BAE SYSTEMS

INSTRUCTION MANUAL

FOR THE

WJ-9040 HFE223 HF EXTENDER

INSTRUCTION MANUAL

FOR THE

WJ-9040 HFE223 HF EXTENDER

WATKINS-JOHNSON COMPANY (WJ 85)
700 QUINCE ORCHARD ROAD
GAITHERSBURG, MARYLAND 20878-1794

November 1987

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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SECTION I

GENERAL DESCRIPTION

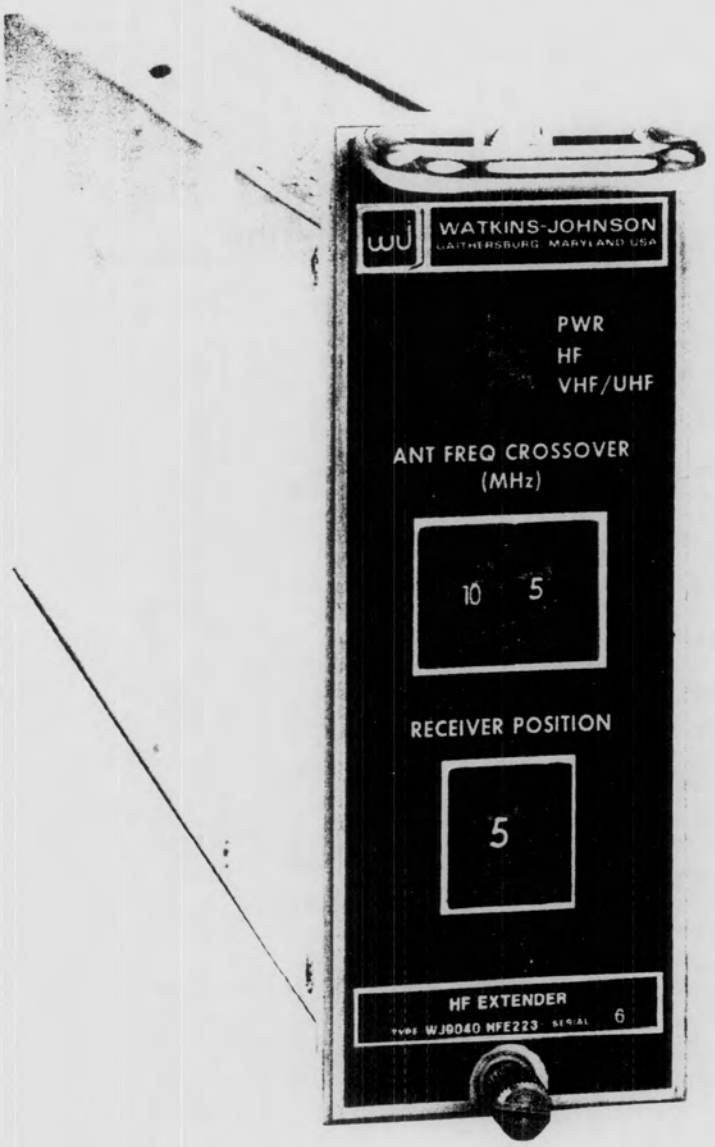


Figure 1-1. WJ-9040 HFE223 HF Extender

SECTION I

GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

The WJ-9040 HFE223 HF Extender is designed to function as a component of the Watkins-Johnson Company WJ-9040 System. The WJ-9040 HFE223 HF Extender extends the frequency of the WJ-8628-4-5 VHF/UHF Master Acquisition Receiver down to 1.5 MHz. The normal frequency range of the WJ-8628-4-5 VHF/UHF Master Acquisition Receiver is 20 to 512 MHz (expandable to 1400 MHz). By using the WJ-9040 HFE223 HF Extender the WJ-8628-4-5 Master Acquisition Receiver acts as one receiver throughout the 1.5 to 1400 MHz frequency range. In some applications the WJ-9040 HFE223 is used along with the WJ-8625-1 VLF Receiver to allow the WJ-8628-4-5 Master Acquisition Receiver to act as one receiver throughout the 200 Hz to 1400 MHz frequency range.

1.2 MECHANICAL CHARACTERISTICS

The HFE223 is normally mounted in a 19-inch wide WJ-9040 System Equipment Frame (EFR100) and occupies one-eighth 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 HFE223 and the EFR100 Equipment Frame backplane. Four SMA connectors provide signal interconnection between the HFE223 and other system equipment (i.e., WJ-8628-4-5).

The unit consists of a main chassis and five major assemblies:

a. Input Switch, Type 371670-1 (A1),

b. Mixer/Amplifier, Type 371396-1 (A2),

c. Amplifier/Filter/Switch, Type 371671-1 (A3),

d. Digital Interface, Type 371672-1 (A4),

e. LED Flexible Board, Type 271134-1 (A5).

The HFE223 is designed for easy disassembly. The front and rear panels are held on by screws and can be easily removed. All operator controls are located on the front panel, along with the PWR, HF and VHF/UHF indicators. All interconnections to the HFE223 are made through the rear panel.

1.3 EQUIPMENT SUPPLIED

No additional equipment is supplied with the WJ-9040 HFE223 HF Extender.

1.4 EQUIPMENT REQUIRED BUT NOT SUPPLIED

The HFE223 requires external equipment for proper operation. The minimum equipment required for operation is as follows:

a. WJ-8628-4-5 VHF/UHF Master Acquisition Receiver,

b. WJ-9040 EFR100 Equipment Frame with:

1. EPS100 Power Supply,
2. SRM105A Site Reference Module,
3. IOM108 I/O Interface Module.

When used with a WJ-8628-4-5 VHF/UHF Master Acquisition Receiver, a WJ-8625-1 VLF Receiver, and a WJ-9040 IFD220 IF Demodulator to form a Broadband Receiving System for RFI/EMI screening or communications intercept and monitoring system, the configuration is as shown in **Figure 1-2.**

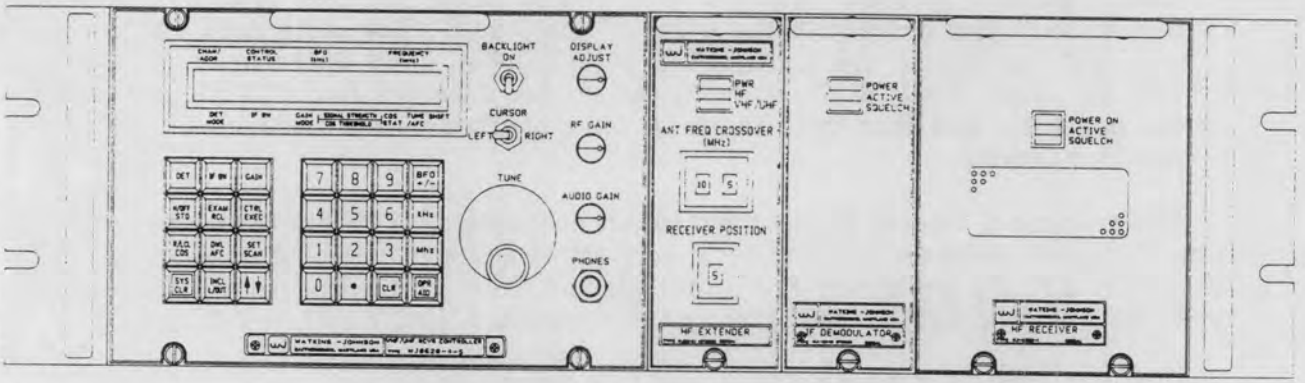


Figure 1-2. WJ-9040 Broadband Receiving System

1.4.1 WJ-8628-4-5 VHF/UHF MASTER ACQUISITION RECEIVER

The WJ-8628-4-5 is the Master VHF/UHF Acquisition Receiver that is the controlling unit for the system.

1.4.2 WJ-9040 EFR100 EQUIPMENT FRAME

The WJ-9040 EFR100 Equipment Frame is used to physically mount the HFE223 and any other WJ-9040 System Equipment contained in the system. The following paragraphs list the WJ-9040 components that are a required part of the Equipment Frame for HFE223 operation.

1.4.2.1 **EPS100 Power Supply**

The EPS100 Power Supply provides +8.2 Vdc, +18 Vdc, -18 Vdc, and +29 Vdc to the HFE223 and other system modules.

1.4.2.2 **SRM105A Site Reference Module**

The SRM105A Site Reference Module provides four highly stable 50 MHz reference signals to be used with the HFE223 and other system modules. The 50 MHz signals are used for the receiver synthesizers. The SRM105A may be locked to a 1, 5, or 10 MHz external reference, or it can be used with its internal 50 MHz reference.

1.4.2.3 **IOM108 I/O Interface Module**

The IOM108 I/O Interface Module is used to interface the HFE223 with other system modules. It is a Digital I/O Module that routes audio and control signals to and from receivers and demodulators. In addition, an IEEE-488 or RS-232 Interface can be plugged into the unit to allow for system remote control.

1.5 TABLE OF SPECIFICATIONS

Table 1-1. WJ-9040 HFE223 HF Extender Specifications

Frequency Range	1.5 to 20 MHz
Tuning Step Size	100 Hz
Noise Figure	13 dB maximum
Gain	0 dB
3rd Order Intercept Point	-5 dBm
IF Rejection	70 dBm
Image Rejection	70 dBm
LO Radiation	-87 dBm maximum
Maximum Usable Bandwidth	500 kHz (contained in WJ-8628-4-5)
Weight	4 lbs.
Size	5.2 inches High, 2.0 inches Wide 14 inches Deep
Connectors:	4 - SMA Connectors 1 - 25 Pin D Connector
Operating Temperature Range	0 to +50°C
Power Consumption	2.5 Watts DC

SECTION II

INSTALLATION AND OPERATION

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, CET 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 and external cables for loose connections, and plug-in items which may have been loosened from their receptacles.

2.2 REPACKING

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°C to +70°C

2.3 INSTALLATION PROCEDURES

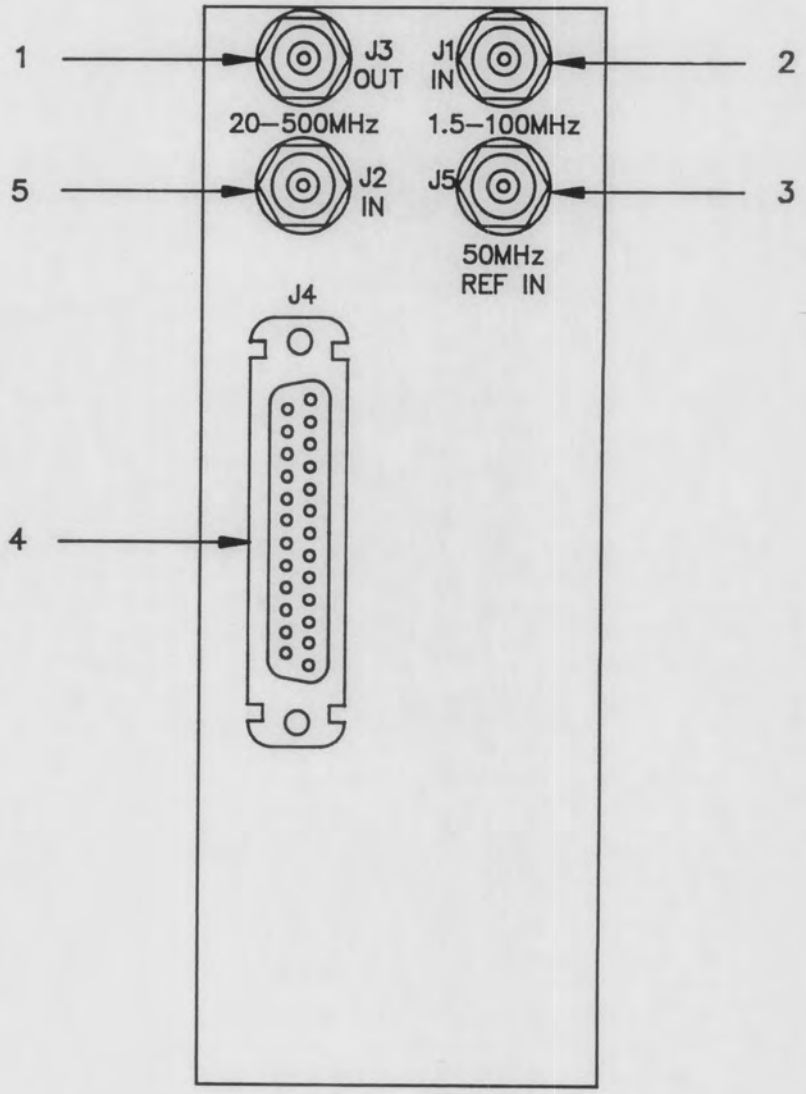
The HFE223 is designed to be mounted in the EFR100 Equipment Frame. Specific installation procedures for the EFR100 Equipment Frame Installation are covered in the **WJ-9040 System Common Equipment Instruction Manual.** However, the following general guidelines should be observed when using the HFE223 in the WJ-9040 operational environment:

a. Operating temperature range should be from 0°C to +50°C.

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

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

d. Secure the HFE223 in the frame by rotating the four front panel locking screws clockwise until tight.



1. 20-500 MHz Output (J3)
2. 1.5-105 MHz Input (J1)
3. 50 MHz REF IN (J5)
4. EFR100 Interface (J4)
5. 20-500 MHz INPUT (J2)

Figure 2-1. WJ-9040 HFE223 HF Extender Rear Panel

The break frequency may be changed during operation if another break point in frequency is desired. When a change in the break frequency is executed during operation, the Master Acquisition Receiver must be made aware of this change by executing a reinitialization of the Master Acquisition Receiver. This may be accomplished by reinitializing the power of the equipment frame in which the Master Acquisition Receiver resides.

2.4.1.2 **RECEIVER POSITION**

This control sets the slot number of the WJ-8628-4-5 Master Acquisition Receiver that is connected to the HFE223. The operator selects this slot number by adjusting the thumb-wheel switch prior to powering up the system.

This control should only be adjusted when equipment is initially installed or when reinstallation causes a new configuration of equipment.

2.4.2 **INDICATORS**

The three front panel indicators on the HFE223 are shown in **Figure 2-2.** These three indicators are discussed in the following paragraphs.

2.4.2.1 **PWR**

The RED PWR indicator is lit when power is applied to the system.

2.4.2.2 **HF**

The AMBER HF indicator is lit when the HF Antenna is selected.

2.4.2.3 **VLF/UHF**

The GREEN VHF/UHF indicator is lit when the VHF/UHF Antenna is selected.

2.5 REMOTE CONTROL COMMANDS FOR HFE223

The following ASCII commands sent by a terminal or computer will alter or interrogate the parameters of a HFE223 HF Extender via the IOM108 and either IEEE-488 or RS-232. The IOM108 data path must first be selected with the **"SLOTn"** command. The status or parameters of the remotely controlled HFE223 may be inquired or altered at any time.

"ANT?"

Asks for operating mode of the HFE. Returns one of the following:

"HF"
"HFE"
"VHF"

"BRK?"

Asks for frequency of the HF/VHF antenna break set by the front panel switches. Returns the frequency in MHz. This parameter is used by a companion Receiver/Controller if it is configured for automatic switching of the antenna inputs on the HFE. The HFE does not use this data for any internal functions, and the remote terminal may override the break frequency by sending the **"HF"** or **"VHF"** commands at any time.

Example: "85 MHz"

"EXAMn"

Asks for a description of the unit in Slot **n**. Returns the unit type and identifies certain options.

Example: " HFE223"

"HF"

Selects the direct HF antenna input with no frequency conversion. This is typically used for receiving signals between 20 MHz and the upper limit of the HF antenna.

"HFE"

Selects the HF antenna input and upconverts the 1.5-20 MHz band to 51.5-70 MHz. Note the associated receiver must be tuned to the upconverted frequency range.

The following examples show the proper sequence of commands when remotely controlling a subsystem with an HFE.

A) To select a frequency from 1.5-19.9999 MHz:

(Assume 15.5 MHz)

Send these commands to the HFE:

SLOTn - Select the IOM108 data path to the HFE.

HFE - Select the HF antenna and upconvert mode.

Send these commands to the Receiver:

SLOTn - Select the IOM108 data path to the Receiver.

FRQ65.5 - Send desired frequency plus 50 MHz.

B) To select a frequency from 20-35 MHz:

(Assume the HF antenna range is 1.5-35 MHz and the desired frequency is 33.5 MHz.)

Send these commands to the HFE:

SLOTn - Select the IOM108 data path to the HFE.

HF - Select the HF antenna, no conversion.

Send these commands to the Receiver:

SLOTn - Select the IOM108 data path to the Receiver.

FRQ33.5 - Send desired frequency.

C) To select a frequency from 35-512 MHz:

(Assume the HF antenna range is 1.5-35 MHz and the desired frequency is 122.5 MHz.)

Send these commands to the HFE:

SLOTn - Select the IOM108 data path to the HFE.

VHF - Select the VHF antenna.

Send these commands to the Receiver:

SLOTn - Select the IOM108 data path to the Receiver.

FRQ122.5 - Send desired frequency.

SECTION III

CIRCUIT DESCRIPTION

3.1 INTRODUCTION

This section describes the general theory of operation of the WJ-9040 HFE223 HF Extender.

3.2 GENERAL DESCRIPTION

As shown in **Figure 6-6,** the WJ-9040 HFE223 HF Extender Main Chassis Schematic, the WJ-9040 HFE223 consists of the following major modules:

a. Input Switch (A1)

b. Mixer Amplifier (A2)

c. Amplifier/Filter/Switch (A3)

d. Digital Interface (A4)

e. LED Flexible Board (A5)

3.2.1 INPUT SWITCH (A1)

Refer to **Figure 6-1,** Input Switch (A1) Schematic Diagram and **Figure 6-6,** WJ-9040 HFE223 HF Extender Schematic Diagram, during the following discussion.

The function of the Input Switch (A1) is to pass RF frequencies from 20-105 MHz directly to the Amplifier/Filter/Switch (A3) and to switch RF frequencies from 1.5-20 MHz through the C8-C17/L1-L5 Filter Network to the Mixer/Amplifier (A2).

RF signals in the 1.5 to 105 MHz range enter the HFE223 at J1. These signals are then routed to the Input Switch (A1) via the Input Switch 1.5-105 MHz Input connection. RF signals from 1.5 to 20 MHz are then switched to Output E2 of the Input Switch. The RF signals are then filtered by the C8-C17/L1-L5 network and are passed to the Mixer/Amplifier (A2) input E2. E1 accepts the 1.5-20 MHz Select Voltage (+15 Vdc = ON, -15 Vdc = OFF) from the Digital Interface (A4) and E3 accepts the 20-105 MHz Select Voltage (+15 Vdc = ON, -15 Vdc = OFF) from the Digital Interface.

RF signals from 20-105 MHz are switched to the 20-105 MHz output of the Input Switch (A1). These signals are then passed to the Amplifier/Filter/Switch (A3) input E3.

3.2.2 MIXER/AMPLIFIER (A2)

Refer to **Figure 6-2,** Mixer/Amplifier (A2) Schematic Diagram, and **Figure 6-6,** WJ-9040 HFE223 HF Extender Schematic Diagram, during the following discussion.

J4 on the Digital Interface (A4) provides the following interfaces within the HFE223:

a. The +18.3 Vdc and -18.3 Vdc supply voltages and the 1.5-20 MHz/20-105 MHz Select signal to the Amplifier/Filter Switch (A3).

b. +8.2 Vdc and -18.3 Vdc supply voltages and the Mixer 1.5-20 MHz Select signal to the Mixer/Amplifier (A2).

c. 1.5-20 MHz Select and 20-105 MHz Select signals to the Input Switch (A1).

d. RF1 Control and RF2 Control Signals to the RF Switch (U1).

3.2.5 LED FLEXIBLE BOARD (A5)

Refer to **Figure 6-5,** LED Flexible Board (A5) Schematic Diagram, and **Figure 6-6,** WJ-9040 HFE223 HF Extender Schematic Diagram, during the following discussion.

The function of the LED Flexible Board (A5) is to provide front panel indications of the power up status and antenna selection.

When power is applied to the unit a voltage is applied from the Digital Interface (A4) through A5P1 (pins 5 and 6) to light the Red Power Indicator on the front panel of the unit.

When the HF Antenna Input is selected a voltage is applied from the Digital Interface (A4) through A5P1 (pins 3 and 4) to light the Amber HF Indicator on the front panel of the unit.

When the VHF/UHF Antenna input is selected a voltage is applied from the Digital Interface (A4) through A5P1 (pins 1 and 2) to light the Green VHF/UHF Indicator on the front panel of the unit.

3.2.6. RF SWITCH (U1)

Refer to **Figure 6-6,** WJ-9040 HFE223 HF Extender Schematic Diagram, an aid in understanding the following description.

The RF Switch (U1) is a PIN Diode Switch that functions as an RF Switch for the 20-500 MHz RF Signals, the 1.5-20 MHz RF Signals, and the 20-105 MHz RF Signals. When RF signals in the 20-500 MHz Frequency Range are received, they are input at J2, processed to the RF1 Input on the RF Switch (U1), are then routed through the RF Switch (U1), and are output at J3. Signals received in the 1.5 to 105 MHz range are received through J1, processed through the Input Switch (A1), Mixer/Amplifier (A2), Amplifier/Filter/Switch (A3) and then are routed to the input of RF Switch (U1) at terminal RF2. These signals are then presented to the 20-500 MHz output at J3.

While this discussion has used frequencies of 1.5-105 MHz and 20-500 MHz, the actually switch, or break frequency between the RF1 and RF2 inputs is determined by the front panel setting of the Ant Freq Crossover (MHz) control. See **paragraph 2.4.1.1** and **paragraph 2.4.1.2** for a discussion of this operator selectable control. Based on the front panel selection, the Digital Interface (A4) will provide a select signal through A4, J4 pin 53 (RF1 Control) and pin 3 (RF2 Control) to switch U1 to the proper input for the given frequency range.

SECTION IV

MAINTENANCE

SECTION IV

MAINTENANCE

4.1 GENERAL

This section provides detailed procedures to perform preventive and corrective maintenance on the WJ-9040 HFE223 HF Extender. Preventive maintenance helps prevent malfunctions or breakdowns. Corrective maintenance includes procedures for returning a malfunctioning Direction Finding Antenna to operating condition.

4.2 PREVENTIVE MAINTENANCE

Preventive maintenance consists of visual inspection, cleaning and lubrication. Although the WJ-9040 HFE223 HF Extender 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 operating environment.
Inspection for damage	60 days	Interval variable depending on operating environment and equipment use.
Performance Tests	180 days	Interval variable depending on operating environment and equipment use.

4.3 VISUAL INSPECTION

Many potential or existing faults can be detected by making a visual inspection of the unit. For this reason, a complete visual inspection should be made on a routine basis and whenever the unit is inoperative. At a minimum, the unit should be inspected for the following items:

1. Inspect the cover, enclosure and front panel for condition of finish and panel markings.
2. Inspect for dents, punctures, or warped areas.
3. Inspect for loose or missing screws or washers.
4. Inspect the receptacles for condition of pins, contacts, and mountings.

4.7 TEST EQUIPMENT REQUIRED

Table 4-2 lists the test equipment required for corrective maintenance of the WJ-9040 HFE223 HF Extender. Equivalent equipment may be used.

Table 4-2. Test Equipment Required

Instrument Type	Interval	Recommended Instrument
Signal Generator	1.5-500 MHz RF Output	HP8640B
Oscilloscope	DC to 50 MHz	HP180C
Digital Voltmeter	DC ranges; 1% or better	Fluke 8100A
Spectrum Analyzer	40-80 MHz	HP8568B
Sweep Generator	40-80 MHz	Wavetek 2001

4.8 HFE223 TEST PROCEDURES

Refer to **Table 4-3** for a listing of typical waveforms and voltage levels. This table will aid in isolating the defective assembly or PC Board.

Table 4-3. Typical Waveforms and Voltage Levels

Test Point	Normal Signal	Function
1. Input Switch (A1)		
1.5-105 MHz Input	1.5-500 MHz RF Signal	HF Input
E2	1.5-20MHz RF Signal	1.5-20 MHz Output
E3	+15 Vdc = ON -15 Vdc = OFF	20-105 MHz Select
E1	+15 Vdc = ON -15 Vdc - OFF	1.5-20 MHz Select
20-105 MHz Output	20-105 MHz RF Signal	20-105 MHz Output

Table 4-3. Typical Waveforms and Voltage Levels (Continued)

Test Point	Normal Signal	Function
4. Digital Interface (A4)		
J1, Pin 1	5 Vdc = Enabled 0 V = Not Enabled	Enable B
J1, Pin 2	Pulses	Command/Control Data Input
J1, Pin 3	Pulse; Active High	Strobe In
J1, Pin 4	Pulses	Data Out
J1 Pin 5	Pulses	Clock
J1, Pins 6, 9, 10	Logic Ground	Logic Ground
J1, Pin 13	+18.3 Vdc	Supply Voltage
J1, Pins 14, 15	+8.2 Vdc	Supply Voltage
J2, Pin 1	5 Vdc	Supply Voltage for (S1B Com)
J2, Pin 2	Logic Ground	Pull Down Resistor
J2, Pin 3	5 Vdc	Supply Voltage for (S1A Com)
J2, Pin 4	Logic Ground	Pull Down Resistor
J2, Pin 5	Logic Ground	Pull Down Resistor
J2, Pin 6	Logic Ground	Pull Down Resistor
J2, Pin 7	Logic Ground	Pull Down Resistor
J2, Pin 8	Logic Ground	Pull Down Resistor
J2, Pin 9	Logic Ground	Pull Down Resistor
J2, Pin 10	Logic Ground	Pull Down Resistor
J2, Pin 11	5 Vdc	Supply Voltage for (S2) Com)
J2, Pin 12	Logic Ground	Pull Down Resistor
J3, Pin 1	5 Vdc = VHF/UHF Ant Sel 0 V = VHF/UHF Antenna Not Selected	VHF/UHF Antenna Selection

SECTION V

REPLACEMENT PARTS LIST

SECTION IV

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 designations.

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 designation 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	Mfr. Code	Name and Address
00779	Amp, Incorporated P.O. Box 3608 Harrisburg, PA 17105	04013	Taurus Corporation 1 Academy Hill Lambertville, NJ 08530
01963	Cherry Electrical Products Corp. 3600 Sunset Avenue Waukegan, IL 60087-3214	04713	Motorola, Incorporated 5005 East McDowell Road Phoenix, AZ 85008
02735	RCA Corporation Solid State Division Route 202 Somerville, NJ 08876	09021	Airco, Incorporated Airco Electronics Bradford, PA 17055

Mfr. Code	Name and Address
11139	Deutsch Company The Electronics Components Div. 700 S. Hathaway Municipal Airport Banning, CA 92220
14632	Watkins-Johnson Company CET Division 700 Quince Orchard Road Gaithersburg, MD 20878-1794
15542	Mini-Circuits Laboratory Div. of Scientific Comp. Corp. 2625 East 14th Street Brooklyn, NY 11235
17856	Siliconix, Inc. 2201 Laurelwood Road Santa Clara, CA 95050
19505	Applied Engineering Prod. Co. Div. of Samarius, Inc. 300 Seymour Avenue Derby, CT 06418
22526	Du Pont El De Nemours and Co. Inc., Photo Products Department Berg Electronics Division Rt. 83 New Cumberland, PA 17070
27014	National Semiconductor Corp. 2950 San Ysidro Way Santa Clara, CA 95051
27956	Relcom 3333 Hillview Avenue Palo Alto, CA 94304
28480	Hewlett-Packard Company Corporate Headquarters 1501 Page Mill Road Palo Alto, CA 94304
29990	American Technical Ceramics 1 Norden Lane Huntington Station, NY 11746
33095	Spectrum Control, Incorporated 152 East Main Street Fairview, PA 16415
51628	TEC, Incorporated 2727 North Fairview Avenue Tucson, AZ 85705-4009
51642	Centre Engineering, Inc. 2830 East College Avenue State College, PA 16801-7515
52673	KSW Electronics Corp. South Bedford Street Burlington, MA 01803
55027	Q-Bit Corporation 311 Pacific Avenue, N.E. Palm Bay, FL 32905
59660	Tusonix, Incorporated 2155 North Forbes Blvd. Suite 107 Tuscon, AZ 85745
71279	Cambridge Thermionic Corp. 445 Concord Avenue Cambridge, MA 02138
71468	ITT Cannon Electric 666 East Dyer Road Santa Ana, CA 92702
73138	Beckman Instruments, Inc. Helipot Div. 2500 Harbor Boulevard Fullerton, CA 92634
77306	Piezo Crystal Company 100 K Street P.O. Box 619 Carlisle, PA 17013-1448

Mfr. Code	Name and Address
80294	Bourns, Instruments Incorporated 6135 Magnolia Avenue Riverside, CA 92506
81073	Grayhill, Incorporated 561 Hillgrove Avenue P.O. Box 10373 La Grange, IL 60525-5914
84048	Vernitron Corporation 2801 72nd Street North P.O. Box 4400 St. Petersburg, FL 33743
91293	Johanson Manufacturing Co. P.O. Box 329 Boonton, NJ 07005
98800	American Precision Ind., Inc. Delevan Electronics Division 270 Quaker Road East Aurora, NY 14052-2114

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, serial number option configuration, 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 the 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 semiconductors 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 lists and schematic diagrams of this manual. However, the semiconductors designated in the manual may be substituted in every case with satisfactory results.

5.5 **TYPE WJ-9040 HFE223 HF EXTENDER** MAIN CHASSIS

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
A1	Input Switch	1	371670-1	14632	
A2	Mixer, Amplifier	1	371396-1	14632	
A3	Amplifier/Filter/Switch	1	371671-1	14632	
A4	Digital Interface	1	371672-1	14632	
A5	LED Flexible Board	1	271134-1	14632	
C1	Capacitor, Ceramic, Feedthru: 470 pF, 20%, 500 V	2	54-794-009-471M	33095	
C2	Same as C1				
C3	Capacitor, Ceramic, Feedthru: 0.05 µF, GMV, 300 V	5	54-785-002-503P	33095	
C4 Thru C7	Same as C3				
C8	Capacitor, Mica, Dipped: 110 pF, 2%, 500 V	1	CM04FD111G03	81439	
C9	Capacitor, Mica, Dipped: 220 pF, 2%, 500 V	1	CM04FD221G03	81349	
C10	Capacitor, Mica, Dipped: 24 pF, 5%, 500 V	1	CM04ED240J03	81349	
C11	Capacitor, Mica, Dipped: 240 pF, 2%, 500 V	1	CM04FD241G03	81349	
C12	Capacitor, Mica, Dipped: 20 pF, 5%, 500 V	1	CM04ED200J03	81349	
C13	Capacitor, Mica, Dipped: 200 pF, 2%, 500 V	2	CM04FD201G03	81349	
C14	Capacitor, Mica, Dipped: 56 pF, 2%, 500 V	1	CM04ED560G03	81349	
C15	Same as C13				
C16	Capacitor, Mica, Dipped: 12 pF, 10%, 500 V	1	CM04CD120J03	81349	
C17	Capacitor, Mica, Dipped: 1800 pF, 2%, 500 V	2	CM06FD182G03	81349	
C18	Same as C17				
C19	Capacitor, Ceramic, Disc: 0.47 µF, 10%, 50 V	3	8131-050-X7RO-474K	59660	
C20	Same as C19				
C21	Same as C19				
CR1	Diode	1	5082-2800	28480	
E1	Terminal, Feedthru, Insulated	5	SFU16Y	04013	
E2 Thru E5	Same as E1				
J1	Connector, Receptacle: SMA	1	9412-7113-000	19505	
J2	Same as J5				
J3	Same as J5				
J4	Connector, Receptacle	1	DBSFY-25P	71468	
J5	Connector, Jack: SMA	3	9030-9023-005	19505	
L2	Coil, Toroidal	1	20681-268	14632	
L2	Coil, Toroidal	1	20681-269	14632	
L3	Same as L2				
L4	Coil, Toroidal	1	20681-270	14632	
L5	Coil, Toroidal	1	20681-271	14632	
L6	Coil, Toroidal	1	20681-297	14632	
P1	Connector, Plug	2	9001-7023-005	19505	
P2	Connector, Shell	1	87456-8	00779	

MAIN CHASSIS

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
P3	Not Used				
P4	Connector, Shell	2	87456-8	00779	
R1	Resistor, Fixed, Film: 2.2 kΩ, 5%, 1/4 W	1	CF1/4-2.2K/J	09021	
R2	Resistor, Fixed, Film: 1.0 kΩ, 5%, 1/4 W	1	CF1/4-1K/J	09021	
R3	Resistor, Fixed, Film: 180Ω, 5%, 1/4 W	3	CF1/4-180 OHMS/J	09021	
R4	Same as R3				
R5	Same as R3				
S1	Switch, Thumbwheel	1	T50-63ME	01963	
S2	Switch, Thumbwheel	1	T50-65ME	01963	
U1	Diode	1	ZMSW-1211	15542	
W1	Cable Assembly	1	17300-404-1	14632	
W2	Cable Assembly	1	17300-404-2	14632	
W3	Cable Assembly	1	271757-1	14632	
W1P1	Same as P1				
W2P1	Connector, Plug	1	9043-7523-005	19505	
W3P1	Connector, Multipin	1	66900-026	22526	

5.5.1 **TYPE 371670-1 INPUT SWITCH** REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	4	34452-1	14632	
C2	Same as C1				
C3	Same as C1				
C4	Capacitor, Ceramic, Chip: 4700 pF, 10%, 50 V	1	ATC700B47KP50X	29990	
C5	Same as C1				
CR1	Diode	2	KS4523	52673	
CR2	Diode	3	5082-3188	28480	
CR3	Same as CR2				
CR4	Same as CR2				
CR5	Same as CR1				
E1	Terminal, Forked	3	140-1941-02-01	71279	
E2	Same as E1				
E3	Same as E1				
R1	Resistor, Fixed, Film: 1.5 kΩ, 5%, 1/8 W	4	CF1/8-1.5K/J	09021	
R2 Thru R4	Same as R1				

5.5.2 TYPE 371396-1 MIXER/AMPLIFIER

REF DESIG PREFIX A2

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
C1	Capacitor, Ceramic, Disc: 1000 pF, 5%, 100 V	4	8121-100-COGO-102J	59660	
C2	Same as C1				
C3	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	4	34452-1	14632	
C4	Same as C3				
C5	Same as C3				
C6	Same as C1				
C7	Same as C3				
C8	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 50 V	1	8121-050-651-104M	59660	
C9	Same as C1				
CR1	Diode	1	5082-3188	28480	
E1	Terminal, Forked	7	140-1941-02-01	71279	
C2 Thru E7	Same as E1				
L1	Coil, Fixed, Molded: 8.2 µH	1	1025-42	99800	
R1	Resistor, Fixed, Film: 3.3 kΩ, 5%, 1/4 W	2	CF1/4-3.3K/J	09021	
R2	Resistor, Fixed, Film: 2.7Ω, 5%, 1/4 W	1	CF1/4-2.7 OHMS/J	09021	
R3	Same as R1				
R4	Resistor, Fixed, Film: 2.7 kΩ, 5%, 1/4 W	1	CF1/4-2.7K/J	09021	
U1	Amplifier, RF	1	MWA130	04713	
U2	Voltage Regulator	1	MC78L05ACP	04713	
U3	Mixer, Balanced	1	M9B	27956	
U4	Integrated Circuit	1	DG303ACJ	17856	
U5	Voltage Regulator	1	MC79L15ACP	14713	

5.5.3 TYPE 371671-1 AMPLIFIER/FILTER/SWITCH

REF DESIG PREFIX A3

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
AT1	Attenuator	1	9950-1050	84048	
C1	Capacitor, Ceramic, Disc: 33 pF, 5%, 100 V	1	8121-100-COGO-330J	59660	
C2	Capacitor, Ceramic, Monolithic: 62 pF, ±2%, 100 V	2	150-100-NPO-620G	51642	
C3	Capacitor, Variable, Ceramic: 5-25 pF, 100 V	2	518-000A5-25	59660	
C4	Capacitor, Ceramic, Disc: 18 pF, 5%, 100 V	1	8111-100-COGO-180J	59660	
C5	Capacitor, Ceramic, Monolithic: 20 pF, ±5%, 100 V	1	100-100-NPO-200J	51642	
C6	Capacitor, Variable, Air: 1.0-10 pF, 250 V	4	8052	91293	
C7	Capacitor, Ceramic, Monolithic: 15 pF, 5%, 100 V	4	811-100-COGO-150J	59660	
C8	Capacitor, Ceramic, Monolithic: 22 pF, ±5%, 100 V	1	100-100-NPO-220J	51642	
C9	Same a C6				
C10	Same as C7				
C11	Same as C7				
C12	Same as C6				
C13	Same as C7				
C14	Capacitor, Ceramic, Disc: 68 pF, 5%, 100 V	1	8121-100-COGO-680J	59660	
C15	Same as C3				
C16	Same as C2				
C17	Same as C6				
C18	Capacitor, Ceramic, Disc: 4700 pF, 20%, 50 V	5	8121-050-651-472M	59660	
C19 Thru C22	Same as C18				
C23	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	5	34452-1	14632	
C24	Same as C23				
C25	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	1	34453-1	14632	
C26	Capacitor, Ceramic, Disc: 1000 pF, 5%, 50 V	1	8121-050-COGO-102J	59660	
C27 Thru C29	Same as C23				
C30	Capacitor, Ceramic, Monolithic: 5.1 pF, ±0.25 pF, 100 V	1	100-100-NPO-519C	51642	
CR1	Diode	4	5082-3188	28480	
CR2 Thru CR4	Same as CR1				
E1	Terminal, Forked	9	140-1941-02-01	71279	
E2 Thru E9	Same as E1				
L1	Coil, Fixed: 0.15 µH	5	1537-00	99800	
L2 Thru L5	Same as E1				
L6	Coil, Variable	1	558-7107-11	71279	
L7	Coil, Fixed: 27 µH	1	1537-48	99800	
R1	Resistor, Fixed, Film: 220Ω, 5%, 1/8 W	1	CF1/8-220 OHMS/J	09021	

REF DESIG PREFIX **A3**

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
R2	Resistor, Fixed, Film: 5.6Ω, 5%, 1/8 W	2	CF1/8-5.6 OHMS/J	09021	
R3	Same as R2				
R4	Resistor, Fixed, Film: 1.5 kΩ, 5%, 1/8 W	4	CF1/8-1.5K/J	09021	
R5 Thru R7	Same as R4				
T1	Transformer	2	T16-1	15542	
T2	Same as T1				
U1	Amplifier, RF	1	QBH-118	55027	
U2	Voltage Regulator	1	MC78L1ACP	04713	
U3	Integrated Circuit	1	DG303ACJ	17856	
U4	Voltage Regulator	1	MC79L15ACP	04713	
Y1	Crystal, Quartz: 49.9975 MHz	1	6280901	74306	

5.5.4 TYPE 371672-1 DIGITAL INTERFACE

REF DESIG PREFIX A4

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	6	34452-1	14632	
C2 Thru C5	Same as C1				
C6	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 50 V	3	34475-1	14632	
C7	Same as C6				
C8	Same as C6				
C9	Same as C1				
J1	Terminal, Strip	1	65610-126	22526	
J2	Connector, Receptacle	2	87571-3	00779	
J3	Connector, Receptacle	1	65624-106	22526	
J4	Same as J2				
R1	Resistor, Fixed, Film: 47Ω, 5%, 1/8 W	3	CF1/8-47 OHMS/J	09021	
R2	Same as R1				
R3	Same as R1				
R4	Resistor, Fixed, Film: 10 kΩ, 5%, 1/8 W	1	CF1/8-10K/J	09021	
RN1	Resistor, Network: 100 kΩ	1	4308R-101-104	80294	
RN2	Resistor, Network: 100 kΩ	1	L10-1C105	73138	
S1	Switch, DIP	1	76BS04	81073	
U1	Integrated Circuit	1	MM74HC08N	27014	
U2	Integrated Circuit	1	MM74HC04N	27014	
U3	Integrated Circuit	2	MM74C165N	27014	
U4	Integrated Circuit	1	MM74HC244N	27014	
U5	Integrated Circuit	1	DG303ACJ	17856	
U6	Same as U3				
U7	Integrated Circuit	1	CD4094BE	02735	
U8	Voltage Regulator	1	MC78L15ACP	04713	
U9	Voltage Regulator	1	MC78L05ACP	04713	
U10	Voltage Regulator	1	MC79L15ACP	04713	

5.5.5 TYPE 271134-1 LED FLEXIBLE BOARD

REF DESIG PREFIX A5

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
DS1	Indicator, LED Tri-Light Red, Yellow, Green	1	L-112-ADC	51628	
DS2	Same as DS1				
DS3	Same as DS1				
P1	Connector, PC Board	1	76314-103	22526	

SECTION VI

SCHEMATIC DIAGRAMS

NOTES :
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/8 W.

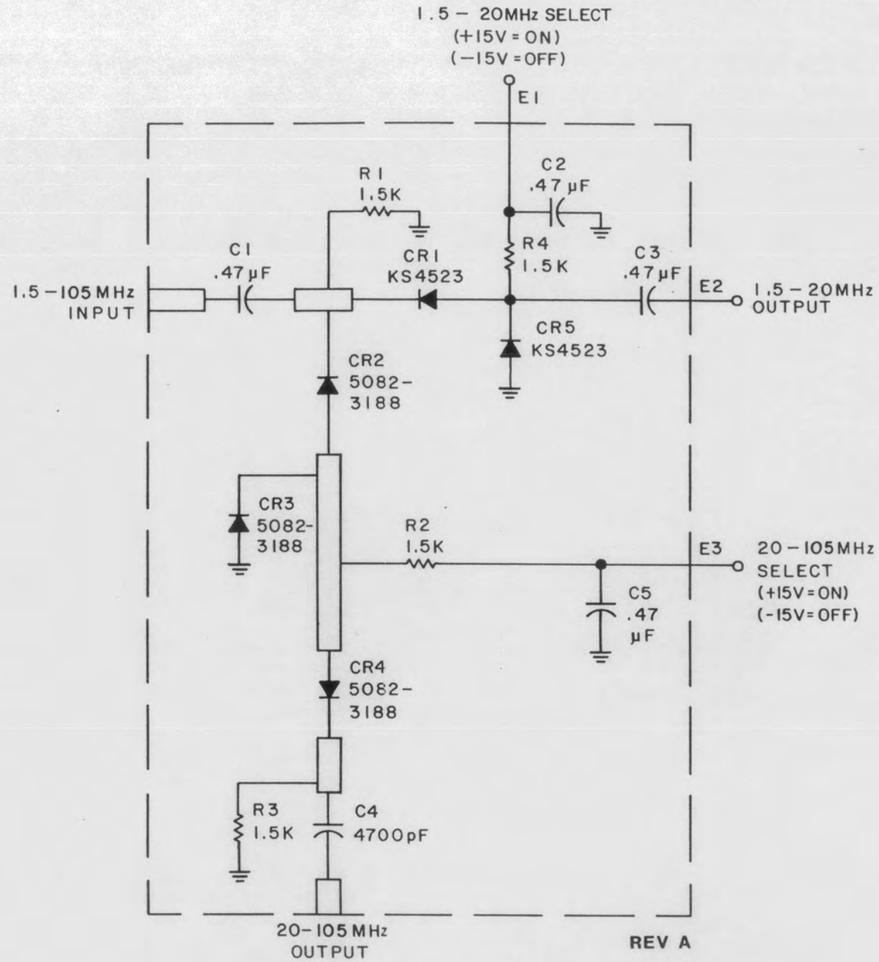


Figure 6-1. Type 371670-1 Input Switch (A1), Schematic Diagram 371678

NOTES:

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

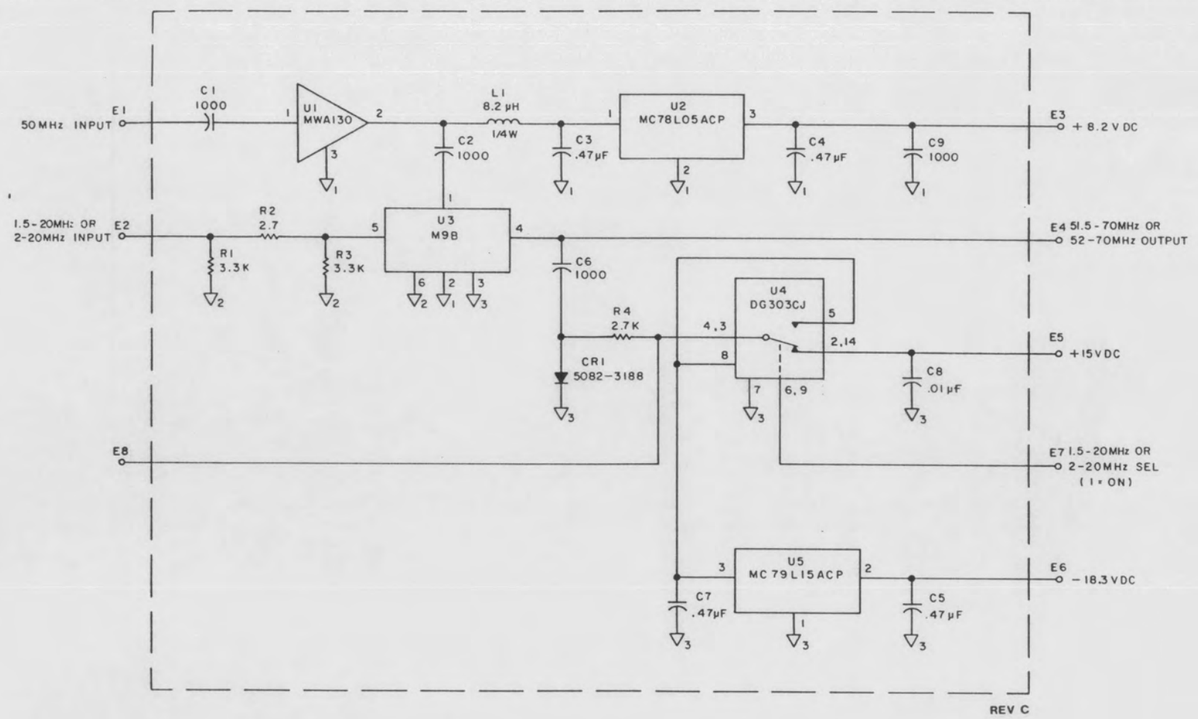
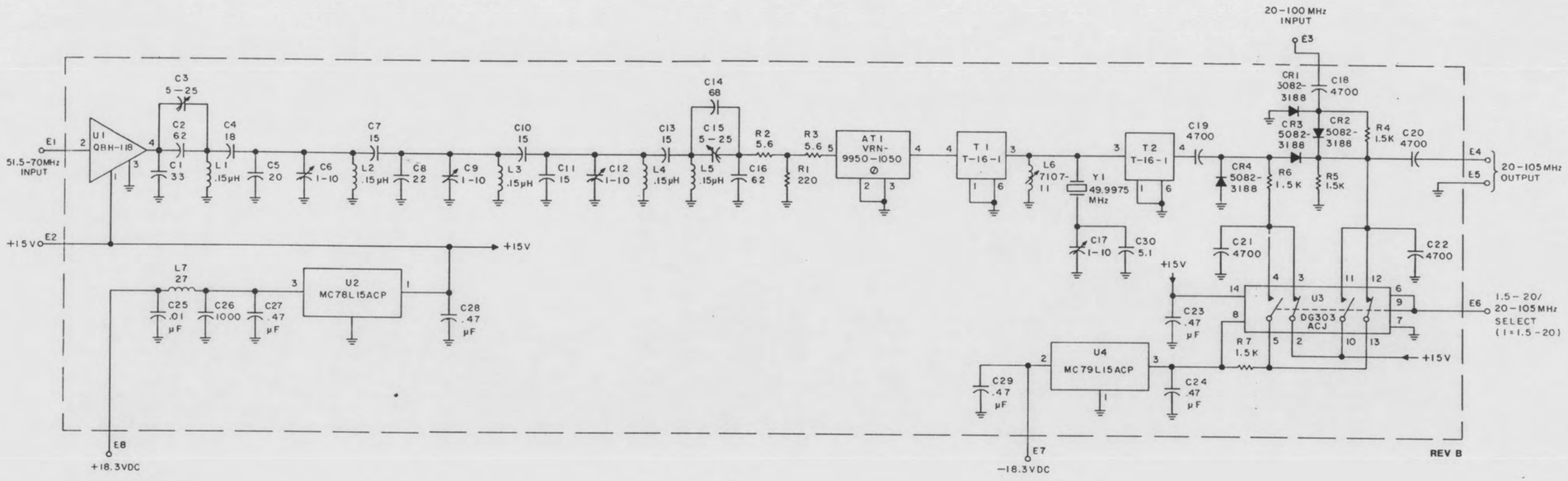


Figure 6-2. Type 371396-1 Mixer/Amplifier (A2), Schematic Diagram 471131



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS ±5%, 1/8W.
   b) CAPACITANCE IS IN pH.
   c) INDUCTANCE IS IN µH.
   d) L1 THRU L5 ARE 1537-00

Figure 6-3 Type 371671-1 Amplifier/Filter/Switch (A3), Schematic Diagram 471279

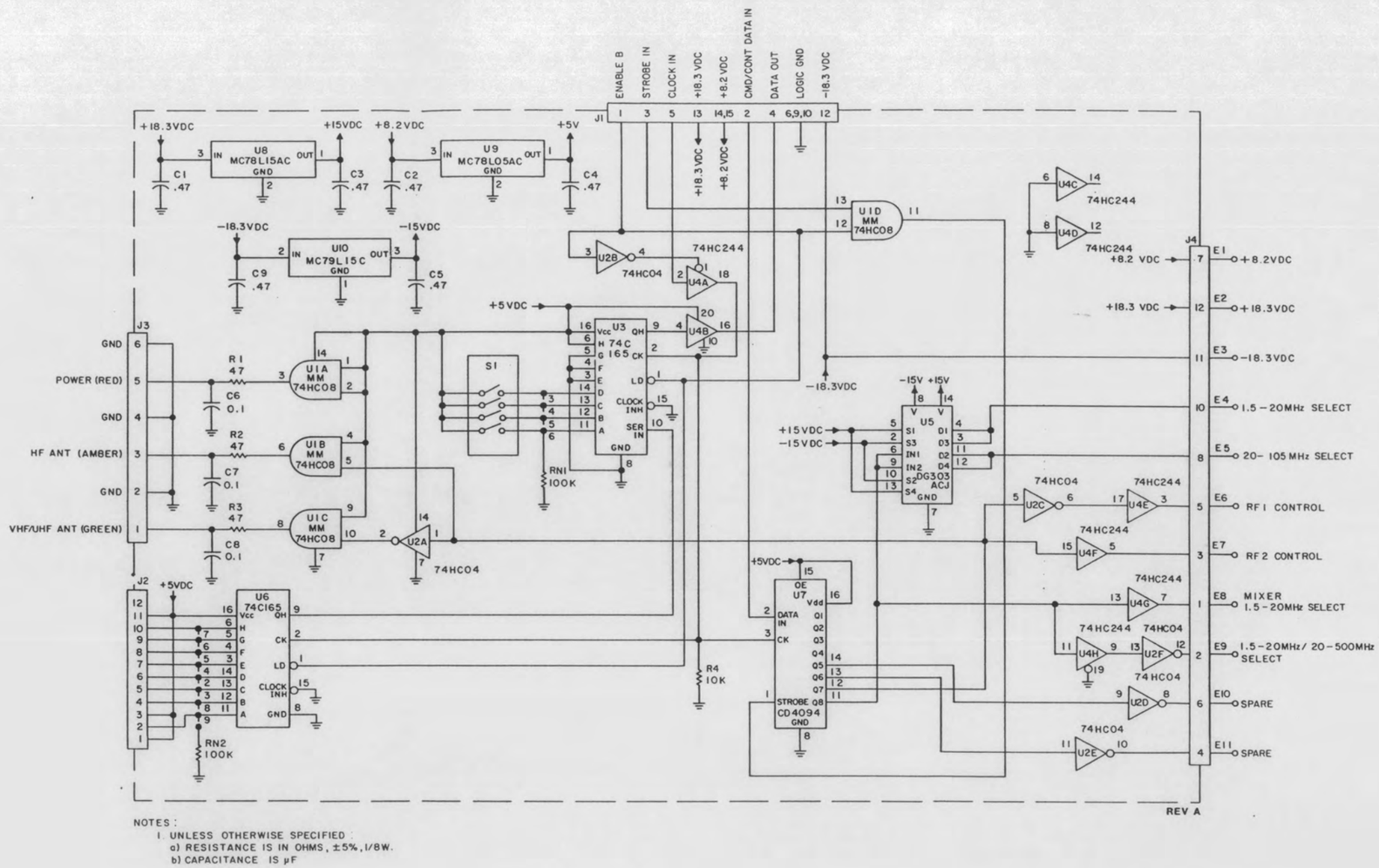


Figure 6-4. Type 371672-1 Digital Interface (A4), Schematic Diagram 471315

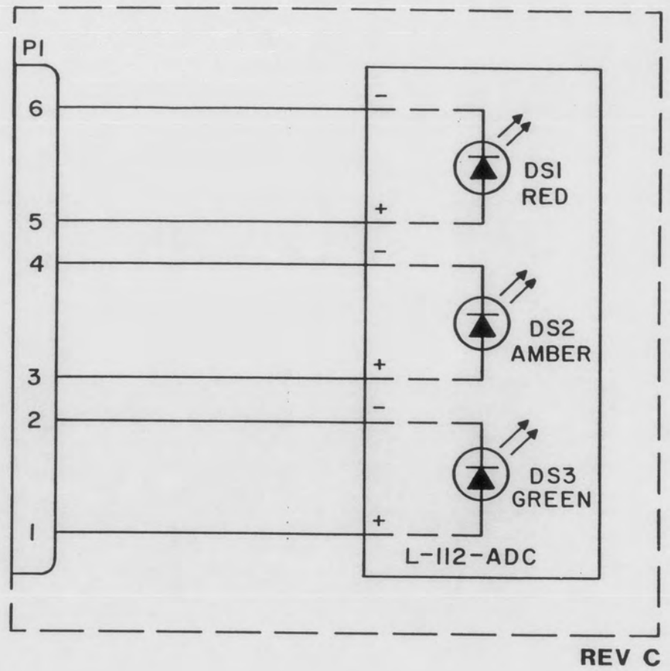


Figure 6-5. Type 271134-1 LED Flexible Board (A5), Schematic Diagram 271135

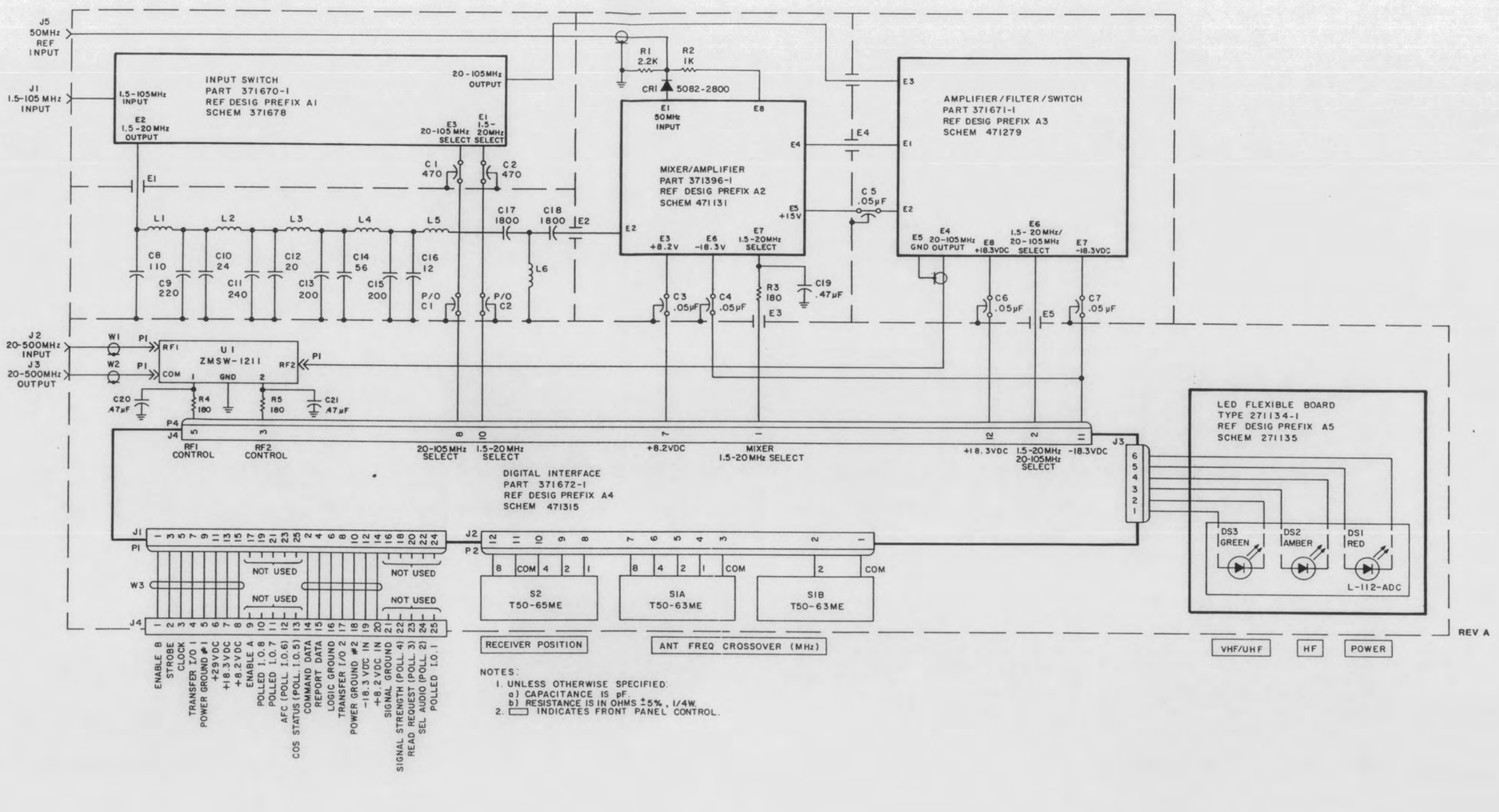


Figure 6-6. WJ-9040 HFE223 HF Extender, Main Chassis Schematic Diagram 471316