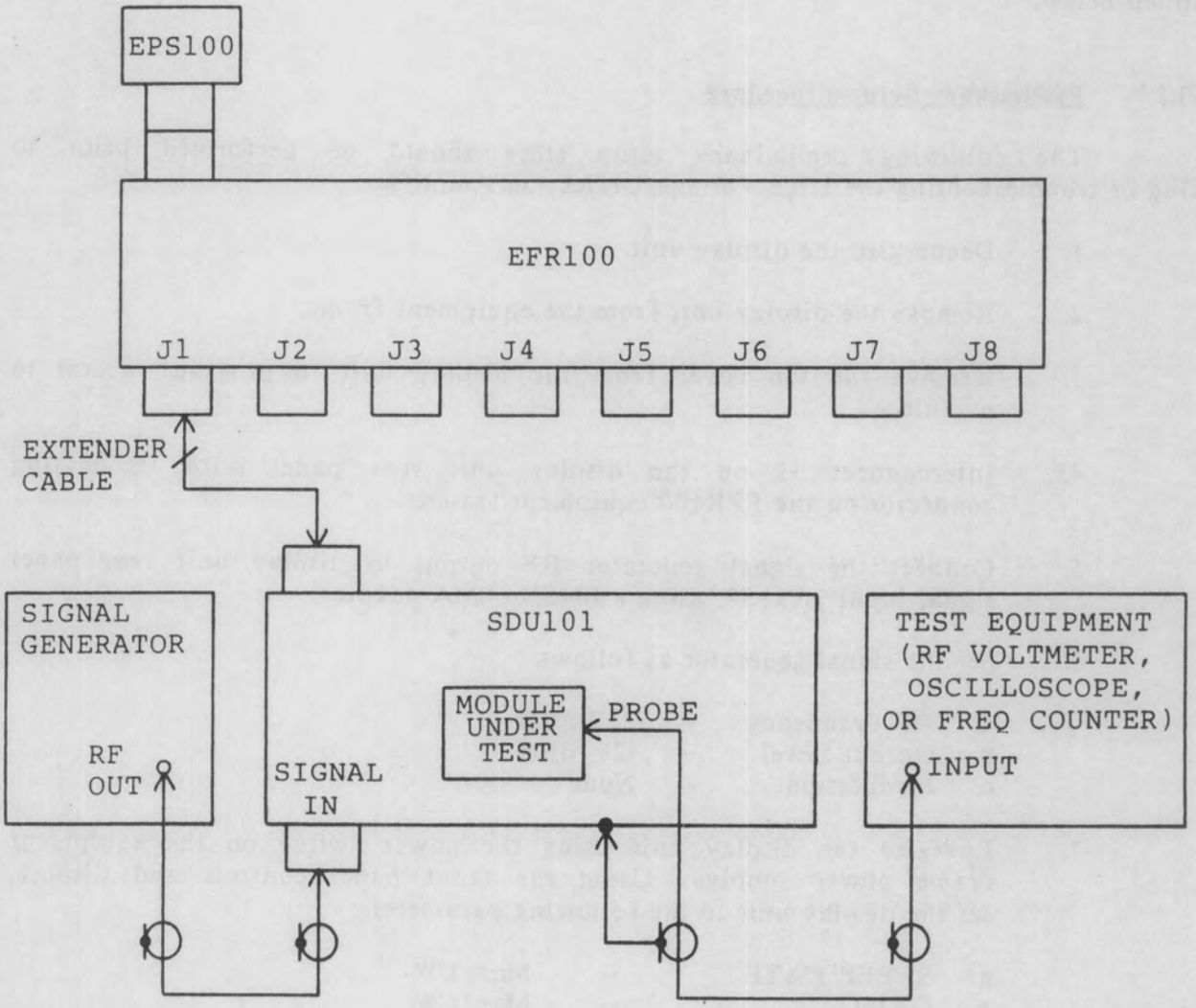

Figure 4-2. Display Unit Module Test Bed Configuration

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4.6.3 HIGH VOLTAGE/DEFLECTION AMPLIFIER (A1) TESTING AND TROUBLESHOOTING

This paragraph describes the procedures to test, troubleshoot and repair the High Voltage/Deflection Amplifier. An oscilloscope, signal generator and digital voltmeter (see **Table 4-2**) are required to perform the tests outlined below.

4.6.3.1 Preliminary Setup Procedure

The following preliminary setup steps should be performed prior to testing or troubleshooting the High Voltage/Deflection Amplifier:

1. Deenergize the display unit.
2. Remove the display unit from the equipment frame.
3. Remove the top cover from the display unit to provide access to module A1.
4. Interconnect J1 on the display unit rear panel with its mating connector on the EFR100 equipment frame.
5. Connect the signal generator RF output to display unit rear panel signal input jack, J8, using a BNC to SMA adaptor.
6. Set the signal generator as follows:

   a. RF Frequency -- 21.4 MHz
   b. Output Level -- -28 dBm
   c. Modulation -- None

7. Energize the display unit using the power switch on the equipment frame power supply. Using the front panel controls and display, set the display unit to the following parameters:

   a. SWEEP RATE -- Max. CW
   b. GAIN -- Max. CW
   c. RESOLN -- AUTO
   d. LIN/LOG/EXT IN -- LOG
   e. SWEEP WIDTH -- 5 MHz
   f. CENTER FREQ -- Mid Range
   g. MKR -- Off

8. Adjust FOCUS, INTENSITY, HORIZ and VERT controls as necessary to achieve adequate trace visibility.

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4.6.3.2 **Testing and Troubleshooting Procedure**

The testing and troubleshooting information in this paragraph is keyed to **Table 4-5**, High Voltage/Deflection Amplifier Fault Isolation Table. This table is used to isolate the module fault to a defective stage or circuit. Perform the following procedures in the sequence given.

1. Perform the preliminary setup procedure in **paragraph 4.6.3.1.**

2. Use the oscilloscope or digital voltmeter to check each test point listed in **Table 4-5.**

3. When a faulty component is found, replace the key component(s) indicated in **Table 4-5.** **Paragraph 4.7**, Parts Replacement Guidelines, should be referred to as an aid in removing and replacing any PCB components.

4. Replacement of the indicated key component(s) will normally restore the faulty test point signal to a normal level. If a faulty signal is still observed after key component replacement, additional signal tracing/fault isolation is necessary. Refer to **paragraph 3.3.1**, High Voltage/Deflection Amplifier Circuit Description, and **Figure 6-1**, High Voltage/Deflection Amplifier Schematic Diagram for additional aid in troubleshooting.

Table 4-5. High Voltage/Deflection Amplifier Fault Isolation Table

Test Point	Normal Signal	Key Components	Comments
U12-2	+15 Vdc	U12	
U13-2	-15 Vdc	U13	
J2-3	-2000 Vdc	Q1, Q2, CR1, CR2	
CR4 anode	+200 Vdc	CR3-CR5	
CR6 anode	+6.3 Vdc	CR6	
U7-1	3.3 Vpp ramp	U7, U3	Horizontal ramp
J2-11,12	120 Vpp ramp	Q6-Q8	Horizontal deflection
U7-7	Short positive pulse	U7-U3	Vertical signal
J2-9,10	50 Vpp pulses	Q3-Q5	Vertical deflection
U6-7	Short positive pulse	U5,U6	Blanking pulse

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4.6.4 SWEEP GENERATOR (A2) TESTING AND TROUBLESHOOTING

This paragraph describes the procedures to test, troubleshoot and repair the Sweep Generator. An oscilloscope and frequency counter (see **Table 4-2**) are required to perform the tests outlined below.

4.6.4.1 Preliminary Setup Procedure

The following preliminary setup steps should be performed prior to testing or troubleshooting the Sweep Generator:

1. Deenergize the display unit.
2. Remove the display unit from the equipment frame.
3. Remove the top cover from the display unit to provide access to module A2.
4. Interconnect J1 on the display unit rear panel with its mating connector on the EFR100 equipment frame.
5. Energize the display unit using the power switch on the equipment frame power supply. Using the front panel controls and display, set the display unit to the following parameters:

a.	SWEEP RATE	--	Max. CW
b.	GAIN	--	Max. CW
c.	RESOLN	--	AUTO
d.	LIN/LOG/EXT IN	--	LOG
e.	SWEEP WIDTH	--	5 MHz
f.	CENTER FREQ	--	Mid Range
g.	MKR	--	Off

6. Adjust FOCUS, INTENSITY, HORIZ and VERT controls as necessary to achieve adequate trace visibility.

4.6.4.2 Testing and Troubleshooting Procedure

The testing and troubleshooting information in this paragraph is keyed to **Table 4-6**, Sweep Generator Fault Isolation Table. This table is used to isolate the module fault to a defective stage or circuit. Perform the following procedures in the sequence given.

1. Perform the preliminary setup procedure in **paragraph 4.6.4.1.**
2. Use the oscilloscope or frequency counter to check each test point listed in **Table 4-6.**

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3. When a faulty component is found, replace the key component(s) indicated in **Table 4-6.** **Paragraph 4.7,** Parts Replacement Guidelines, should be referred to as an aid in removing and replacing any PCB components.

4. Replacement of the indicated key component(s) will normally restore the faulty test point signal to a normal level. If a faulty signal is still observed after key component replacement, additional signal tracing/fault isolation is necessary. Refer to **paragraph 3.3.2,** Sweep Generator Circuit Description, and **Figure 6-2,** Sweep Generator Schematic Diagram for additional aid in troubleshooting.

Table 4-6. Sweep Generator Fault Isolation Table

Test Point	Normal Signal	Key Components	Comments
U2-7	20 Vpp	Q1, Q2, U2	Horiz. Ramp
U1-3	10 Vpp	U1	
U3-1	10 Vpp	U1, U2, U3	

4.6.5 INPUT FILTER/CONVERTER (A4A1) TESTING AND TROUBLESHOOTING

This paragraph describes the procedures to test, troubleshoot and repair the Input Filter/Converter. A signal generator and an oscilloscope (see **Table 4-2**) are required to perform the tests outlined below.

4.6.5.1 Preliminary Setup Procedure

The following preliminary setup steps should be performed prior to testing or troubleshooting the :

1. Deenergize the display unit.

2. Remove the display unit from the equipment frame.

3. Remove the top cover from the display unit to provide access to module A4 and open the long cover to access A4A1.

4. Interconnect J1 on the display unit rear panel with its mating connector on the EFR100 equipment frame.

5. Connect the signal generator RF output to display unit rear panel signal input jack, J8, using a BNC to SMA adaptor.

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6. Set the signal generator as follows:

   a. RF Frequency -- 21.4 MHz
   b. Output Level -- -28 dBm
   c. Modulation -- None

7. Energize the display unit using the power switch on the equipment frame power supply. Using the front panel controls and display, set the display unit to the following parameters:

   a. SWEEP RATE -- Max. CW
   b. GAIN -- Max. CW
   c. RESOLN -- AUTO
   d. LIN/LOG/EXT -- LOG
   e. SWEEP WIDTH -- 5 MHz
   f. CENTER FREQ -- Mid Range
   g. MKR -- Off

8. Adjust FOCUS, INTENSITY, HORIZ and VERT controls as necessary to achieve adequate trace visibility.

4.6.5.2 **Testing and Troubleshooting Procedure**

The testing and troubleshooting information in this paragraph is keyed to **Table 4-7**, Input Filter/Converter Fault Isolation Table. This table is used to isolate the module fault to a defective stage or circuit. Perform the following procedures in the sequence given.

1. Perform the preliminary setup procedure in **paragraph 4.6.5.1.**

2. Use the oscilloscope to check each test point listed in **Table 4-7.**

3. When a faulty component is found, replace the key component(s) indicated in **Table 4-7.** **Paragraph 4.7**, Parts Replacement Guidelines, should be referred to as an aid in removing and replacing any PCB components.

4. Replacement of the indicated key component(s) will normally restore the faulty test point signal to a normal level. If a faulty signal is still observed after key component replacement, additional signal tracing/fault isolation is necessary. Refer to **paragraph 3.3.3**, Input Filter/Converter Circuit Description and **Figure 6-5**, Input Filter/Converter Schematic Diagram for additional aid in troubleshooting.

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Table 4-7. Input Filter/Converter Fault Isolation Table

Test Point	Normal Signal	Key Components	Comments
E1	-28 dBm		SM Input Signal
U8-7	+12 Vdc	U8, CR4, CR5	
U1-RF	-32 dBm	K1, FL1	
U4-2	+16 dBm	U4	Sweep LO input
FL2-OUT	-38 dBm	U3, FL2	8.56 MHz IF
U7-2	-6 dBm	U5, K2, U7	
U7-2	-6 dBm	K2, FL3	Place in NB mode.

4.6.6 SWEEP/MARKER OSCILLATOR (A4A2) TESTING AND TROUBLESHOOTING

This paragraph describes the procedures to test, troubleshoot and repair the Sweep/Marker Oscillator. A frequency counter and an oscilloscope (see Table 4-2) are required to perform the tests outlined below.

4.6.6.1 Preliminary Setup Procedure

The following preliminary setup steps should be performed prior to testing or troubleshooting the Sweep Oscillator:

1. Deenergize the display unit.
2. Remove the display unit from the equipment frame.
3. Remove the top cover from the display unit to provide access to module A4 and open the long cover to access A4A2.
4. Interconnect J1 on the display unit rear panel with its mating connector on the EFR100 equipment frame.
5. Energize the display unit using the power switch on the equipment frame power supply. Using the front panel controls and display, set the display unit to the following parameters:

Courtesy of http://BlackRadios.terryo.org

a. SWEEP RATE -- Max. CW
b. GAIN -- Max. CW
c. RESOLN -- AUTO
d. LIN/LOG/EXT IN -- LOG
e. SWEEP WIDTH -- 5 MHz
f. CENTER FREQ -- Mid Range
g. MKR -- Off

6. Adjust FOCUS, INTENSITY, HORIZ and VERT controls as necessary to achieve adequate trace visibility.

4.6.6.2 **Testing and Troubleshooting Procedure**

The testing and troubleshooting information in this paragraph is keyed to **Table 4-8**, Sweep Oscillator Fault Isolation Table. This table is used to isolate the module fault to a defective stage or circuit. Perform the following procedures in the sequence given.

1. Perform the preliminary setup procedure in **paragraph 4.6.6.1.**

2. Use the oscilloscope to check each test point listed in **Table 4-8.**

3. When a faulty component is found, replace the key component(s) indicated in **Table 4-8.** **Paragraph 4.7**, Parts Replacement Guidelines, should be referred to as an aid in removing and replacing any PCB components.

4. Replacement of the indicated key component(s) will normally restore the faulty test point signal to a normal level. If a faulty signal is still observed after key component replacement, additional signal tracing/fault isolation is necessary. Refer to **paragraph 3.3.4**, Sweep/Marker Oscillator Circuit Description, and **Figure 6-6**, Sweep/Marker Oscillator Schematic Diagram for additional aid in troubleshooting.

Table 4-8. Sweep/Marker Oscillator Fault Isolation Table

Test Point	Normal Signal	Key Components	Comments
Q2-B	64 mVpp	Q1, CR1	Low level sweep LO
E9	0.64 Vpp	Q2, Q3, T1	LO output
E8	6.4 mVpp	Q4, Y1	Marker out

Courtesy of http://BlackRadios.terryo.org

4.6.7 OUTPUT AMPLIFIER (A4A4) TESTING AND TROUBLESHOOTING

This paragraph describes the procedures to test, troubleshoot and repair the Output Amplifier. A signal generator and an oscilloscope (see **Table 4-2**) are required to perform the tests outlined below.

4.6.7.1 Preliminary Setup Procedure

The following preliminary setup steps should be performed prior to testing or troubleshooting the Output Amplifier:

1. Deenergize the display unit.
2. Remove the display unit from the equipment frame.
3. Remove the top cover from the display unit to provide access to module A4 and the "L" shaped cover to access A4A4.
4. Interconnect J1 on the display unit rear panel with its mating connector on the EFR100 equipment frame.
5. Connect the signal generator RF output to display unit rear panel signal input jack, J8, using a BNC to SMA adaptor.
6. Set the signal generator as follows:

   a. RF Frequency -- 21.4 MHz
   b. Output Level -- -28 dBm
   c. Modulation -- None

7. Energize the display unit using the power switch on the equipment frame power supply. Using the front panel controls and display, set the display unit to the following parameters:

   a. SWEEP RATE -- Max. CW
   b. GAIN -- Max. CW
   c. RESOLN -- AUTO
   d. LIN/LOG/EXT IN -- LIN
   e. SWEEP WIDTH -- 5 MHz
   f. CENTER FREQ -- Mid Range
   g. MKR -- Off

8. Adjust FOCUS, INTENSITY, HORIZ and VERT controls as necessary to achieve adequate trace visibility.

Courtesy of http://BlackRadios.terryo.org

4.6.7.2 **Testing and Troubleshooting Procedure**

The testing and troubleshooting information in this paragraph is keyed to **Table 4-9**, Output Amplifier Fault Isolation Table. This table is used to isolate the module fault to a defective stage or circuit. Perform the following procedures in the sequence given.

1. Perform the preliminary setup procedure in **paragraph 4.6.7.1.**

2. Use the oscilloscope to check each test point listed in **Table 4-9.**

3. When a faulty component is found, replace the key component(s) indicated in **Table 4-9.** **Paragraph 4.7**, Parts Replacement Guidelines, should be referred to as an aid in removing and replacing any PCB components.

4. Replacement of the indicated key component(s) will normally restore the faulty test point signal to a normal level. If a faulty signal is still observed after key component replacement, additional signal tracing/fault isolation is necessary. Refer to **paragraph 3.3.5**, Output Amplifier Circuit Description, and **Figure 6-7**, Output Amplifier Schematic Diagram for additional aid in troubleshooting.

Table 4-9. Output Amplifier Fault Isolation Table

Test Point	Normal Signal	Key Components	Comments
E1	-6 dBm		IF Input Signal
U1-1	+12 dBm	Q1, Q2	
U3-3	+1 Vdc	U1, CR8	Detected Vert Signal
E9	+1 Vdc	U3	
E9	+1 Vdc	U2	Place unit in LOG display.

4.6.8 **INTERFACE (A4A5) TESTING AND TROUBLESHOOTING**

This paragraph describes the procedures to test, troubleshoot and repair the Interface. A signal generator and an oscilloscope (see **Table 4-2**) are required to perform the tests outlined below.

Courtesy of http://BlackRadios.terryo.org

4.6.8.1 Preliminary Setup Procedure

The following preliminary setup steps should be performed prior to testing or troubleshooting the Interface:

1. Deenergize the display unit.

2. Remove the display unit from the equipment frame.

3. Remove the top cover from the display unit to provide access to module A4A5.

4. Interconnect J1 on the display unit rear panel with its mating connector on the EFR100 equipment frame.

5. Connect the signal generator RF output to display unit rear panel signal input jack, J8, using a BNC to SMA adaptor.

6. Set the signal generator as follows:

   a. RF Frequency -- 21.4 MHz
   b. Output Level -- -28 dBm
   c. Modulation -- None

7. Energize the display unit using the power switch on the equipment frame power supply. Using the front panel controls and display, set the display unit to the following parameters:

   a. SWEEP RATE -- Max. CW
   b. GAIN -- Max. CW
   c. RESOLN -- AUTO
   d. LIN/LOG/EXT IN -- LOG
   e. SWEEP WIDTH -- 5 MHz
   f. CENTER FREQ -- Mid Range
   g. MKR -- Off

8. Adjust FOCUS, INTENSITY, HORIZ and VERT controls as necessary to achieve adequate trace visibility.

4.6.8.2 Testing and Troubleshooting Procedure

The testing and troubleshooting information in this paragraph is keyed to **Table 4-10**, Interface Fault Isolation Table. This table is used to isolate the module fault to a defective stage or circuit. Perform the following procedures in the sequence given.

Courtesy of http://BlackRadios.terryo.org

1. Perform the preliminary setup procedure in **paragraph 4.6.8.1.**

2. Use the oscilloscope to check each test point listed in **Table 4-10.**

3. When a faulty component is found, replace the key component(s) indicated in **Table 4-10.** **Paragraph 4.7,** Parts Replacement Guidelines, should be referred to as an aid in removing and replacing any PCB components.

4. Replacement of the indicated key component(s) will normally restore the faulty test point signal to a normal level. If a faulty signal is still observed after key component replacement, additional signal tracing/fault isolation is necessary. Refer to **paragraph 3.3.6,** Interface Circuit Description, and **Figure 6-8,** Interface Schematic Diagram for additional aid in troubleshooting.

Table 4-10. Interface Fault Isolation Table

Test Point	Normal Signal	Key Components	Comments
E27	1.0 Vpp pulse		Vertical input signal
U2-1	1.0 Vpp pulse	U2	DC offset as a function of R4
E22	Low	U1	
E23	Low	U1	Place display in LIN mode.

4.7 PARTS REPLACEMENT GUIDELINES

This paragraph provides techniques to assist the technician in replacing components on PC boards.

WARNING

To prevent electrical shock or damage to the unit, always disconnect the display unit from the ac power source before soldering or replacing components.

Courtesy of http://BlackRadios.terryo.org

4.7.1 SOLDERING TECHNIQUES

When removing components from a printed circuit board for inspection or replacement, be especially careful not to damage the track. The soldering iron power should be no higher than 40 watts, and a solder sipper or wicking procedure should be employed when removing solder. Noncorrosive solder flux should be used when removing solder by wicking. In returning components to the board, make sure that holes are clear and that leads do not catch the edge of the track and lift it from the board. A good grade of rosin core 60/40 solder should be used. Do not heat longer than is necessary to achieve a good joint. A heat sink should be used where possible.

4.7.2 COMPONENT REPLACEMENT

The following are specific guidelines for replacing the various kinds of components:

1. When soldering or unsoldering diodes or resistors, solder quickly to allow as little heat conduction as possible. When wiring permits, use a heat sink between the soldering iron and the part.

2. When soldering or unsoldering transistors, use a low wattage iron and a heat sink. Solder as quickly as possible. The use of a circular solder tip to heat all three joints simultaneously is recommended.

3. When soldering or unsoldering glass or ceramic capacitors, use a heat sink between the capacitor and the iron. Excessive heat will crack the capacitor body.

4. When any electronic part is removed, note the position of the part and its leads, and replace it the same way.

4.8 ADJUSTMENT/ALIGNMENT PROCEDURES

4.8.1 GENERAL

The following Adjustment and Alignment Procedures should not be performed on a routine basis, but instead, should be used as aids in troubleshooting and post-repair testing. Before alignment is attempted, the technician should first perform the relevant procedures to determine which module needs alignment.

Courtesy of http://BlackRadios.terryo.org

4.8.2 SWEEP GENERATOR (A2) ALIGNMENT

1. Deenergize the display unit.

2. Remove the Spectrum Display Unit from the EFR100 Equipment Frame.

3. Remove the top cover from the display unit to provide access to module A2.

4. Connect J1 on the display unit rear panel to its mating connector on the EFR100 Equipment Frame using an extender cable.

5. Set the display unit front panel controls as follows:

a.	CENTER FREQ	--	Mid Range
b.	MARKER	--	ON
c.	SWEEP WIDTH	--	5 MHz
d.	VAR SWP WIDTH	--	Max. CW
e.	LIN/LOG/EXT IN	--	LIN
f.	SWEEP RATE	--	Max. CW
g.	GAIN	--	Max. CW
h.	PULL/-30 DB	--	In

6. Energize the display unit using the power switch on the equipment frame. Adjust the INTENSITY, FOCUS, VERTICAL and HORIZONTAL controls for adequate trace visibility.

7. Connect a frequency counter to the Horizontal (X) Output jack J5 on the rear panel.

8. Connect an oscilloscope to A2U2-7. Adjust A2R15 and A2R21 for a positive-going ramp of 20 Vpp centered around 0 Vdc.

9. Adjust A2R10 to set ramp rate at 25 Hz as measured on the frequency counter.

10. Rotate front panel SWEEP RATE control to max. CCW. Adjust A2R9 to set ramp rate at 5 Hz as measured on the frequency counter.

11. Connect an oscilloscope to the front panel variable sweep width control wiper (center terminal) and rotate the control to max. CW. Set the sweep width switch to position #6 (5MHz) and adjust A2R6 for 10 Vpp.

12. Repeat step 11 for positions #5 through #1 using the following settings:

Courtesy of http://BlackRadios.terryo.org

Position	SWP Width	Pot Adjust	Voltage
5	2 MHz	A2R5	4 Vpp
4	1 MHz	A2R4	2 Vpp
3	500 kHz	A2R3	1 Vpp
2	200 kHz	A2R2	0.4 Vpp
1	100 kHz	A2R1	0.2 Vpp

13. This completes the Sweep Generator Alignment Procedure.

4.8.3 INPUT FILTER/CONVERTER (A4A1) ALIGNMENT

1. Deenergize the display unit.

2. Remove the display unit from the EFR100 Equipment Frame.

3. Remove the top cover from the display unit to provide access to module A4.

4. Connect J1 on the display unit rear panel to its mating connector on the EFR100 Equipment Frame using an extender cable.

5. Set the display unit front panel controls as follows:

a.	CENTER FREQ	--	Mid Range
b.	MARKER	--	ON
c.	SWEEP WIDTH	--	5 MHz
d.	VAR SWP WIDTH	--	Max. CW
e.	LIN/LOG/EXT IN	--	LIN
f.	SWEEP RATE	--	Max. CW
g.	GAIN	--	Max. CW
h.	PULL/-30 DB	--	In

6. Energize the display unit using the power switch on the equipment frame. Adjust the INTENSITY, FOCUS, VERTICAL and HORIZONTAL controls for adequate trace visibility.

7. Disconnect jumper wire from A4A1E6. Disconnect jumper wire A4A1JW1. Connect an RF sweep generator RF output to the C11 side of JW1. Connect a 50 ohm detector and oscilloscope to A4A1E6.

8. Set sweep generator center frequency to 8.56 MHz and sweep width to 250 kHz. Set sweep generator output level to -20 dBm.

9. Adjust A4A1C18 and A4A1C23 to display a peak tuned response at 8.56 MHz with a -3 dB bandwidth of typically 120 kHz.

Courtesy of http://BlackRadios.terryo.org

10. Remove all test equipment and reconnect all disconnected jumper wires.

11. This completes the Input Filter/Converter alignment procedure.

4.8.4 OUTPUT AMPLIFIER (A4A4) ALIGNMENT

1. Deenergize the display unit.

2. Remove the display unit from the EFR100 Equipment Frame.

3. Remove the top cover from the display unit to provide access to module A4.

4. Connect J1 on the display unit rear panel to its mating connector on the EFR100 Equipment Frame using an extender cable.

5. Set the display unit front panel controls as follows:

a.	CENTER FREQ	--	Mid Range
b.	MARKER	--	ON
c.	SWEEP WIDTH	--	5 MHz
d.	VAR SWP WIDTH	--	Max. CW
e.	LIN/LOG/EXT IN	--	LIN
f.	SWEEP RATE	--	Max. CW
g.	GAIN	--	Max. CW
h.	PULL/-30 DB	--	In

6. Energize the display unit using the power switch on the equipment frame. Adjust the INTENSITY, FOCUS, VERTICAL and HORIZONTAL controls for adequate trace visibility.

7. Disconnect wire to A4A4E1.

8. Connect a signal generator RF output to A4A4E1. Set the output frequency to 8.56 MHz and output level to -60 dBm.

9. Connect a digital voltmeter to A4A4E9. Adjust A4A4L1 and A4A4L2 for maximum level indication on the voltmeter.

10. Disconnect all test equipment and reconnect any disconnected jumper wires. This completes the Output Amplifier alignment procedure.

Courtesy of http://BlackRadios.terryo.org

SECTION V

REPLACEMENT PARTS LIST

5.1 UNIT NUMBERING METHOD

The unit numbering method of assigning reference designations (electrical symbol numbers) has been used to identify assemblies, subassemblies (and modules) and parts. An example of the unit numbering method follows:

Subassembly Designation A1	R1 Class and No. of Item
Identify from right to left as:	First (1) resistor (R) of first (1) subassembly (A)

As shown on the main chassis schematic, components which are an integral part of the main chassis have no subassembly designation.

5.2 REFERENCE DESIGNATION PREFIX

Partial reference designations have been used on the equipment and on the illustrations in this manual. The partial reference designations consist of the class letter(s) and identifying item number. The complete reference designations may be obtained by placing the proper prefix before the partial reference designations. Reference Designation Prefixes are provided on drawings and illustrations in parentheses within the figure titles.

5.3 LIST OF MANUFACTURERS

Mfr. Code	Name and Address
01121	Allen-Bradley Company 1201 South 2nd Street Milwaukee, WI 53204
01221	Kalamazoo Machine Company Kalamazoo, MI
02735	RCA Corporation Solid State Division Route 202 Somerville, NJ 08876
04713	Motorola, Incorporated Semiconductor Products Division 5005 East McDowell Road Phoenix, AZ 85008
06776	Robinson-Nugent, Inc. 800 E. 8th Street Albany, IN 47150
07263	Fairchild Camera & Instr. Corp. Semiconductor Division 464 Ellis Street Mountain View, CA 94040
08717	Airco, Incorporated Airco Electronics Bradford, PA 17055
11532	Teledyne Relays Teledyne Ind., Inc. 12525 Daphne Avenue Hawthorne, CA 90250

Courtesy of http://BlackRadios.terryo.org

Mfr. Code	Name and Address
13103	Thermalloy Company, Inc. 2021 West Valley View Lane P.O. Box 810839 Dallas, TX 75381
14482	Watkins-Johnson Co. 3333 Hillview Avenue Palo Alto, CA 94304
14632	Watkins-Johnson Co. 700 Quince Orchard Road Gaithersburg, MD 20878
15542	Mini-Circuits Laboratories Division of Scientific Components Corp. 2625 E. 14th Street Brooklyn, NY 11235
17554	Corning Components, Inc. One Components Drive Biddeford, ME AJ3675
17856	Siliconix, Inc. 2201 Laurelwood Road Santa Clara, CA 95050
19505	Applied Eng. Products, Co. Division of Samarious, Inc. 300 Seymour Avenue Derby, CT 06418
20183	General Atronics Corporation 1200 East Mermaid Lane Philadelphia, PA 19118
22526	Du Pont El De Nemours and Co. Inc., Photo Products Dept. Berg Electronics Div., Rt. 83 New Cumberland, PA 17070
25088	Siemens Corporation 186 Wood Avenue South Iselin, NJ 08330
25526	Cand M MFG Co., Inc. Bethesda, MD
27014	National Semi-Conductor Corp. 2950 San Ysidro Way Santa Clara, CA 95051
28480	Hewlett-Packard Company Corporate Headquarters 1501 Page Mill Road Palo Alto, CA 94304
33095	Spectrum Control, Inc. 152 E. Main Street Fairview, PA 16415
51057	Vibro-Meter Corporation 22109 S. Vermont Avenue Torrance, CA 90502
51406	Morata Erie North America, Inc. 1148 Franklin Road, SE Marietta, GA 30067
51628	TEC, Incorporated 2727 North Fairview Avenue Tucson, AZ 85705
51642	Centre Engineering, Inc. 2820 E. College Avenue State College, PA 16801

Courtesy of http://BlackRadios.terryo.org

Mfr. Code	Name and Address
52673	KSW Electronics Corp. Burlington, MA 01803
54473	Matsushita Electric Corp. One Panasonic Way P.O. Box 1501 Secaucus, NJ 07094
56289	Sprague Electric Company Marshall Street North Adams, MA 01247
56637	RCD Components, Incorporated 330 Bedford Street Manchester, NH 03101
59660	Tusonix, Inc. 2155 N. Forbes Blvd. Tucson, AZ 85745
60979	Amplifonix, Incorporated 2010 Cabot Boulevard, West Langhorne, PA 19047
70903	Cooper Belden Electronic Wire and Cable 2000 S. Batavia Avenue Geneva, IL 60134
71279	Cambridge Thermionic Corp. 445 Concord Avenue Cambridge, MA 02138
71468	ITT Canon Electric Div. of ITT Corp. 10550 Talbert Ave. P.O. Box 8040 Fountain Valley, CA 92708
72136	Electro Motive Mfg. Co., Inc. South Park & John Streets Willimantic, CT 06226
73138	Beckman Instruments, Inc. Helipot Division 2500 Harbor Boulevard Fullerton, CA 92634
76055	Mallory Controls Co. State Road 28 West P.O. Box 327 Frankfort, IN 46041
8K838	Varo Quality Semiconductor, Inc. 100 N. Shiloh Road P.O. Box 469013 Garland, TX 75046
80131	Electronic Industries Assoc. 2001 Eye Street, N.W. Washington, DC 20006
81073	Grayhill, Incorporated 561 Hillgrove Avenue P.O. Box 10373 La Grange, IL 60525
81349	Military Specifications
81350	Joint Army-Navy Specifications
82413	Precision Tube Company, Inc. Wissahickon Ave. & Church Rd. North Wales, PA 19454

Courtesy of http://BlackRadios.terryo.org

Mfr. Code	Name and Address
84048	Vernitron Corp. 2801 72nd Street North P.O. Box 44000 St. Petersburg, FL 33743
84411	American Shizuki Corporation 301 West O Street O Gallala, NE 69153
91984	Maida Development Co. 20 South Libby P.O. Box 3529 Hampton, VA 23663
95146	Alco Electronic Products, Inc. P.O. Box 1348 North Andover, MA 01842
98800	American Precision Ind., Inc. Delevan Division 270 Quaker Road East Aurora, NY 14052

5.4 PARTS LIST

The parts list which follows contains all electrical parts used in the equipment and certain mechanical parts which are subject to unusual wear or damage. When ordering replacement parts from Watkins-Johnson Company, specify the type and serial number of the equipment and the reference designation and description of each part ordered. The list of manufacturers provided in **paragraph 5.3** and the manufacturer's part number for components are included as a guide to the user of the equipment in the field. These parts may not necessarily agree with the parts installed in the equipment; however, the parts specified in this list will provide satisfactory operation of the equipment. Replacement parts may be obtained from any manufacturer as long as the physical and electrical parameters of the part selected agree with the original indicated part. In the case of components defined by a military or industrial specification, a vendor which can provide the necessary component is suggested as a convenience to the user.

NOTE

As improved semi-conductors become available, it is the policy of Watkins-Johnson to incorporate them in proprietary products. For this reason some transistors, diodes, and integrated circuits installed in the equipment may not agree with those specified in the parts list and schematic diagrams of this manual. However, the semi-conductors designated in the manual may be substituted in every case with satisfactory results.

Courtesy of http://BlackRadios.terryo.org

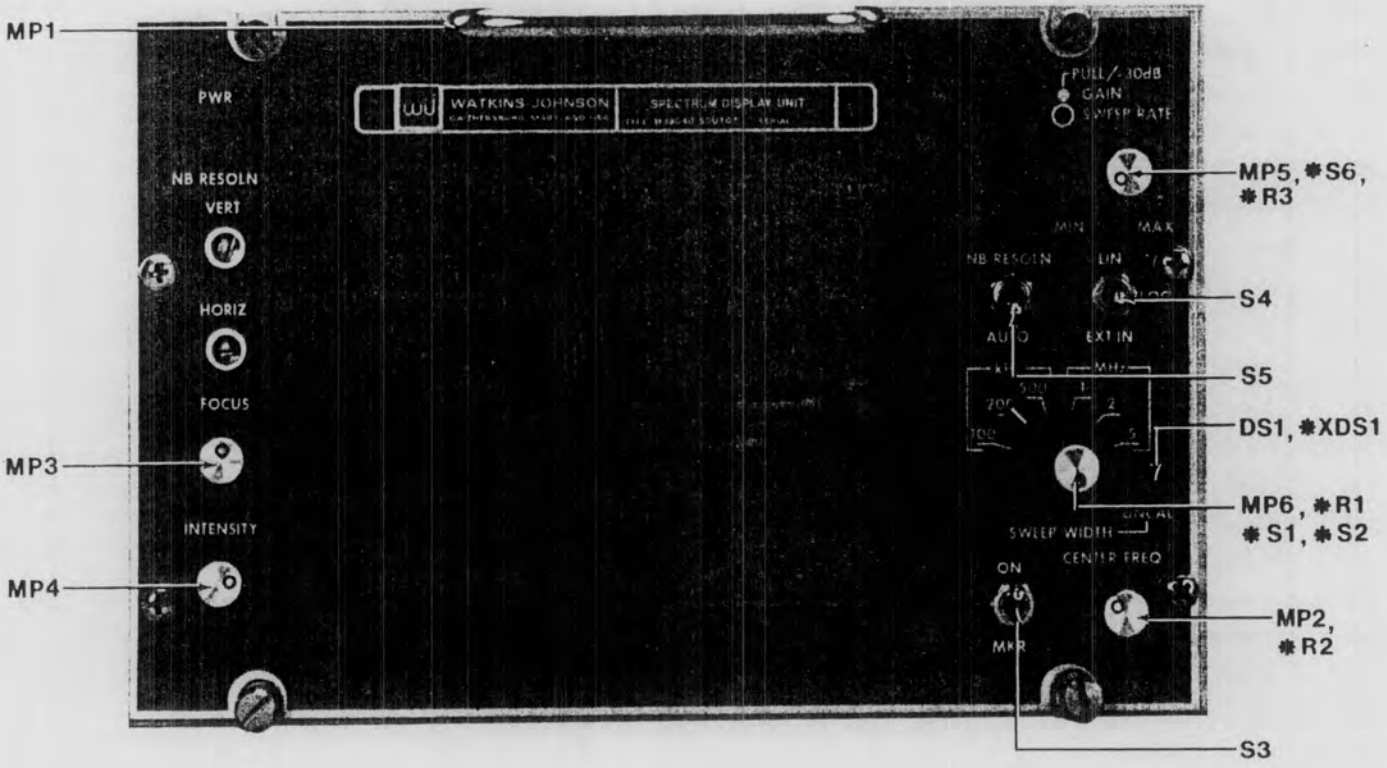
5.5 **TYPE WJ-9040 SDU101 SPECTRUM DISPLAY UNIT, MAIN CHASSIS**

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
A1	High Voltage and Deflection Amplifier	1	794546-1	14632	
A2	Sweep Generator	1	794547-1	14632	
A3	LED Flexible Board	1	271134-1	14632	
A4	Converter	1	794535-1	14632	
DS1	Lamp/LED	1	4A0	08717	
J1	Connector, Receptacle	1	DBSFY-25P	71468	
J2	Connector, Jack, SMA	7	9030-9023-005	19505	
J3 Thru J8	Same as J2				
MP1	Handle, Front	1	10221-B-0632-4A	06540	
MP2	Knob, Round	3	PS50D1/B	21604	
MP3	Same as MP2				
MP4	Same as MP2				
MP5	Knob	1	PS50D1/70C2/BLK	21604	
MP6	Knob	1	PS50D1/70CP2/B-BSPT	21604	
MP7	Display Window	1	371550-1	14632	
P1	Connector, Plug	1	65043-017	22526	
R1	Resistor, Variable, W-Switch: 100 kΩ, 10%	1	27M280	01121	
R2	Resistor, Variable, Compound: 10 kΩ, 10%, 1/2 W	1	RV6NAYSA13A	81349	
R3	Resistor, Variable, W-Switch: 1 kΩ/10 kΩ, 10%, 1 W	1	27M387	01121	
S1	Switch, Rotary (Part of R1)				
S2	Switch, Rotary	1	271600-1	14632	
S3	Switch Toggle	2	MTA106D	95146	
S4	Switch, Toggle	1	MTA106E	95146	
S5	Same as S3				
S6	Switch, Push-Pull (Part of R3)				
V1	Tube, CRT	1	D1047P31	20183	
W1	Cable Assembly	1	271609-1	14632	
W2	Cable Assembly	1	271610-1	14632	
W3	Cable Assembly	1	271608-1	14632	
W4	Cable Assembly	1	271608-2	14632	
W5	Cable Assembly	1	17300-377-1	14632	
W6	Cable Assembly	1	17300-377-2	14632	
W7	Cable Assembly	1	17300-377-3	14632	
W8	Cable Assembly	1	17300-377-4	14632	
W9	Cable Assembly	1	17300-377-5	14632	
W10	Cable Assembly	1	17300-377-6	14632	
W11	Cable Assembly	1	17300-377-7	14632	
W1P1	Connector, Multipin	1	66900-026	22526	
W2P1	Housing	1	65409-012	22526	
W3P1	Connector, Plug	4	66900-016	22526	

Courtesy of http://BlackRadios.terryo.org

MAIN CHASSIS

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
W3P2	Same as W3P1				
W4P1	Same as W3P1				
W4P2	Same as W3P1				
W5P1	Connector, Plug	6	2105-7521-005	19505	
W6P1	Same as W5P1				
W7P1	Same as W5P1				
W8P1	Same as W5P1				
W9P1	Same as W5P1				
W10P1	Same as W5P1				
W11P1	Connector, Jack, SMB	1	2002-7571-005	19505	
XDS1	Socket, Lamp Assembly	1	122B-AL-QB-4A0	08717	
XV1	Socket, Tube	1	B14-244	20183	



*DENOTES HIDDEN PART

Figure 5-1. WJ-9040 SDU101 Spectrum Display Unit, Front Panel, Location of Components

Courtesy of http://BlackRadios.terryo.org

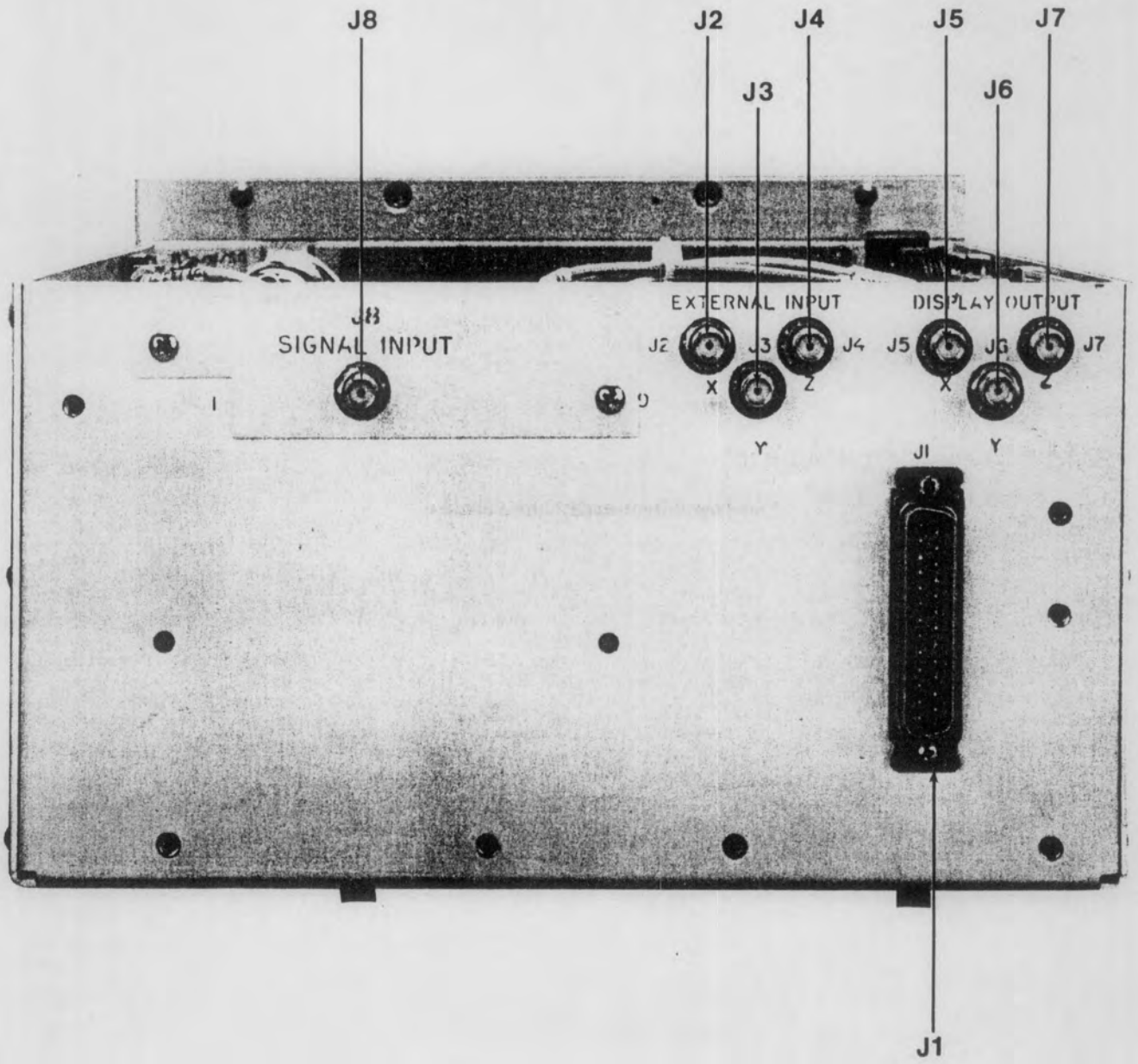


Figure 5-2. WJ-9040 SDU101 Spectrum Display Unit, Rear Panel, Location of Components

Courtesy of http://BlackRadios.terryo.org

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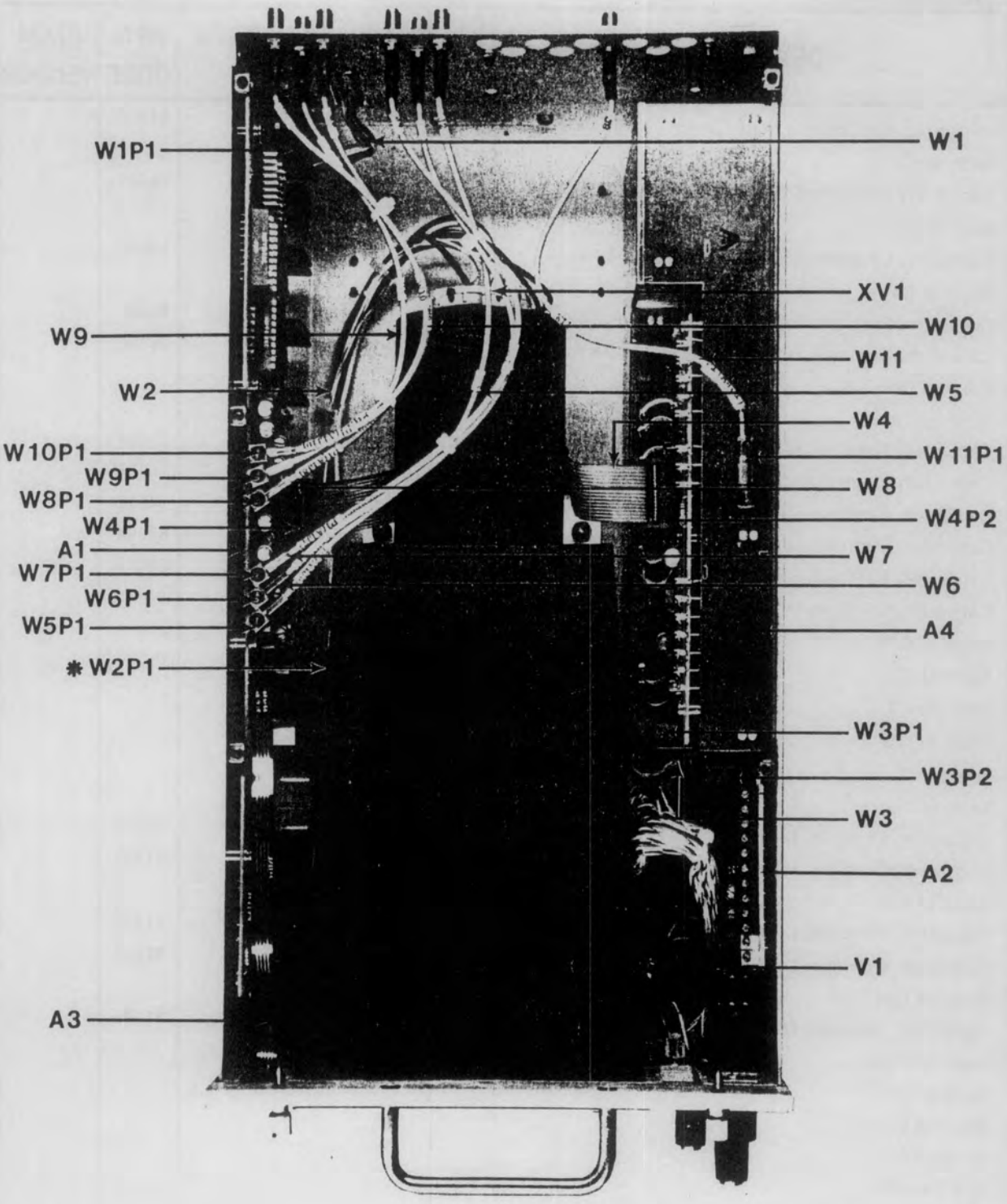


* DENOTES HIDDEN LINES

Figure 5-3. WJ-9040 SDU101 Spectrum Display Unit, Top View, Location of Components

Courtesy of http://BlackRadios.terryo.org

5.5.1 **TYPE 794546-1 HI-VOLTAGE AND DEFLECTION AMPLIFIER**

REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
C1	Capacitor, Electrolytic, Aluminum: 33 µF, 10%, 25 V	7	ECE-A1EK330	54473	
C2	Same as C1				
C3	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	7	34452-1	14632	
C4	Same as C3				
C5	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	2	34453-1	14632	
C6	Same as C5				
C7	Capacitor, Electrolytic, Tantalum: 4.7 µF, 10%, 35 V	1	CS13BF475K	81349	
C8	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 3 kV	3	30GAS10	56289	
C9	Same as C8				
C10	Same as C8				
C11	Capacitor, Mylar, Dipped: 0.22 µF, 20%, 400 V	1	B32234B6224M	25088	
C12	Capacitor, Electrolytic, Tantalum: 200 µF, 20%, 15 V	1	MTP207M015P1C	76055	
C13	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 50 V	3	34475-1	14632	
C14	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 200 V	3	8131-200-651-104M	59660	
C15	Capacitor, Ceramic, Disc: 2200 pF, 10%, 50 V	1	8121-050-X7RO-222K	59660	
C17	Capacitor, Ceramic, Disc: 1000 pF, 10%, 200 V	1	CK05BX102K	81349	
C18	Same as C13				
C19	Same as C1				
C20	Same as C3				
C21	Same as C13				
C22	Same as C1				
C23	Same as C3				
C24	Capacitor, Ceramic, Disc: 150 pF, 10%, 200 V	2	CK05BX151K	81349	
C25	Capacitor, Ceramic, Disc: 27 pF, 10%, 200 V	1	CK05BX270K	81349	
C26	Same as C24				
C27	Capacitor, Ceramic, Disc: 180 pF, 10%, 200 V	1	CK05BX181K	81349	
C28	Capacitor, Ceramic, Disc: 680 pF, 10%, 200 V	2	CK05BX681K	81349	
C29	Same as C28				
C30	Capacitor, Ceramic, Disc: 1500 pF, 10%, 100 V	2	CK05BX152K	81349	
C31	Same as C30				
C32	Same as C3				
C33	Same as C1				
C34	Same as C3				
C35	Same as C1				
C36	Same as C3				
C37	Same as C1				
C38	Same as C14				
C39	Same as C14				
C16*	Capacitor, Mica, Dipped: 430 pF, 2%, 300 V	1	DM15-431G	72136	
CR1	Diode, Rectifier	2	VA30X	8K838	
CR2	Same as CR1				

Courtesy of http://BlackRadios.terryo.org

REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
CR3	Diode	15	1N4005	80131	
CR4 Thru CR6	Same as CR3				
CR7	Diode	6	1N4449	80131	
CR8 Thru CR12	Same as CR7				
CR13 Thru CR23	Same as CR3				
CR24	Diode	2	1N458A	80131	
CR25	Same as CR24				
E1	Terminal, Forked	2	140-1941-02-01	71279	
E2	Same as E1				
J1	Terminal, Strip	1	65610-126	22526	
J2	Connector, Receptacle	1	65542-112	22526	
J3	Connector, Receptacle	1	68667-001	25526	
J4	Connector, Receptacle	2	65610-116	22526	
J5	Connector, Receptacle, SMB	6	2010-1511-000	19505	
J6 Thru J10	Same as J5				
J11	Connector, Receptacle	2	65610-120	22526	
J12	Same as J4				
J13	Same as J11				
J14	Terminal Strip	1	65500-103	22526	
P1	Connector, Plug	1	65474-001	22526	
Q1	Transistor	2	2N2102	80131	
Q2	Same as Q1				
Q3	Transistor	4	2N3440	80131	
Q4	Same as Q3				
Q5	Transistor	2	2N3904	80131	
Q6	Same as Q3				
Q7	Same as Q3				
Q8	Same as Q5				
RA1	Heatsink	3	6106B-14	13103	
RA2	Same as RA1				
RA3	Same as RA1				
RA4	Heatsink	2	2225B	13103	
RA5	Same as RA4				
R1	Resistor, Variable, Compound: 500 kΩ, 10%, 1 W	1	72M1N048S504U	01121	
R2	Resistor, Variable, Compound: 2.5 MΩ, 10%, 1 W	1	72M1N048S255U	01121	
R3	Resistor, Variable, Compound: 100 kΩ, 10%, 1 W	2	70M1N132S104U	01221	

Courtesy of http://BlackRadios.terryo.org

REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
R4	Same as R3				
R5	Resistor, Fixed, Film: 22 kΩ, 5%, 1/4 W	12	CF1/4-22K/J	09021	
R6 Thru R8	Same as R5				
R9	Resistor, Fixed, Film: 4.7Ω, 5%, 1/4 W	4	BW1/4F 4.7OHM	56637	
R10	Same as R9				
R11	Resistor, Fixed, Film: 10 kΩ, 5%, 1/4 W	17	CF1/4-10K/J	09021	
R12	Resistor, Fixed, Film: 47 kΩ, 5%, 1/4 W	4	CF1/4-47K/J	09021	
R13	Same as R12				
R14	Same as R11				
R15	Resistor, Fixed, Compound: 22 MΩ, 5%, 1/2 W	2	RCR20G226JS	81349	
R16	Same as R15				
R17	Resistor, Fixed, Film: 100 kΩ, 5%, 1/4 W	7	CF1/4-100K/J	09021	
R18*	Resistor, Fixed, Film: 330 kΩ, 5%, 1/4 W	1	CF1/4-330K/J	09021	
R19	Resistor, Fixed, Compound: 1.8 MΩ, 5%, 1/2 W	1	RCR20G185JS	81349	
R20	Resistor, Fixed, Compound: 3.9 MΩ, 5%, 1/2 W	1	RCR20G395JS	81349	
R21	Resistor, Fixed, Compound: 4.7 MΩ, 5%, 1/2 W	1	RCR20G475J2	81349	
R22	Resistor, Fixed, Film: 200 kΩ, 5%, 1/4 W	1	CF1/4-200K/J	09021	
R23	Resistor, Fixed, Film: 12 kΩ, 5%, 1/4 W	1	CF1/4-12K/J	09021	
R24	Resistor, Variable, Film: 200 kΩ, 10%, 1/2 W	6	62PAR200K	73138	
R25	Same as R24				
R26	Resistor, Fixed, Film: 200Ω, 5%, 1/4 W	3	CF1/4-200 OHMS/J	09021	
R27	Same as R26				
R28	Same as R26				
R29	Resistor, Variable, Film: 2 kΩ, 10%, 1/2 W	3	62PAR2K	73138	
R30	Same as R29				
R31 Thru R33	Same as R11				
R34	Resistor, Variable, Film: 20 kΩ, 10%, 1/2 W	3	62PAR20K	73138	
R35	Same as R34				
R36	Same as R11				
R37	Same as R5				
R38	Same as R5				
R39	Same as R11				
R40	Same as R24				
R41	Resistor, Fixed, Film: 100Ω, 5%, 1/4 W	4	CF1/4-100 OHMS/J	09021	
R42	Same as R5				
R43	Same as R5				
R44	Same as R11				
*	Nominal value, final value factory selected.				

Courtesy of http://BlackRadios.terryo.org

REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
R45	Same as R24				
R46	Same as R41				
R47	Same as R17				
R48	Same as R17				
R49	Same as R11				
R50 Thru R52	Same as R17				
R53	Same as R41				
R54	Same as R41				
R55	Same as R17				
R56	Same as R5				
R57	Same as R5				
R58	Resistor, Fixed, Film: 430Ω, 5%, 1/4 W	1	CF1/4-430 OHMS/J	09021	
R59	Same as R5				
R60	Same as R5				
R61	Same as R34				
R62	Resistor, Fixed, Film: 330Ω, 5%, 1/4 W	2	CF1/4-330 OHMS/J	09021	
R63	Resistor, Fixed, Film: 2.7 kΩ, 5%, 1/4 W	2	CF1/4-2.7K/J	09021	
R64	Same as R11				
R65	Resistor, Fixed, Film: 2.4 kΩ, 5%, 1/4 W	2	CF1/4-2.4K/J	09021	
R66	Same as R62				
R67	Same as R63				
R68	Same as R11				
R69	Same as R65				
R70	Same as R9				
R71	Same as R9				
R72	Resistor, Fixed, Film: 178 kΩ, 1%, 1/10 W	4	RN55C1783F	81349	
R73	Same as R12				
R74	Same as R72				
R75	Same as R24				
R76	Resistor, Fixed, Film: 5.62 kΩ, 1%, 1/10 W	2	RN55C5621F	81349	
R77	Same as R76				
R78	Same as R11				
R79	Resistor, Fixed, Film: 7.5 kΩ, 5%, 1/4 W	2	CF1/4-7.5K/J	09021	
R80	Resistor, Fixed, Film: 4.7 kΩ, 5%, 1/4 W	2	CF1/4-4.7K/J	09021	
R81	Same as R11				
R82	Resistor, Fixed, Film: 3.9 kΩ, 5%, 1/4 W	2	CF1/4-3.9K/J	09021	
R83	Same as R72				
R84	Same as R12				
R85	Same as R72				

Courtesy of http://BlackRadios.terryo.org

REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
R86	Same as R24				
R87	Resistor, Fixed, Film: 2.05 kΩ, 1%, 1/10 W	2	RN55C2051F	81349	
R88	Same as R87				
R89	Same as R11				
R90	Resistor, Fixed, Film: 8.2 kΩ, 5%, 1/4 W	2	CF1/4-8.2K/J	09021	
R91	Same as R80				
R92	Same as R11				
R93	Same as R82				
R94	Resistor, Fixed, Compound: 10Ω, 5%, 1/2 W	1	RCR20G100JS	81349	
R95	Same as R29				
R96	Same as R11				
R97	Same as R11				
R98	Resistor, Fixed, Compound: 1.0Ω, 5%, 1/2 W	1	EB10G5	01121	
R99	Resistor, Fixed, Film: 1.0 kΩ, 5%, 1/4 W	2	CF1/4-1K/J	09021	
R100	Same as R90				
R101	Same as R79				
R102	Resistor, Fixed, Film: 15 kΩ, 5%, 1/4 W	1	CF1/4-15K/J	09021	
R103	Same as R99				
S1	Switch, Dip	3	76SB10	81073	
S2	Same as S1				
S3	Same as S1				
T1	Transformer	1	170542-1	14632	
U1	Isolator	1	4N38A	80131	
U2	Integrated Circuit	1	DG201ABK	17856	
U3	Integrated Circuit	1	DG202BK	17856	
U4	Integrated Circuit	4	CA082E	02735	
U5 Thru U7	Same as U4				
U8	Diode	3	TND903	56289	
U9	Same as U8				
U10	Same as U8				
U11	Voltage Regulator	1	LM340T-5.0	27014	
U12	Voltage Regulator	1	LM340T-15	27014	
U13	Voltage Regulator	1	LM320T-15	27014	
VR1	Diode Zener: 68 V	1	1N5266A	80131	
VR2	Diode Zener: 5.6 V	1	1N752A	80131	
XU4	Socket, Integrated Circuit	4	ICN-083-S3-T	06776	
XU5 Thru XU7	Same as XU4				

Courtesy of http://BlackRadios.terryo.org

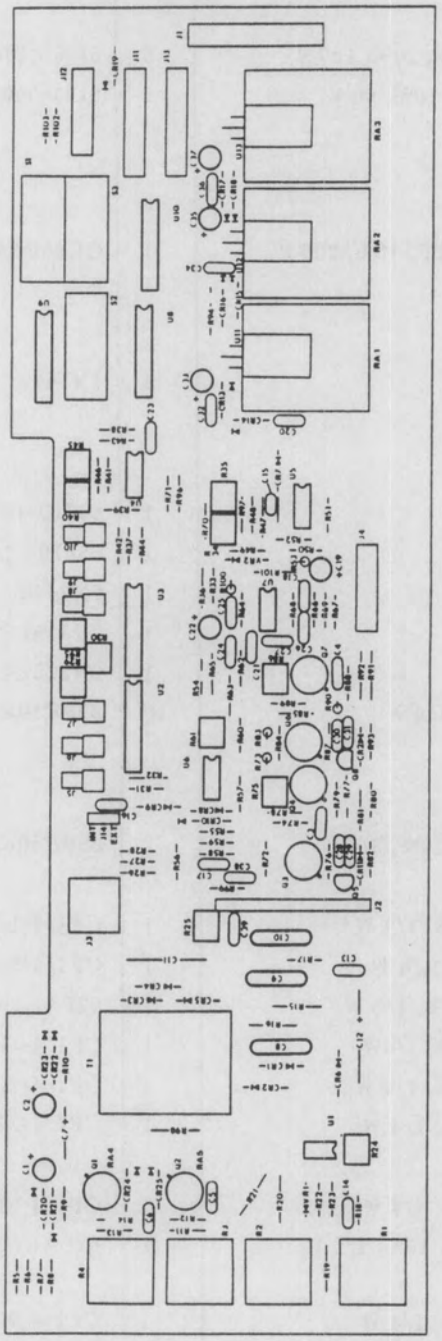


Figure 5-4. Type 794546-1 HI-Voltage and Deflection Amplifier (A1), Location of Components

Courtesy of http://BlackRadios.terryo.org

5.5.2 TYPE 794547-1 SWEEP GENERATOR REF DESIG PREFIX A2

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
C1	Capacitor, Electrolytic, Aluminum: 33 µF, 10%, 25 V	2	ECE-A1EK330	54473	
C2	Same as C1				
C3	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 100 V	6	8131M100-651-104M	59660	
C4	Capacitor, Ceramic, Disc: 1 µF, 10%, 50 V	2	8141-050-X7R0-105K	59660	
C5	Same as C4				
C6	Not Used				
C7	Same as C3				
C8	Capacitor, Ceramic, Disc: 1000 pF, 10%, 200 V	1	CK05BX102K	81349	
C9 Thru C12	Same as C3				
CR1	Diode	6	1N4449	80131	
CR2 Thru CR6	Same as CR1				
J1	Connector, Receptacle	1	65610-140	22526	
J2	Connector, Receptacle	1	65610-116	22526	
Q1	Transistor	1	2N2646	80131	
Q2	Transistor	1	2N3251	80131	
Q3	Transistor	1	2N2222A	80131	
R1	Resistor, Variable: 10 kΩ, 10%, 3/4 W	10	89PR10K	73138	
R2 Thru R10	Same as R1				
R11	Resistor, Variable, Film: 50 kΩ, 10%, 3/4 W	2	89PR50K	73138	
R12	Same as R11				
R13	Resistor, Fixed, Film: 1.5 kΩ, 5%, 1/4 W	1	CF1/4-1.5K/J	09021	
R14	Resistor, Fixed, Film: 680Ω, 5%, 1/4 W	1	CF1/4-680 OHMS/J	09021	
R15	Resistor, Variable, Film: 1 kΩ, 5%, 1/2 W	2	62PAR1K	73138	
R16	Resistor, Fixed, Film: 1.0 kΩ, 5%, 1/4W	1	CF1/4-1K/J	09021	
R17	Resistor, Fixed, Film: 2.2 kΩ, 5%, 1/4 W	3	CF1/4-2.2K/J	09021	
R18	Resistor, Fixed, Film: 22 kΩ, 5%, 1/4 W	1	CF1/4-22K/J	09021	
R19	Same as R15				
R20	Resistor, Fixed, Film: 51 kΩ, 5%, 1/4 W	4	CF1/4-51K/J	09021	
R21	Resistor, Variable, Film: 100 kΩ, 10%, 1/2 W	1	62PAR100K	73138	
R22	Same as R20				
R23	Resistor, Fixed, Film: 20 kΩ, 5%, 1/4 W	1	CF1/4-20K/J	09021	
R24	Resistor, Variable, Film: 2 kΩ, 10%, 1/2 W	1	62PAR2K	73138	
R25	Resistor, Fixed, Film: 8.2 kΩ, 5%, 1/4 W	1	CF1/4-8.2K/J	09021	
R26	Resistor, Fixed, Film: 22Ω, 5%, 1/4 W	1	CF1/4-11 OHMS/J	09021	
R27	Resistor, Fixed, Film: 22 kΩ, 5%, 1/4 W	1	CF1/4-22K/J	09021	
R28	Resistor, Fixed, Film: 10 kΩ, 5%, 1/4 W	2	CF1/4-10K/J	09021	

Courtesy of http://BlackRadios.terryo.org

REF DESIG PREFIX A2

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
R29	Same as R28				
R30	Resistor, Fixed, Film: 27 kΩ, 5%, 1/4 W	1	CF1/4-17K/J	09021	
R31	Resistor, Fixed, Film: 1 MΩ, 5%, 1/4 W	1	CF1/4-1MEG/J	09021	
R32	Resistor, Fixed, Film: 1.3 kΩ, 5%, 1/4 W	1	CF1/4-1.3K/J	09021	
R33	Resistor, Fixed, Film: 110 kΩ, 5%, 1/4 W	1	CF1/4-110K/J	09021	
R34	Resistor, Fixed, Film: 300Ω, 5%, 1/4 W	1	CF1/4-300 OHMS/J	09021	
R35	Same as R17				
R36	Resistor, Fixed, Film: 100 kΩ, 5%, 1/4 W	2	CF1/4-100K/J	09021	
R37	Same as R20				
R38	Same as R20				
R39	Same as R36				
R40	Same as R17				
R41	Resistor, Fixed, Film: 6.8 kΩ, 55, 1/4 W	1	CF1/4-6.8K/J	09021	
R42	Resistor, Fixed, Film: 47 kΩ, 5%, 1/4 W	1	CF1/4-47K/J	09021	
RT1	Thermistor	1	2D102	50157	
U1	Integrated Circuit	1	DG303ACJ	17856	
U2	Integrated Circuit	2	CA082E	02735	
U3	Same as U2				
VR1	Diode Zener: 5.6 V	1	1N752A	80131	
VR2	Diode Zener: 8.2 V	1	1N756A	80131	

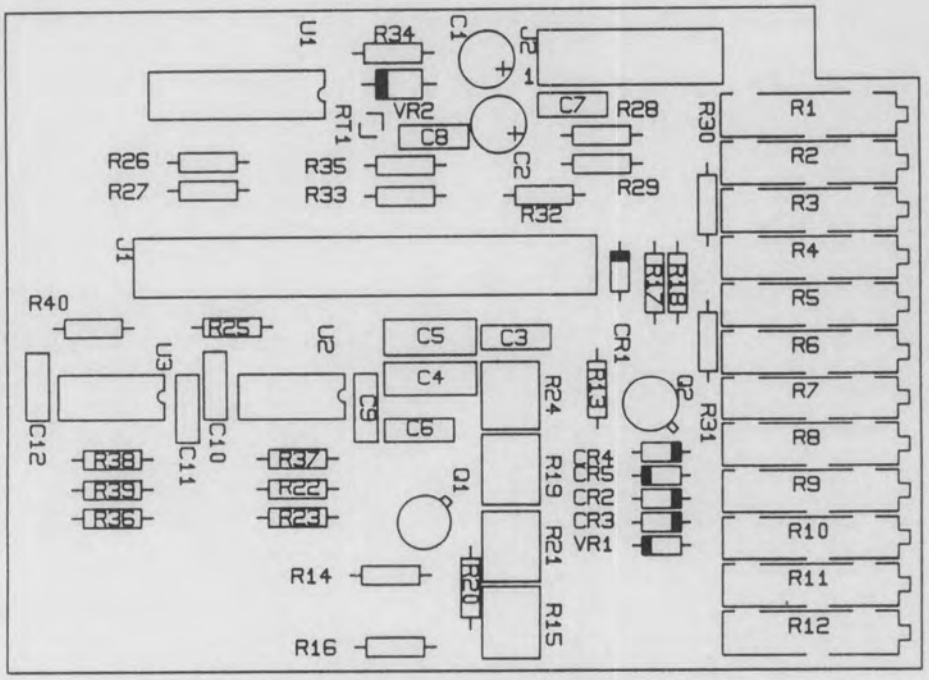


Figure 5-5. Type 794547-1 Sweep Generator (A2)
Location of Components

Courtesy of http://BlackRadios.terryo.org

5.5.3 TYPE 271134-1 LED FLEXIBLE BOARD REF DESIG PREFIX A3

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
DS1 Thru DS3	Indicator, LED Tri-Light (Red, Yellow, Green)	1	L-112-ADC	51628	
P1	Connector, PC Board	1	76314-103	22526	

Courtesy of http://BlackRadios.terryo.org

5.5.4 **TYPE 794535-1 CONVERTER** REF DESIG PREFIX A4

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
A1	Input, Filter/Converter	1	371484-1	14632	
A2	Sweep/Marker, Oscillator	1	371485-1	14632	
A3	Not Used				
A4	Output Amplifier	1	15801-5	14632	
A5	Interface	1	371487-1	14632	
C1	Capacitor, Ceramic, Feedthru: 0.015 µF, GMV, 50 V	18	9900-153	33095	
C2	Same as C1				
C3	Same as C1				
C4	Capacitor, Ceramic, Feedthru: 100 pF, GMV, 50 V	5	SCI9900-101	33095	
C5	Same as C4				
C6 Thru C15	Same as C1				
C16 Thru C19	Not Used				
C20 Thru C24	Same as C1				
C25 Thru C27	Same as C4				
J1	Connector, Receptacle, SMB	1	2012-7511-000	19505	
R1	Resistor, Fixed, Film: 2.7Ω, 5%, 1/4 W	3	CF1/4-2.7 OHMS/J	09021	
R2	Same as R1				
R3	Same as R1				

Courtesy of http://BlackRadios.terryo.org

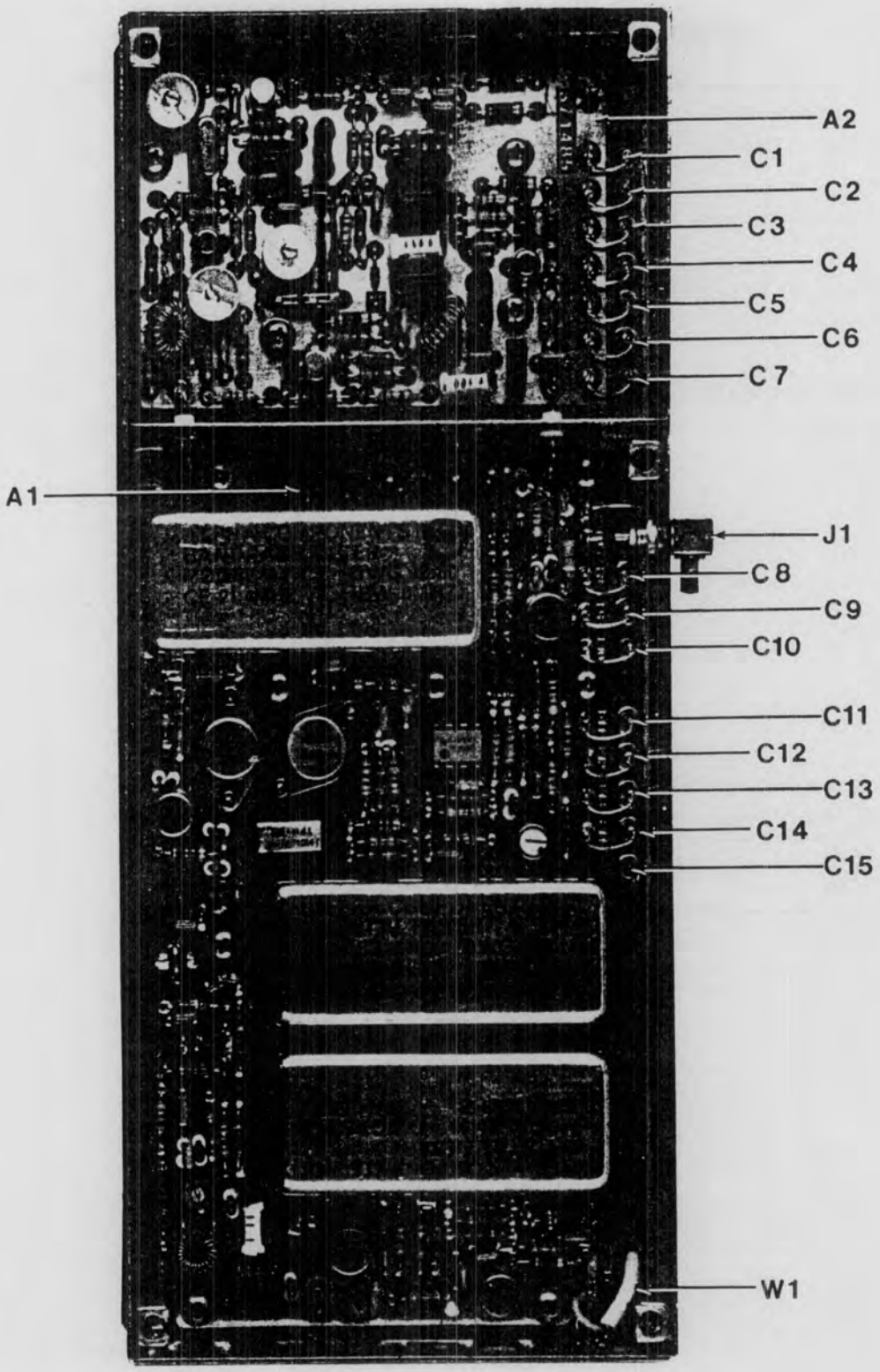


Figure 5-6. Type 794535-1 Converter (A4), Top View, Location of Components

Courtesy of http://BlackRadios.terryo.org

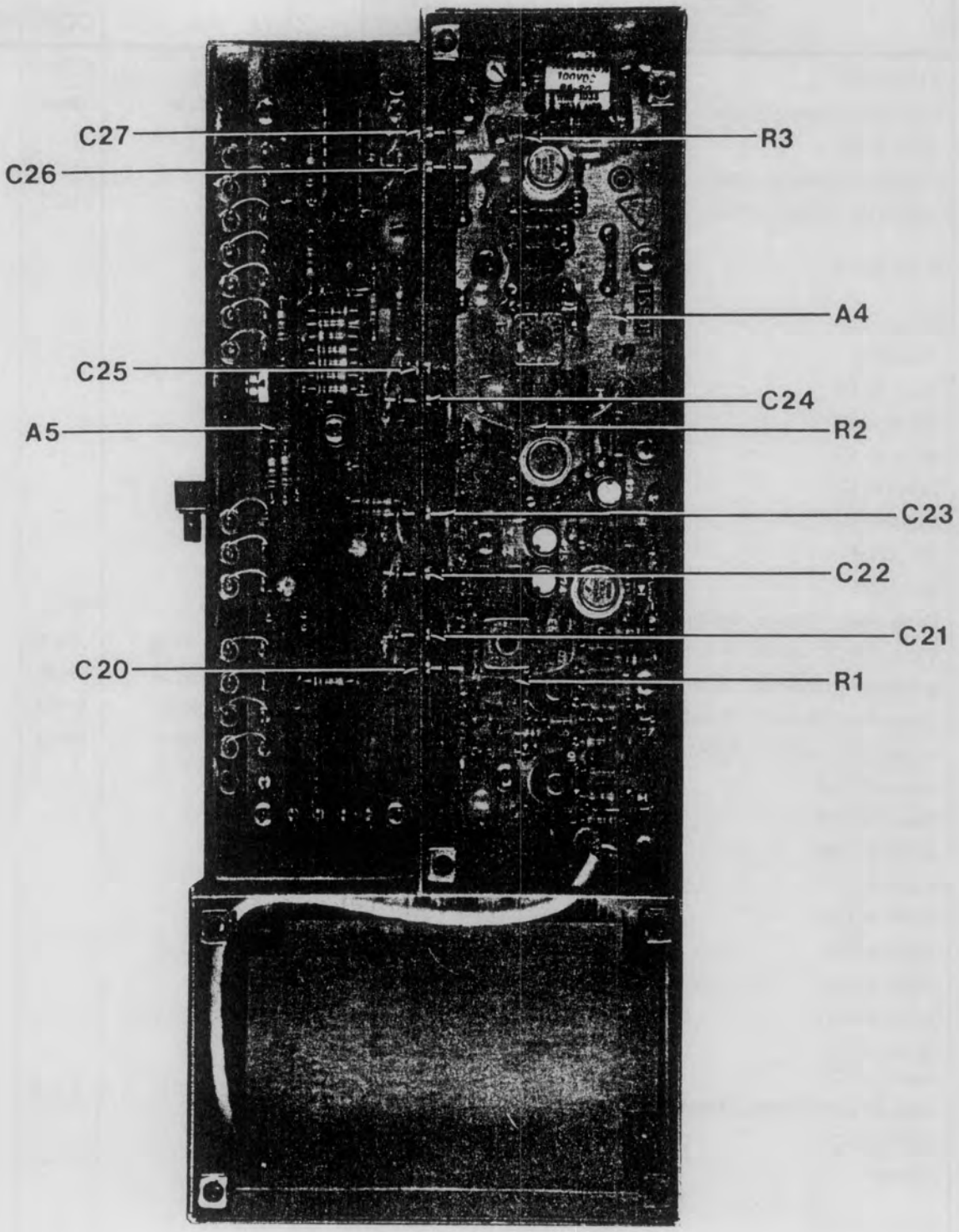


Figure 5-7. Type 794535-1 Converter (A4), Bottom View, Location of Components

Courtesy of http://BlackRadios.terryo.org

5.5.4.1 Type 371484-1 Input Filter/Converter REF DESIG PREFIX A4A1

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
AT1	Attenuator	1	9955-1050	84048	
C1	Capacitor, Ceramic, Disc: 4700 pF, 20%, 50 V	6	8121-050-651-472M	59660	
C2	Same as C1				
C3	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	6	34452-1	14632	
C4	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	8	34453-1	14632	
C5 Thru C8	Same as C1				
C9	Same as C4				
C10	Not Used				
C11	Same as C4				
C12	Same as C3				
C13	Same as C3				
C14	Same as C4				
C15	Same as C4				
C16	Not Used				
C17	Not Used				
C18	Capacitor, Variable, Ceramic: 5-25 pF, 100 V	2	518-000A5-25	59660	
C19	Capacitor, Ceramic, Monolithic: 220 pF, 5%, 100 V	2	8121-100-C0G0-221J	59660	
C20	Capacitor, Ceramic, Disc: 100 pF, 5%, 100 V	2	8121-100-C0G0-101J	59660	
C21	Capacitor, Ceramic, Monolithic: 2400 pF, ±2%, 100 V	2	200-100-NPO-242G	51642	
C22	Capacitor, Ceramic, Tubular: 1.5 pF, ±.25 pF, 500 V	1	301-000C0K0-159C	59660	
C23	Same as C18				
C24	Same as C19				
C25	Same as C20				
C26	Same as C21				
C27	Same as C4				
C28	Same as C3				
C29	Same as C4				
C30	Same as C4				
C31	Same as C3				
C32	Same as C3				
C33	Capacitor, Ceramic, Monolithic: 150 pF, ±2%, 100 V	2	150-100-NPO-151G	51642	
C34	Same as C33				
CR1	Diode	5	1N4449	80131	
CR2 Thru CR5	Same as CR1				
E1	Terminal, Forked	15	140-1941-02-01	71279	
E2 Thru E15	Same as E1				
FL1	Filter, Bandpass	1	92450	14632	

Courtesy of http://BlackRadios.terryo.org

REF DESIG PREFIX A4A1

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
FL3	Filter, Bandpass	1	92451-2	14632	
JW1	Wire, Electrolytic, Buss		8022 24AWG Busswire	70903	
JW2	Same as JW1				
K1	Relay	2	712-5	11532	
K2	Same as K1				
L1	Coil, Fixed, Molded	1	1025-50	99800	
L2	Coil, Fixed, Molded	2	1025-36	99800	
L3	Same as L2				
L4	Not Used				
L5	Coil, Fixed, Molded	2	1025-54	99800	
L6	Not Used				
L7	Not Used				
L8	Coil, Mounted	1	271423-29	14632	
L9	Coil, Mounted	1	271423-30	14632	
L10	Same as L5				
L11	Coil, Fixed	1	1025-10	99800	
R1	Resistor, Fixed, Film: 10 kΩ, 5%, 1/4 W	3	CF1/4-10K/J	09021	
R2	Resistor, Fixed, Film: 22Ω, 5%, 1/4 W	2	CF1/4-22 OHMS/J	09021	
R3	Resistor, Fixed, Film: 18Ω, 5%, 1/4 W	1	CF1/4-18 OHMS/J	09021	
R4	Resistor, Fixed, Film: 300Ω, 5%, 1/4 W	2	CF1/4-300 OHMS/J	09021	
R5	Same as R4				
R6	Resistor, Fixed, Film: 1.1 kΩ, 5%, 1/4 W	1	CF1/4-1.1K/J	09021	
R7	Resistor, Fixed, Film: 82.5Ω, 1%, 1/10 W	2	RN55C82R5F	81349	
R8	Resistor, Fixed, Film: 143Ω, 1%, 1/10 W	2	RN55C1430F	81349	
R9	Same as R7				
R10	Same as R8				
R11	Resistor, Fixed, Film: 12Ω, 5%, 1/4 W	3	CF1/4-12 OHMS/J	09021	
R12	Resistor, Fixed, Film: 430Ω, 5%, 1/4 W	6	CF1/4-430 OHMS/J	09021	
R13	Same as R12				
R14	Resistor, Fixed, Film: 24Ω, 5%, 1/4 W	2	CF1/4-24 OHMS/J	09021	
R15	Resistor, Fixed, Film: 220Ω, 5%, 1/4 W	4	CF1/4-220 OHMS/J	09021	
R16	Same as R15				
R17	Resistor, Fixed, Film: 2.2 kΩ 5%, 1/4 W	2	CF1/4-2.2K/J	09021	
R18	Same as R14				
R19	Same as R15				
R20	Same as R15				
R21	Resistor, Fixed, Film: 390Ω, 5%, 1/4 W	1	CF1/4-390 OHMS/J	09021	
R22	Not Used				
R23	Resistor, Fixed, Film: 5.6Ω, 5%, 1/4 W	2	CF1/4-5.6 OHMS/J	09021	
R24	Resistor, Fixed, Film: 910Ω, 5%, 1/4 W	2	CF1/4-910 OHMS/J	09021	
R25	Same as R24				

Courtesy of http://BlackRadios.terryo.org

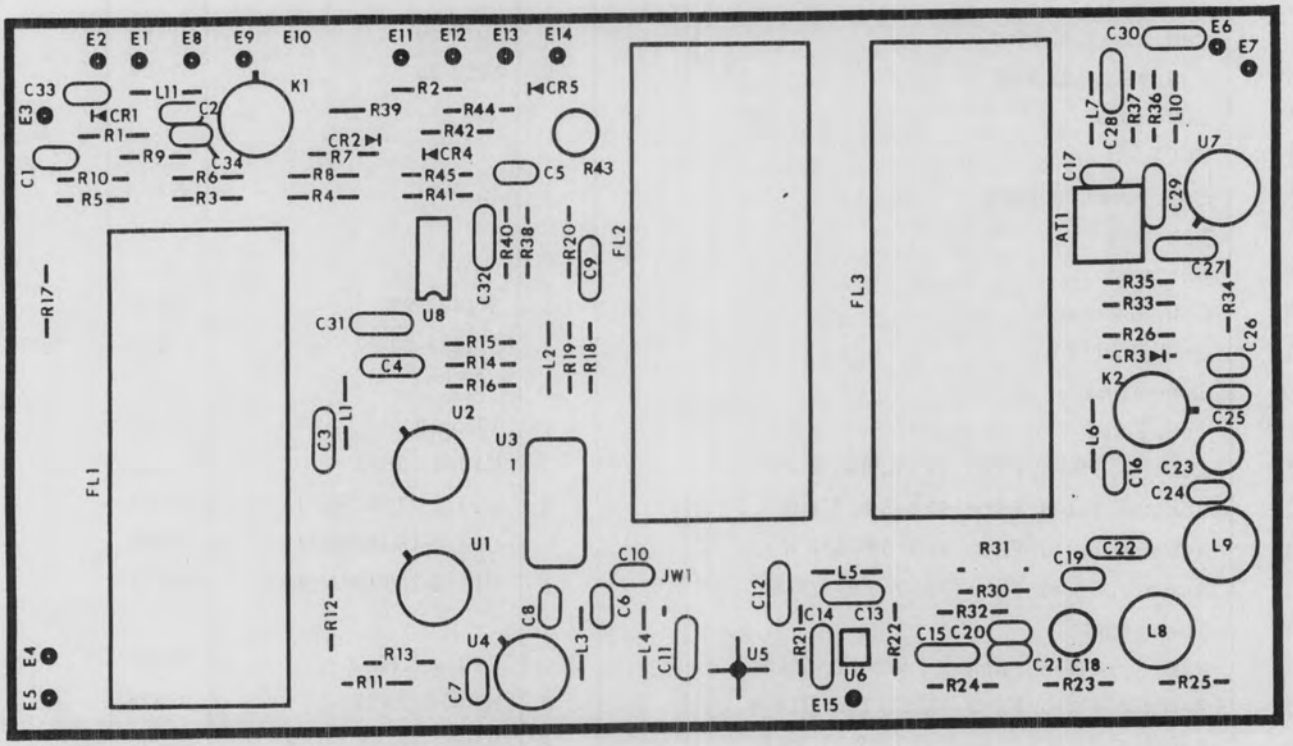


Figure 5-8. Type 371484-1 Input Filter/Converter (A4A1), Location of Components

Courtesy of http://BlackRadios.terryo.org

REF DESIG PREFIX A4A1

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
R26	Same as R2				
R27 Thru R29	Not Used				
R30	Same as R11				
R31	Same as R12				
R32	Same as R12				
R33	Same as R11				
R34	Same as R12				
R35	Same as R12				
R36	Same as R23				
R37	Resistor, Fixed, Film: 91Ω, 5%, 1/4 W	1	CF1/4-91 OHMS/J	09021	
R38	Same as R1				
R39	Same as R1				
R40	Resistor, Fixed, Film: 18 kΩ, 5%, 1/4 W	1	CF1/4-18K/J	09021	
R41	Resistor, Fixed, Film: 22 kΩ, 5%, 1/4 W	1	CF1/4-22K/J	09021	
R42	Resistor, Fixed, Film: 5.6 kΩ, 5%, 1/4 W	1	CF1/4-5.6K/J	09021	
R43	Resistor, Variable, Film: 50 kΩ, 10%, 1/2 W	1	62PR50K	73138	
R44	Same as R17				
R45	Resistor, Fixed, Film: 100 kΩ, 5%, 1/4 W	1	CF1/4-100K/J	09021	
U1	Attenuator	1	TG9001	60979	
U2	Amplifier	1	A87-1	14482	
U3	Mixer, Doubled, Balanced	1	TFM-2H	15542	
U4	Amplifier RF	1	MWA130	04713	
U5	Amplifier	1	MAR-1	15542	
U6	Not Used				
U7	Amplifier, RF	1	MWA120	04713	
U8	Integrated Circuit	1	CA082E	02735	
XU8	Socket, Integrated Circuit	1	ICN-083-S3-T	06776	

Courtesy of http://BlackRadios.terryo.org

5.5.4.2 **Type 371485-1 Sweep/Marker Oscillator** REF DESIG PREFIX A4A2

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
C1	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	16	34453-1	14632	
C2	Same as C1				
C3	Capacitor, Mica, Dipped: 22 pF, 5%, 500 V	2	CM05ED220J03	81349	
C4	Same as C3				
C5	Capacitor, Ceramic, Tubular: 12 pF, 5%, 500 V	1	301-000C0G0-120J	59660	
C6	Same as C1				
C7	Capacitor, Mica, Dipped: 91 pF, 2%, 500 V	1	CM05FD910G03	81349	
C8	Capacitor, Mica, Dipped: 430 pF, 5%, 500 V	2	DM15-431J	72136	
C9 Thru C12	Same as C1				
C13	Capacitor, Ceramic, Tubular: 10 pF, ±0.5 pF, 500 V	1	301-000C0H0-100D	59660	
C14	Capacitor, Variable, Ceramic: 2-8 pF, 350 V	2	538-011A2-8	59660	
C15	Samke as C1				
C16	Capacitor, Variable, Ceramic: 5.5-18 pF, 350 V	1	538-011A5.5-18	59660	
C17 Thru C20	Same as C1				
C21	Capacitor, Ceramic, Monolithic: 8.2 pF, ±0.5 pF, 100 V	1	8101-100-C0H0-829D	59660	
C22	Capacitor, Electrolytic, Tantalum: 47 µF, 20%, 20 V	1	MMJ-020-476R-20	17554	
C23 Thru C25	Same as C1				
C26	Same as C14				
C27	Capacitor, Ceramic, Disc: 33 pF, 5%, 100 V	1	8121-100-C0G0-330J	59660	
C28	Capacitor, Mica, Dipped: 47 pF, 2%, 500 V	1	CM05ED470G03	81349	
C29	Same as C8				
C30	Same as C1				
CR1	Diode, Varicap	1	KV3901	52673	
CR2	Diode	1	5082-3188	28480	
CR3	Not Used				
E1	Terminal, Forked	9	140-1941-02-01	71279	
E2 Thru E9	Same as E1				
L1	Coil, Toroidal	1	20681-302	14632	
L2	Inductor	2	1131-41	14632	
L3	Same as L2				
L4	Coil, Fixed	5	1025-50	99800	
L5 Thru L8	Same as L4				
L9	Coil, Fixed	2	1025-56	99800	
L10	Same as L9				

Courtesy of http://BlackRadios.terryo.org

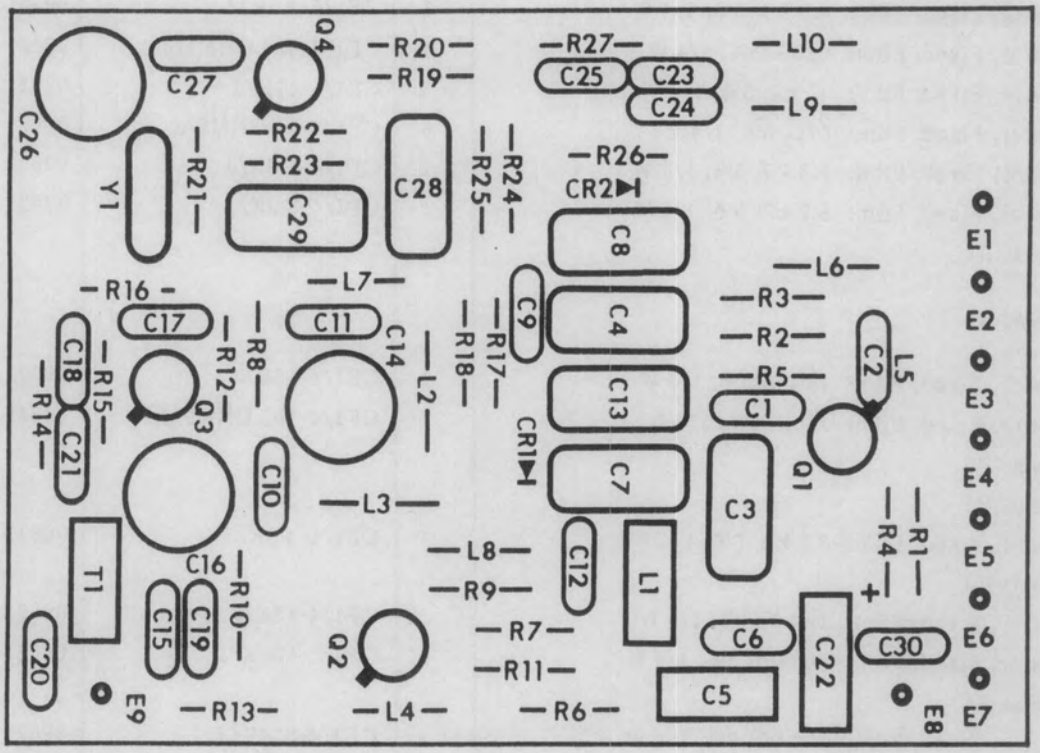


Figure 5-9. Type 371485-1 Sweep/Marker Oscillator (A4A2), Location of Components

Courtesy of http://BlackRadios.terryo.org

REF DESIG PREFIX A4A2

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
Q1	Transistor	2	2N2857/JAN	811350	
Q2	Transistor	2	2N3478	80131	
Q3	Same as Q1				
Q4	Same as Q2				
R1	Resistor, Fixed, Film: 20Ω, 5%, 1/4 W	2	CF1/4-20 OHMS/J	09021	
R2	Resistor, Fixed, Film: 4.3 kΩ, 5%, 1/4 W	1	CF1/4-4.3K/J	09021	
R3	Resistor, Fixed, Film: 620Ω, 5%, 1/4 W	1	CF1/4-620 OHMS/J	09021	
R4	Resistor, Fixed, Film: 47 kΩ, 5%, 1/4 W	3	CF1/4-47K/J	09021	
R5	Resistor, Fixed, Film: 51Ω, 5%, 1/4 W	6	CF1/4-51 OHMS/J	09021	
R6	Resistor, Fixed, Film: 1.8 kΩ, 5%, 1/4 W	1	CF1/4-1.8K/J	09021	
R7	Resistor, Fixed, Film: 8.2 kΩ, 5%, 1/4 W	1	CF1/4-8.2K/J	09021	
R8	Same as R4				
R9 Thru R11	Same as R5				
R12	Resistor, Fixed, Film: 15 kΩ, 5%, 1/4 W	1	CF1/4-15K/J	09021	
R13	Resistor, Fixed, Film: 100Ω, 5%, 1/4 W	1	CF1/4-100 OHMS/J	09021	
R14	Same as R5				
R15	Same as R1				
R16	Resistor, Fixed, Film: 3.3 kΩ, 5%, 1/4 W	4	CF1/4-3.3K/J	09021	
R17	Same as R4				
R18	Resistor, Fixed, Film: 18 kΩ, 5%, 1/4 W	1	CF1/4-18K/J	09021	
R19	Resistor, Fixed, Film: 100 kΩ, 5%, 1/4 W	1	CF1/4-100K/J	09021	
R20	Same as R5				
R21	Resistor, Fixed, Film: 330 kΩ, 5%, 1/4 W	1	CF1/4-330K/J	09021	
R22	Resistor, Fixed, Film: 220Ω, 5%, 1/4 W	1	CF1/4-220 OHMS/J	09021	
R23	Same as R16				
R24	Same as R16				
R25	Resistor, Fixed, Film: 510Ω, 5%, 1/4 W	1	CF1/4-510 OHMS/J	09021	
R26	Resistor, Fixed, Film: 4.7Ω, 5%, 1/4 W	1	CF1/4-4.7 OHMS/J	09021	
R27	Same as R16				
T1	Transformer, Toroidal	1	21428-62	14632	
Y1	Crystal, Quartz: 21.400 MHz	1	96402-1	14632	

Courtesy of http://BlackRadios.terryo.org

5.5.4.3 Type 15801-5 Output Amplifier REF DESIG PREFIX A4A4

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
C1	Capacitor, Electrolytic, Tantalum: 27 µF, 10%, 35 V	4	196D276X9035TE4	56289	
C2	Capacitor, Mica, Dipped: 470 pF, 5%, 500 V	1	DM15-471J	72136	
C3	Capacitor, Ceramic, Disc: 1000 pF, GMV, 500 V	5	59Z5U102P	91984	
C4	Capacitor, Ceramic, Disc: 5000 pF, 20%, 100 V	4	C023B101E502M	56289	
C5 Thru C7	Same as C3				
C8	Same as C4				
C9	Capacitor, Mica, Dipped: 56 pF, 2%, 500 V	1	CM05ED560G03	81349	
C10	Capacitor, Mica, Dipped: 270 pF, 2%, 500 V	1	CM05FD271G03	81349	
C11	Same as C4				
C12	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 100 V	4	8131M100-651-104M	59660	
C13	Same as C12				
C14	Same as C12				
C15	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 200 V	3	8131A200Z5U103M	59660	
C16	Same as C1				
C17	Same as C12				
C18	Same as C15				
C19	Same as C1				
C20	Same as C15				
C21	Capacitor, Mica, Dipped: 33 pF, 2%, 500 V	1	CM05ED330G03	81349	
C22	Capacitor, Mica, Dipped: 24 pF, 5%, 500 V	1	CM05ED240J03	81349	
C23	Same as C3				
C24	Same as C4				
C25	Capacitor, Mica, Dipped: 15 pF, 5%, 500 V	1	CM05CD150J03	81349	
C26	Same as C1				
C27	Capacitor, Fixed, Plastic: 3300 pF, 10%, 100 V	1	WMF1D33	14655	
C28	Capacitor, Plastic, Tubular: 0.022 µF, 5%, 100 V	1	663UW223-5-1W	84411	
CR1	Diode	5	1N462A	80131	
CR2 Thru CR5	Same as CR1				
CR6	Diode	2	1N4449	80131	
CR7	Same as CR6				
CR8	Diode	2	5082-2800	28480	
CR9	Same as CR8				
E1	Terminal, Forked	9	140-1941-02-01	71279	
E2 Thru E9	Same as E1				
L1	Coil, Variable	1	558-7107-23	71279	
L2	Coil, Variable	1	558-7107-24	71279	
Q1	Transistor	2	841001-1	14632	

Courtesy of http://BlackRadios.terryo.org

REF DESIG PREFIX A4A4

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
Q2	Same as Q1				
R1	Resistor, Fixed, Film: 1.2 kΩ, 5%, 1/4 W	2	CF1/4-1.2K/J	09021	
R2	Resistor, Fixed, Film: 120 kΩ, 5%, 1/4 W	2	CF1/4-120K/J	09021	
R3	Resistor, Fixed, Film: 33 kΩ, 5%, 1/4 W	2	CF1/4-33K/J	09021	
R4	Resistor, Fixed, Film: 4.7 kΩ, 5%, 1/4 W	5	CF1/4-4.7K/J	09021	
R5	Resistor, Fixed, Film: 100 kΩ, 5%, 1/4 W	5	CF1/4-100K/J	09021	
R6	Resistor, Fixed, Film: 10 kΩ, 5%, 1/4 W	6	CF1/4-10K/J	09021	
R7	Resistor, Fixed, Film: 10Ω, 5%, 1/4 W	2	CF1/4-10 OHMS/J	09021	
R8	Resistor, Fixed, Film: 620Ω, 5%, 1/4 W	1	CF1/4-620 OHMS/J	09021	
R9	Resistor, Fixed, Film: 330Ω, 5%, 1/4 W	2	CF1/4-330 OHMS/J	09021	
R10	Same as R7				
R11	Same as R2				
R12	Same as R6				
R13	Resistor, Fixed, Film: 68 kΩ, 5%, 1/4 W	1	CF1/4-68K/J	09021	
R14	Same as R3				
R15	Same as R4				
R16	Resistor, Fixed, Film: 100Ω, 5%, 1/4 W	3	CF1/4-100 OHMS/J	09021	
R17	Same as R9				
R18	Resistor, Fixed, Film: 2.7 kΩ, 5%, 1/4 W	2	CFk1/4-2.7K/J	09021	
R19	Same as R16				
R20	Resistor, Fixed, Film: 47Ω, 5%, 1/4 W	3	CF1/4-47 OHMS	09021	
R21	Same as R6				
R22	Resistor, Fixed, Film: 6.2 kΩ, 5%, 1/4 W	1	CF1/4-6.2K/J	09021	
R23	Same as R18				
R24	Resistor, Variable, Film: 500Ω, 10%, 1/2 W	2	62PR500	73138	
R25	Same as R24				
R26	Same as R20				
R27	Same as R1				
R28	Resistor, Variable, Film: 50 kΩ, 10%, 1/2 W	1	62PR50K	73138	
R29	Resistor, Fixed, Film: 1.0 MΩ, 5%, 1/4 W	2	CF1/4-1M/J	09021	
R30	Resistor, Fixed, Film: 2.7Ω, 5%, 1/4 W	3	CF1/4-2.7 OHMS/J	09021	
R31	Same as R6				
R32	Same as R16				
R33	Resistor, Fixed, Compound: 5.1 kΩ, 5%, 1/4 W	3	RCR07G512JS	81349	
R34	Same as R6				
R35	Same as R33				
R36	Same as R20				
R37	Same as R5				
R38	Same as R30				
R39	Same as R29				
R40	Same as R6				

Courtesy of http://BlackRadios.terryo.org

REF DESIG PREFIX A4A4

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
R41	Same as R5				
R42	Same as R5				
R43	Same as R30				
R44	Same as R5				
R45	Same as R33				
R46	Resistor, Fixed, Film: 560Ω, 5%, 1/4 W	1	CF1/4-560 OHMS/J	09021	
R47	Resistor, Fixed, Film: 5 kΩ, 10%, 1/2 W	1	62PR5K	73138	
R48	Resistor, Fixed, Film: 1.8 kΩ, 5%, 1/4 W	1	CF1/4-1.8K/J	09021	
U1	Integrated Circuit	1	MC1550G	04713	
U2	Integrated Circuit	2	741HC	07263	
U3	Same as U2				

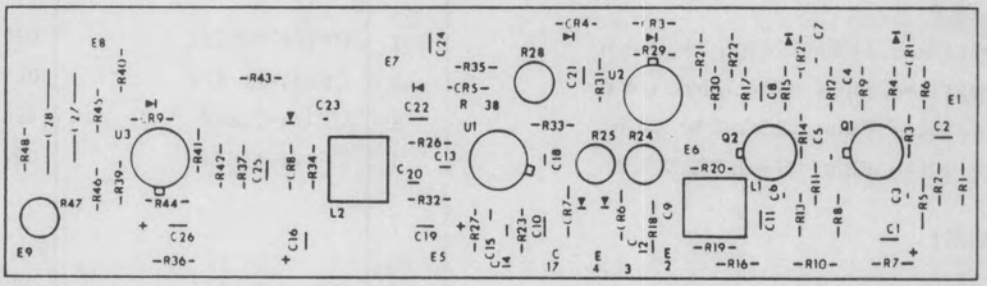


Figure 5-10. Type 15801-5 Output Amplifier (A4A4), Location of Components

Courtesy of http://BlackRadios.terryo.org

5.5.4.4 Type 371487-1 Interface

REF DESIG PREFIX A4A5

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
C1	Capacitor, Electrolytic, Aluminum: 33 µF, 10%, 25 V	2	ECE-A1EK330	54473	
C2	Same as C1				
C3	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 100 V	4	8131M100-651-104M	59660	
C4	Capacitor, Ceramic, Disc: 0.01 µF, 10%, 100 V	1	CK05BX103K	81349	
C5	Same as C3				
C6	Same as C3				
C7	Capacitor, Ceramic, Disc: 150 µF, 10%, 100 V	1	CK05BX151K	81349	
C8	Same as C3				
CR1	Diode	2	1N4449	80131	
CR2	Same as CR1				
E1	Terminal, Forked	27	140-1941-02-01	71279	
E2 Thru E27	Same as E1				
J1	Connector, Receptacle	2	65610-116	22526	
J2	Same as J1				
L1	Coil, Fixed	1	553-3635-61	71279	
Q1	Transistor	1	2N2222A	80131	
R1	Resistor, Fixed, Film: 10 kΩ, 5%, 1/4 W	13	CF1/4-10K/J	09021	
R2	Resistor, Fixed, Film: 5.1 kΩ, 5%, 1/4 W	1	CF1/4-5.1K/J	09021	
R3	Resistor, Fixed, Film: 47Ω, 5%, 1/4 W	1	CF1/4-47 OHMS	09021	
R4	Resistor, Variable, Film: 10 kΩ, 10%, 1/2 W	1	62PAR10K	73138	
R5	Same as R1				
R6	Resistor, Fixed, Film: 100 kΩ, 5%, 1/4 W	1	CF1/4-100K/J	09021	
R7	Resistor, Fixed, Film: 680 kΩ, 5%, 1/4 W	1	CF1/4-680K/J	09021	
R8	Resistor, Fixed, Film: 22 kΩ, 5%, 1/4 W	1	CF1/4-22K/J	09021	
R9	Resistor, Fixed, Film: 47 kΩ, 5%, 1/4 W	1	CF1/4-47K/J	09021	
R10 Thru R19	Same as R1				
R20	Resistor, Fixed, Film: 2.4 kΩ, 5%, 1/4 W	1	CF1/4-2.4K/J	09021	
R21	Same as R1				
U1	Integrated Circuit	1	DG303ACJ	17856	
U2	Integrated Circuit	1	CA082E	02735	
U3	Integrated Circuit	1	MM74HC08N	27014	
U4	Integrated Circuit	1	MM74HC04N	27014	
U5	Integrated Circuit	1	MM74HC32N	27014	

Courtesy of http://BlackRadios.terryo.org

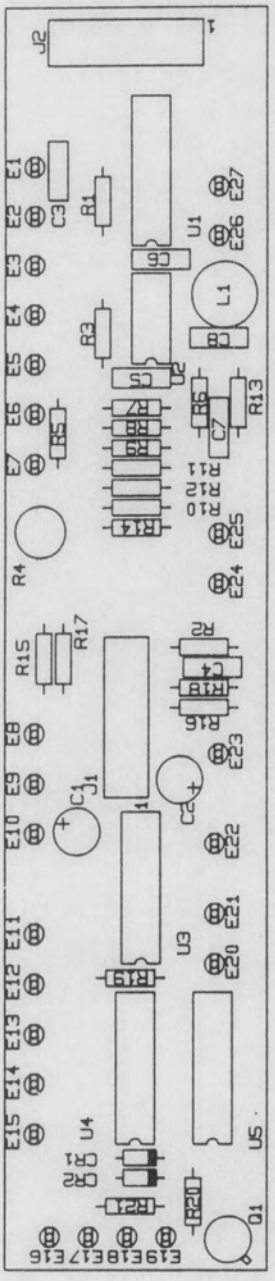


Figure 5-11. Type 371487-1 Interface (A4A5), Location of Components

Courtesy of http://BlackRadios.terryo.org

SECTION VI

SCHEMATIC DIAGRAMS

Courtesy of http://BlackRadios.terryo.org

ES.
UNLESS OTHERWISE SPECIFIED:
a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
b) CAPACITANCE IS µF.

2. ▭ INDICATES FRONT PANEL CONTROL.

3 SYSTEM CONFIGURATION DETERMINED:
S1 SWITCHES 1 THRU 10 & S2 & S3
SWITCHES 1 THRU 9 ARE "NORMALLY OPEN".
SELECTION TO "NORMALLY CLOSED" IS DETERMINED BY CUSTOMER APPLICATION / SYSTEM CONFIGURATION.

4. NOMINAL VALUE, FINAL VALUE FACTORY SELECTED.

NOTES CONT-
5. CW ON POTENTIOMETERS INDICATES CLOCKWISE ROTATION OF ACTUATOR.

6. J11 IS USED WITH MSI-A1 OPTION
J12 IS USED WITH MSI-A2 OR HFC-A2
J13 IS USED WITH HFC-A1 OPTION

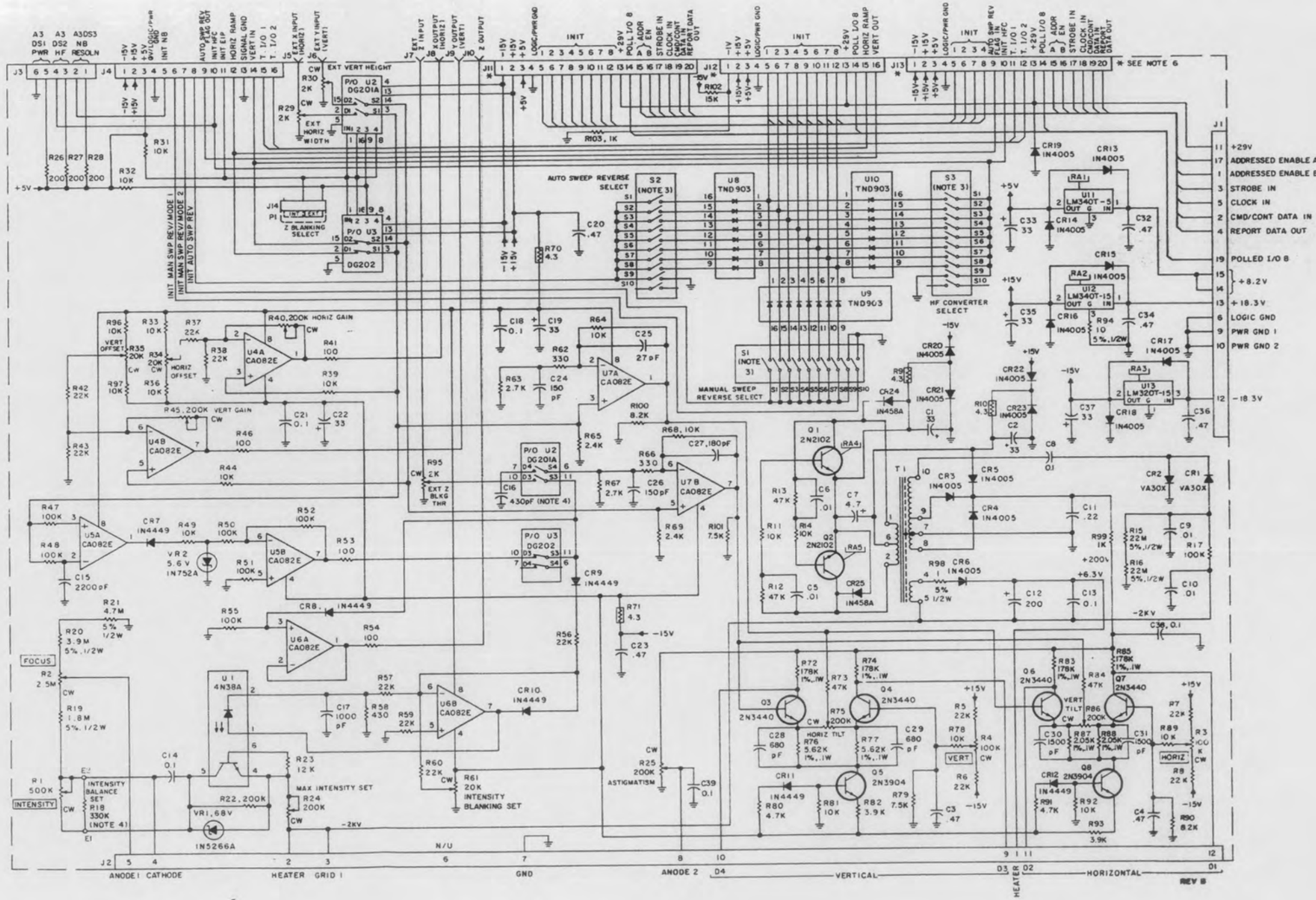


Figure 6-1. Type 794546-1 High Voltage/Deflection Amplifier (A1), Schematic Diagram 570391

Courtesy of http://BlackRadios.terryo.org

NOTES
1. UNLESS OTHERWISE SPECIFIED
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W
   b) CAPACITANCE IS µF.
2. CW ON POTENTIOMETERS INDICATES CLOCKWISE ROTATION OF ACTUATOR.

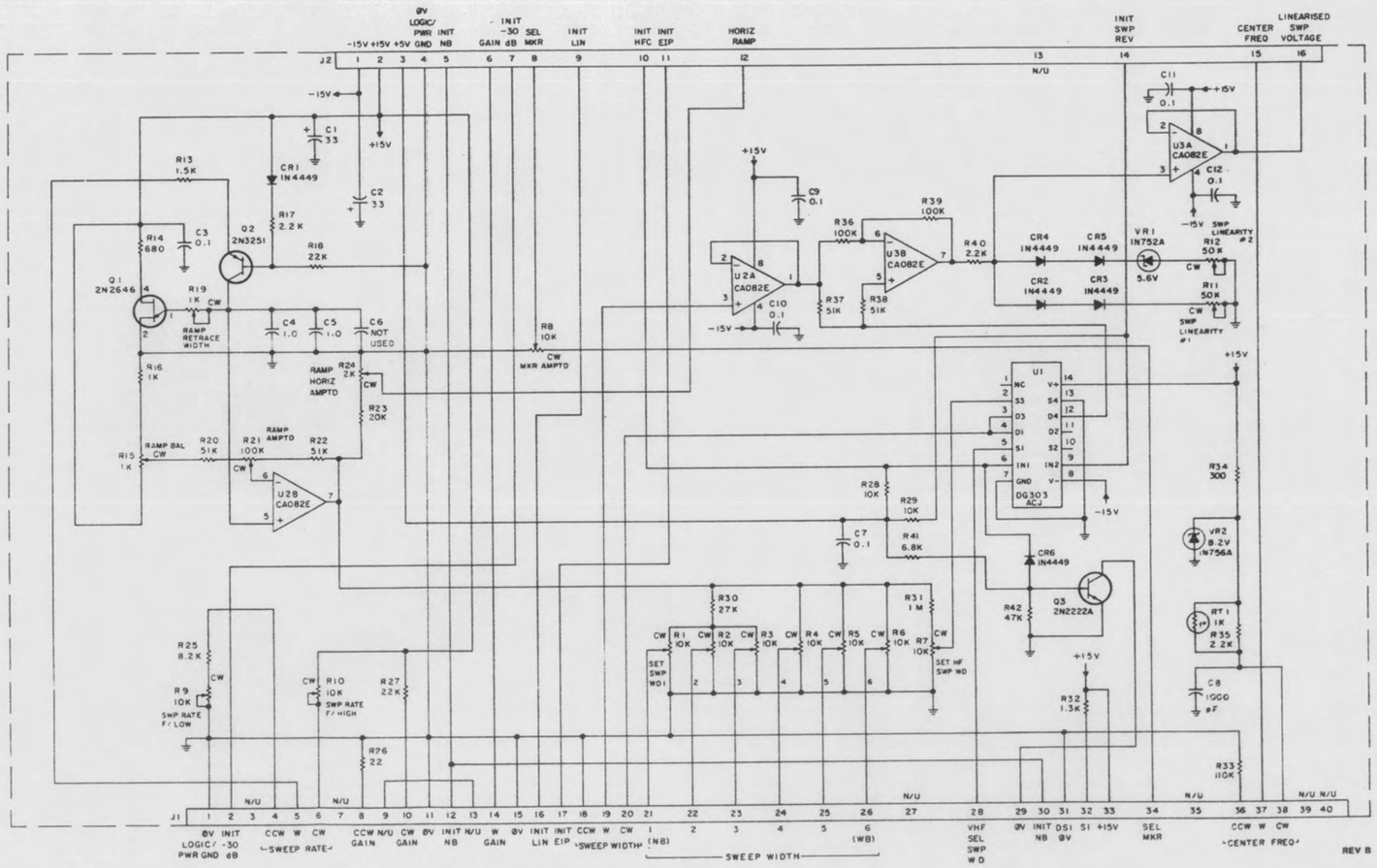


Figure 6-2. Type 794547-1 Sweep Generator (A2), Schematic Diagram 570389

Courtesy of http://BlackRadios.terryo.org

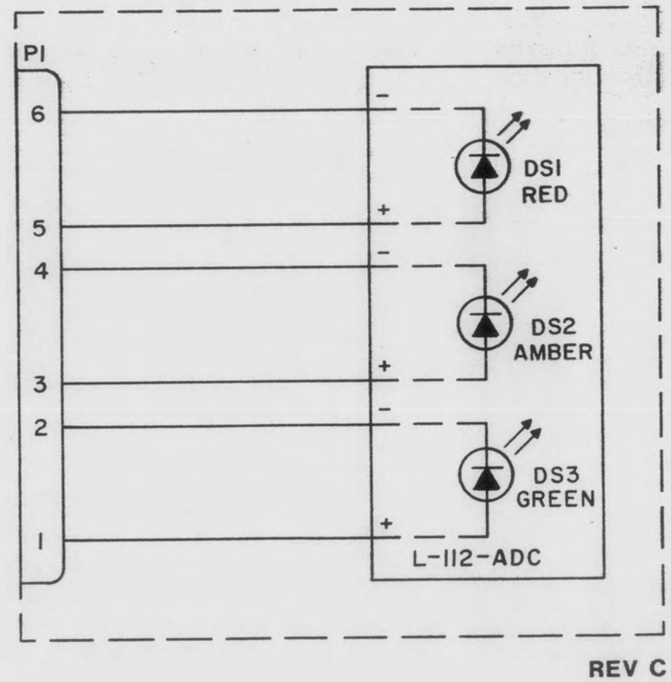


Figure 6-3. Type 271134-1 LED Flexible Board (A3), Schematic Diagram 271135

Courtesy of http://BlackRadios.terryo.org

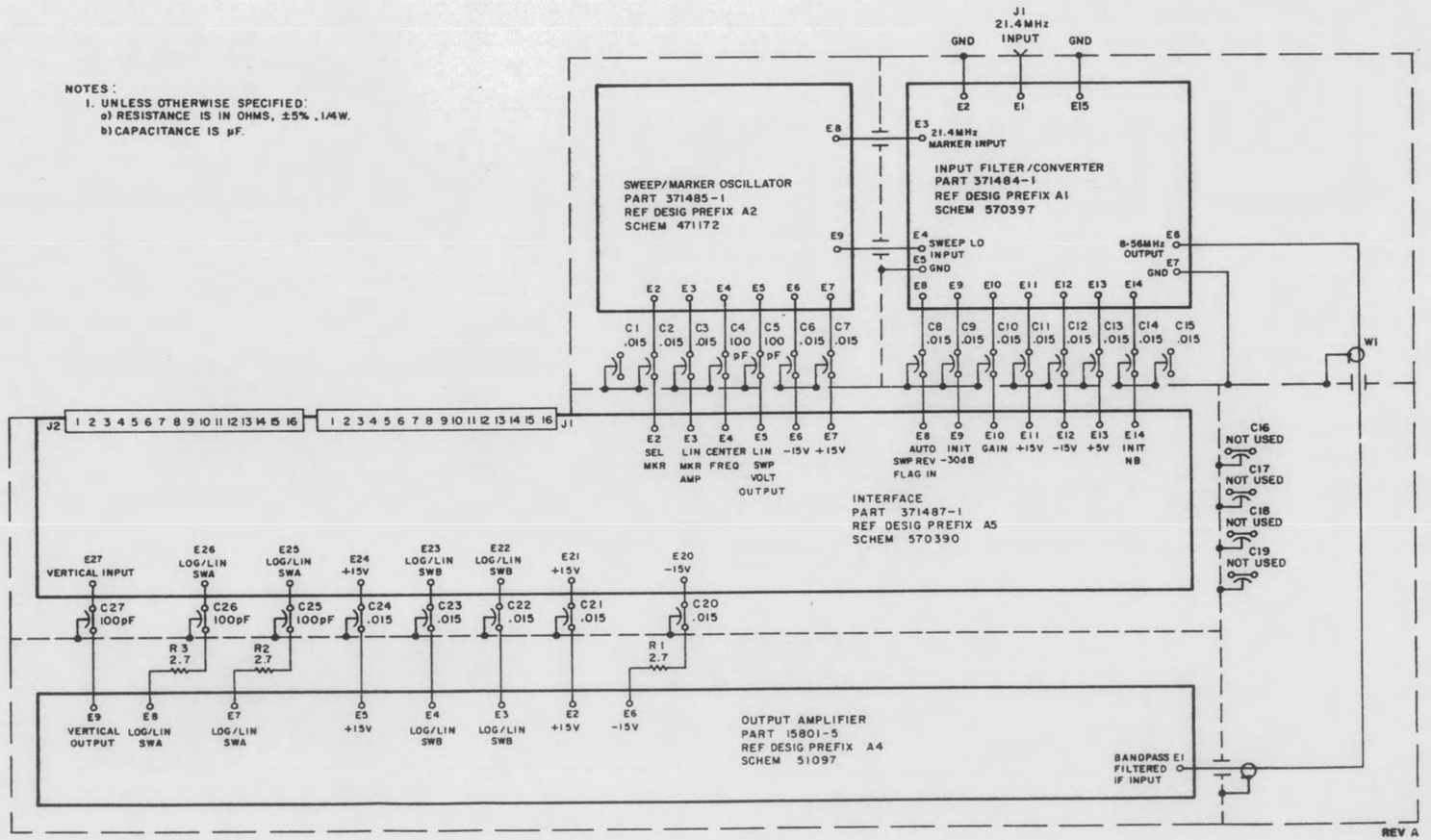


Figure 6-4. Type 794535-1 Input Filter/Converter (A4), Schematic Diagram 471173

Courtesy of http://BlackRadios.terryo.org

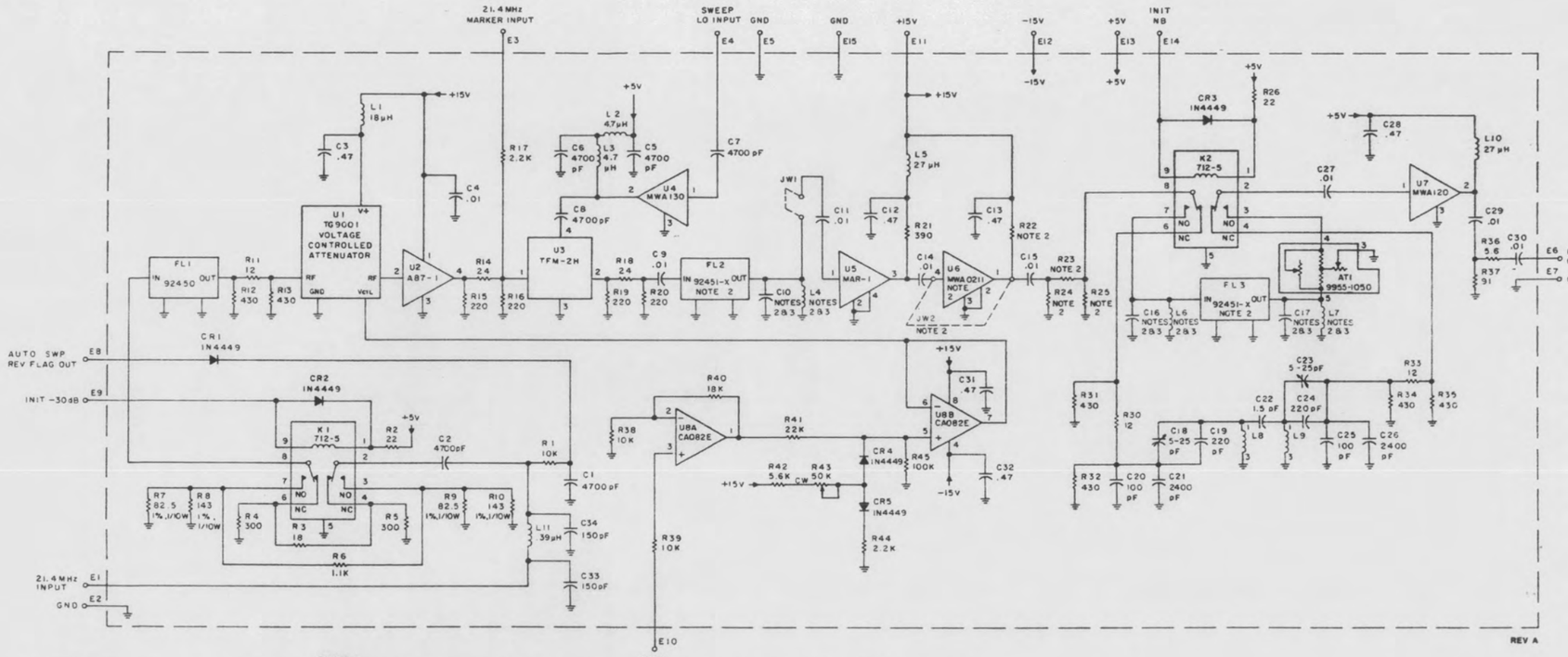


TABLE I

PART NUMBER	USED ON	FL2	FL3	RESOLUTION BANDWIDTH WB	RESOLUTION BANDWIDTH NB	C10	C16	C17	L4	L6	L7	R22	R23	R24	R25	R27	R28	R29	U6	JW2
371484-1	794535-1,SDU101	92451-1	92451-2	20KHz	6KHz	N/U	N/U	N/U	N/U	N/U	N/U	N/U	5.6	910	910	N/U	N/U	N/U	N/U	USED
371484-2	794535-2,SDU100	92451-1	92451-3	20KHz	2KHz	N/U	N/U	N/U	N/U	N/U	N/U	N/U	5.6	910	910	N/U	N/U	N/U	N/U	USED
371484-3		92451-5	92451-2	20KHz	6KHz	N/U	N/U	N/U	N/U	N/U	N/U	360	51	120	120	N/U	N/U	N/U	USED	N/U
371484-4		92451-5	92451-3	20KHz	2KHz	N/U	N/U	N/U	N/U	N/U	N/U	360	51	120	120	N/U	N/U	N/U	USED	N/U

NOTES
1. UNLESS OTHERWISE SPECIFIED
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W
   b) CAPACITANCE IS μF
2. DIFFERENCE BETWEEN PART NUMBERS IS SHOWN IN TABLE I
3. NOMINAL VALUE, FINAL VALUE FACTORY SELECTED
4. CW ON POTENTIOMETER INDICATES CLOCKWISE ROTATION OF ACTUATOR

Figure 6-5. Type 371484-1 Input Filter/Converter (A4A1), Schematic Diagram 570397

Courtesy of http://BlackRadios.terryo.org

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W
   b) CAPACITANCE IS pF.

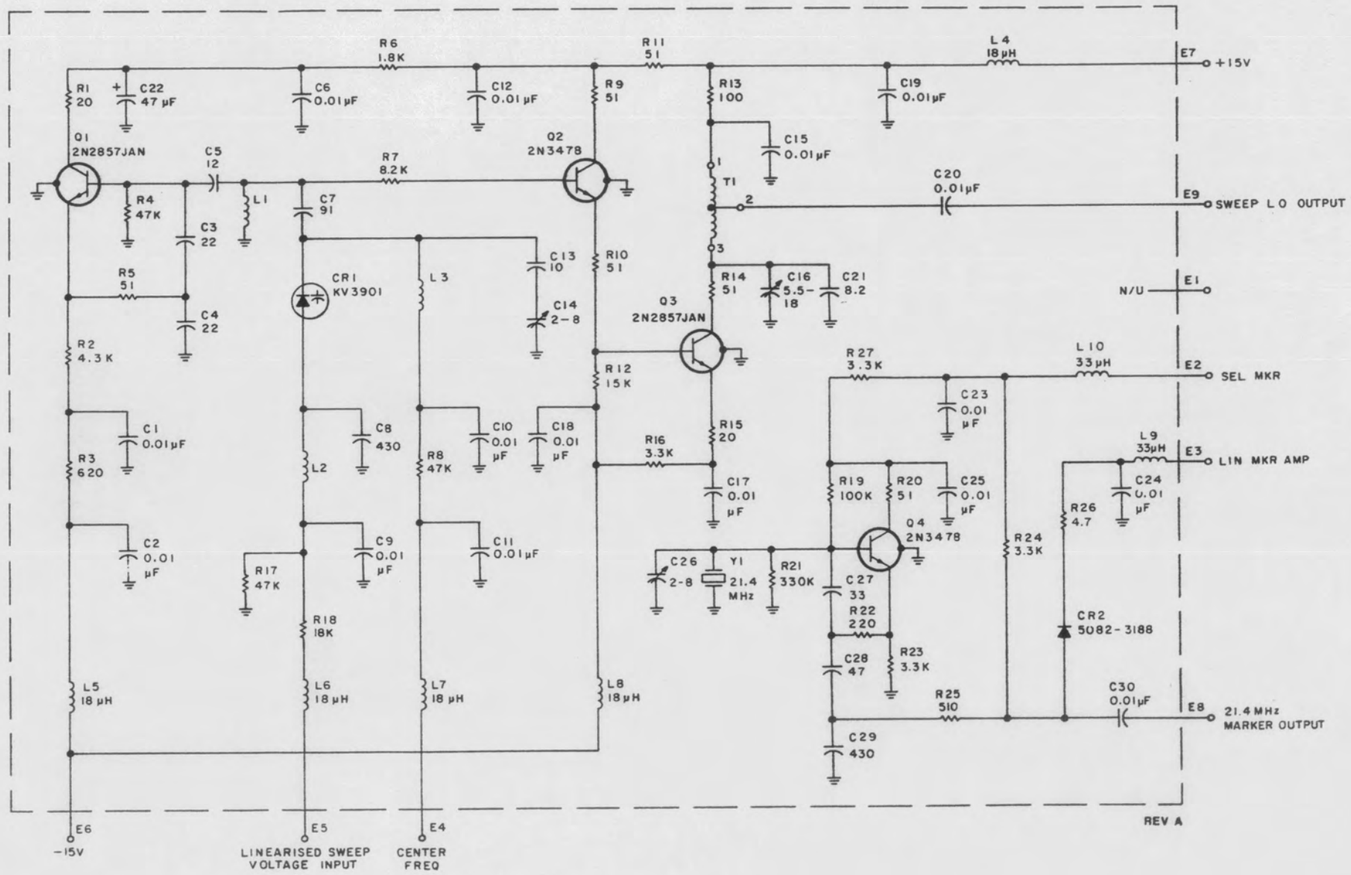


Figure 6-6. Type 371485-1 Sweep Marker/Oscillator (A4A2), Schematic Diagram 471172

Courtesy of http://BlackRadios.terryo.org

NLESS OTHERWISE SPECIFIED
RESISTANCE IS MEASURED IN OHMS, ±5%, 1/4W
CAPACITANCE IS pF
CW ON POTENTIOMETERS INDICATES FULL CLOCKWISE POSITION OF ACTUATOR
LEAD ARRANGEMENT FOR U2 & U3 IS SHOWN IN DETAIL A
LEAD ARRANGEMENT FOR U1 IS SHOWN IN DETAIL B
FFERENCE BETWEEN TYPES IS LISTED IN TABULATION

DETAIL A

DETAIL B

TABULATION

PART NO	C1	C16	C19	C26	R1	R46	R47	R48	R28
15801-2	27µF	27µF	27µF	27µF	NU	680	1K	47K	20K
15801-3	22µF	22µF	22µF	22µF	NU	680	1K	47K	20K
15801-4	27 µF	27µF	27µF	27µF	1.2K	560	5K	220	20K
15801-5	27 µF	27µF	27µF	27µF	1.2K	560	5K	1.8K	50K

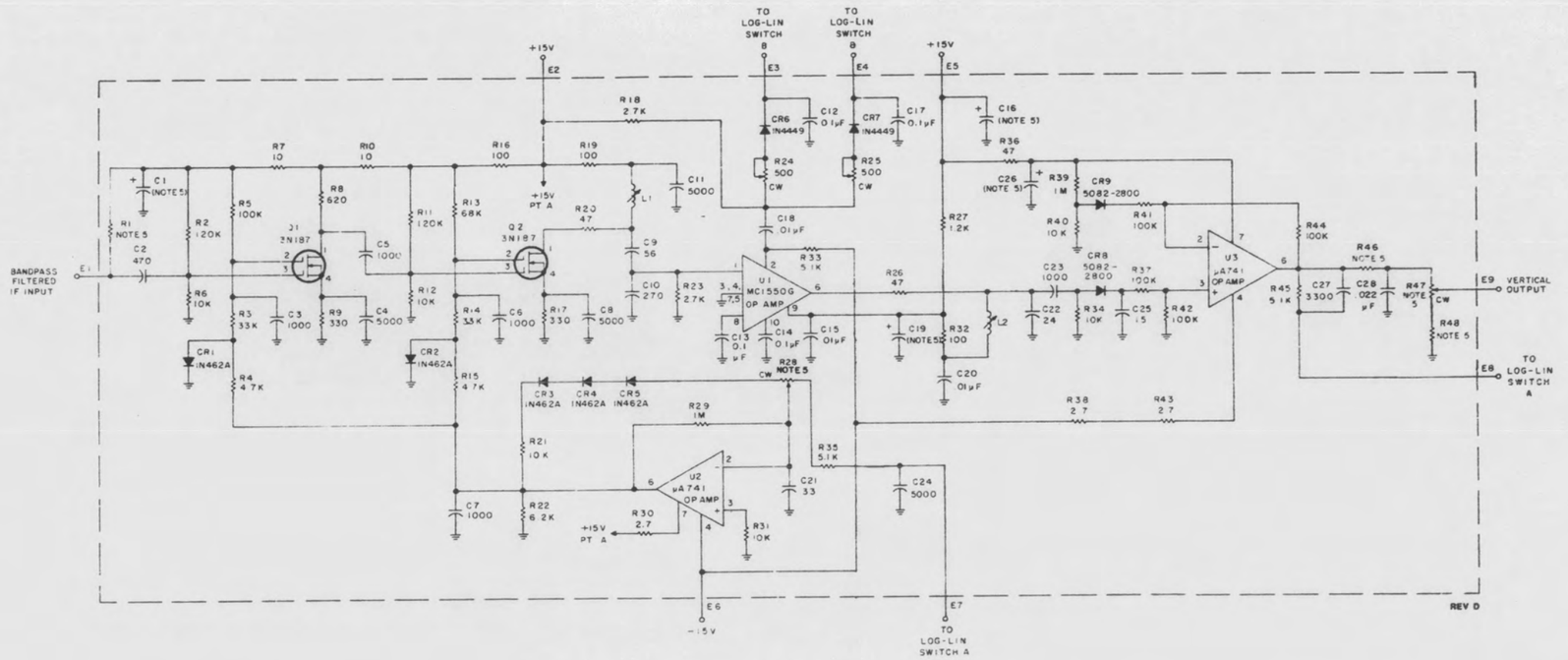
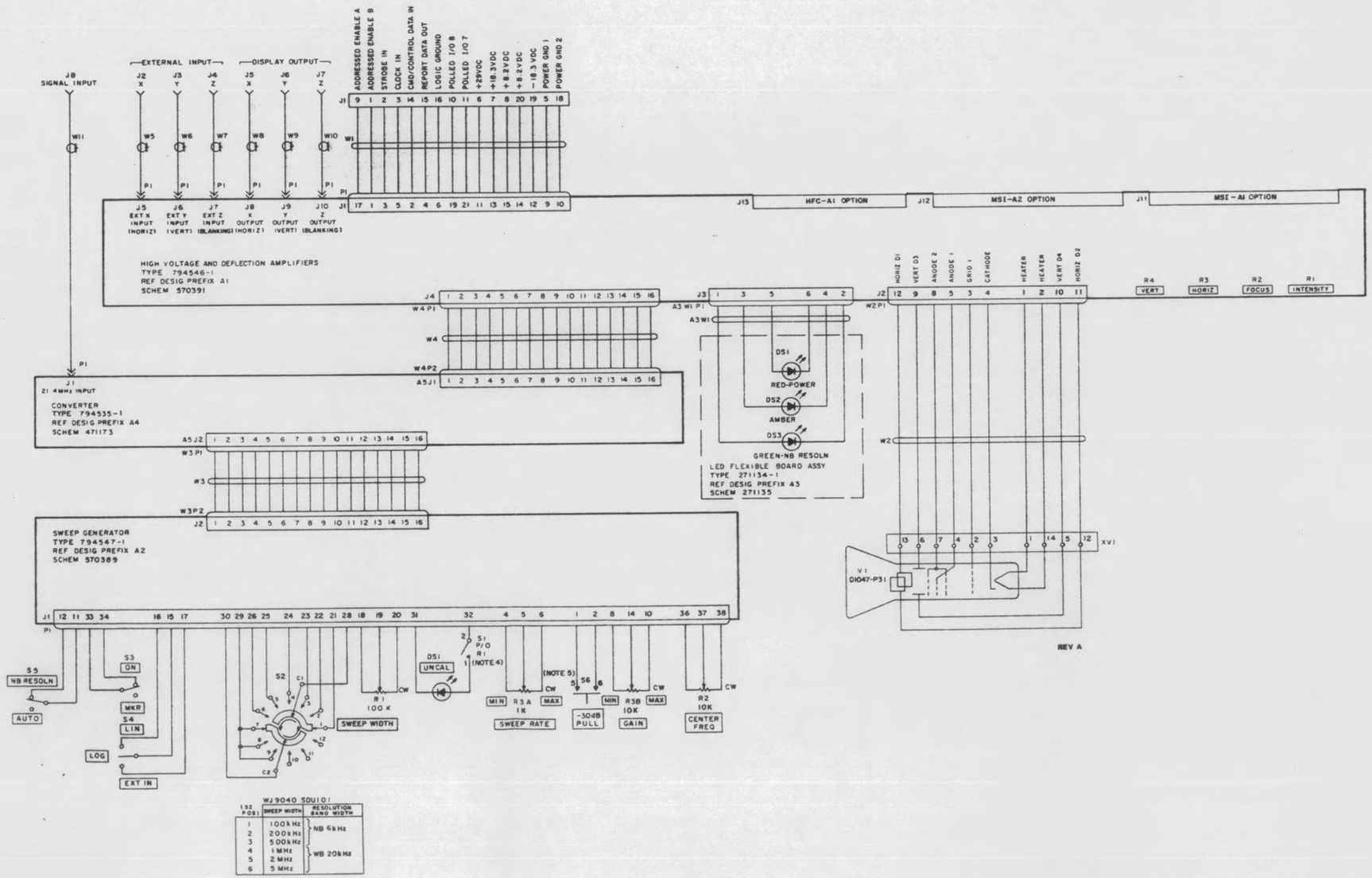


Figure 6-7. Type 15801-5 Output Amplifier (A4A4), Schematic Diagram 51097

Courtesy of http://BlackRadios.terryo.org

NOTES
1. UNLESS OTHERWISE SPECIFIED
   a) RESISTANCE IS IN OHMS ±5%, 1/4W
2. ▭ INDICATES FRONT PANEL CONTROL
3. CW ON POTENTIOMETERS INDICATES CLOCKWISE ROTATION OF ACTUATOR
4. S1 IS OPEN WHEN R1 IS FULLY CLOCKWISE.
5. S6 IS OPEN WHEN R38/S6 IS PUSHED IN.



WJ9040 SDU101

I52 POS	SWEEP WIDTH	RESOLUTION BAND WIDTH
1	100kHz	NB 6kHz
2	200kHz	
3	500kHz	
4	1MHz	WB 20kHz
5	2MHz	
6	5MHz	

Figure 6-9. WJ-9040 SDU101 Spectrum Display Unit Main Chassis, Schematic Diagram 570384

Courtesy of http://BlackRadios.terryo.org

NOTES
1. UNLESS OTHERWISE SPECIFIED.
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS μF.
2. CW ON POTENTIOMETER INDICATES CLOCKWISE ROTATION OF ACTUATOR.

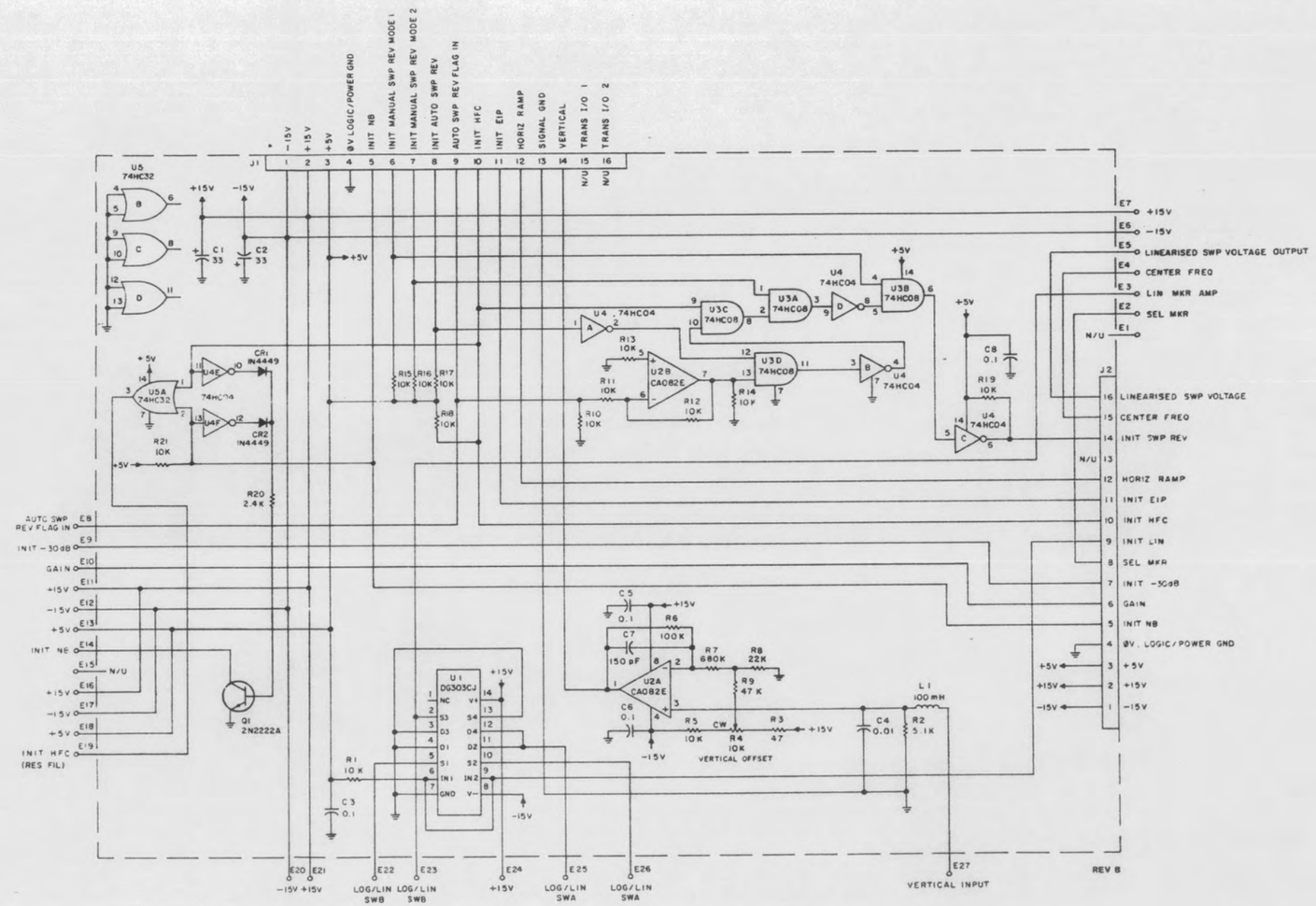


Figure 6-8. Type 371487-1 Interface (A4A5), Schematic Diagram 570390