INSTRUCTION MANUAL

FOR

WJ-8940B RECEIVING SYSTEM

WATKINS-JOHNSON

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WJ-8940B RECEIVING SYSTEM

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WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted. Extreme caution should be exercised in working with the equipment with any of the protective covers removed.

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SECTION I

GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

1.1.1 The WJ-8940B Receiving System is a multipurpose receiving system designed for reception, measurement and analysis of signals in the frequency range from 5 kHz to 1 GHz. The receiving system is a versatile instrument that is well suited for RFI/EMI electromagnetic compatibility investigations, wideband surveillance coverage, and analysis of narrowband and broadband emanations. To provide these capabilities the WJ-8940B Receiving System includes such features as RF preselection, synthesized local oscillators, automatic RF attenuation, self calibration, logarithmic operation and linear FM detection modes and semi-automatic local or remote control.

1.1.2 Other features are included in the WJ-8940B Receiving System that provide flexibility of operation. A maximum of six sensors may be connected to the receiving system and selected as required by the operator. The receiving system may be manually tuned or scanned between operator set start and stop frequencies. Seventeen IF bandwidths are provided, ranging from 200 Hz to 50 MHz in a 1, 2, 5 sequence. Peak, average and quasi-peak video measurement modes are included, with a selection of time constants and sample rates. Measurements may be made in dBuV for narrowband testing or dBuV/MHz for broadband operation. A display of all parameters of the receiving system and measurement data is provided on an alpha-numeric display for easy reference. In local operation all functions may be entered by the operator through a 32 key-keyboard on the front panel. In the remote mode an external controller can be used to control the functions of the WJ-8940B. Outputs from the receiving system include video, audio, analog X, Y, Z for a storage oscilloscope and digital interfaces for a digital plotter and hardcopy terminal.

1.1.3 The WJ-8940B Receiving System consists of six units. The WJ-8940B Tuner Synthesizer Unit/(TSU), WJ-8940B IF Demodulator/(IFD), WJ-8940B Auxiliary Synthesizer/(AS), WJ-8940B Power Supply/(PS), and the WJ-8940B Circuit Breaker/(CB). Each of these assemblies is modular in design which facilitates mobile or fixed installation.

1.1.4 The Digital Control Unit/(DCU) controls the functions of the WJ-8940B Receiving System. All data and timing required by the TSU, IFD and AS are generated by the DCU based on the parameters entered by the operator in the local mode or from an external controller in the remote mode.

1.1.4.1 The DCU has a LSI-11 microprocessor for its control. The microprocessor is controlled by an operating program stored in a read-only memory (ROM). Operator interface with the DCU consists of a 32 key-keyboard for entering commands, a tuning wheel for frequency control, analog gain controls for audio and AM IF gain and a 256-character alphanumeric display for displaying current WJ-8940B parameters and measurement data. All commands entered by the operator are checked and verified by the DCU. If a command is incorrect, the DCU will prompt the operator to correct the error. This continuous verification of operator commands ensures that all data presented to the system is valid at all times.

1.1.4.2 The DCU can directly control a Tektronix 4662 digital plotter for plotting the results of a scan. After the completion of each single scan the DCU will produce, at the request of the operator, a scaled graph of the scan spectrum with labeled axis on the plotter. A header is printed above the graph, listing the receiving system parameters used for that scan.

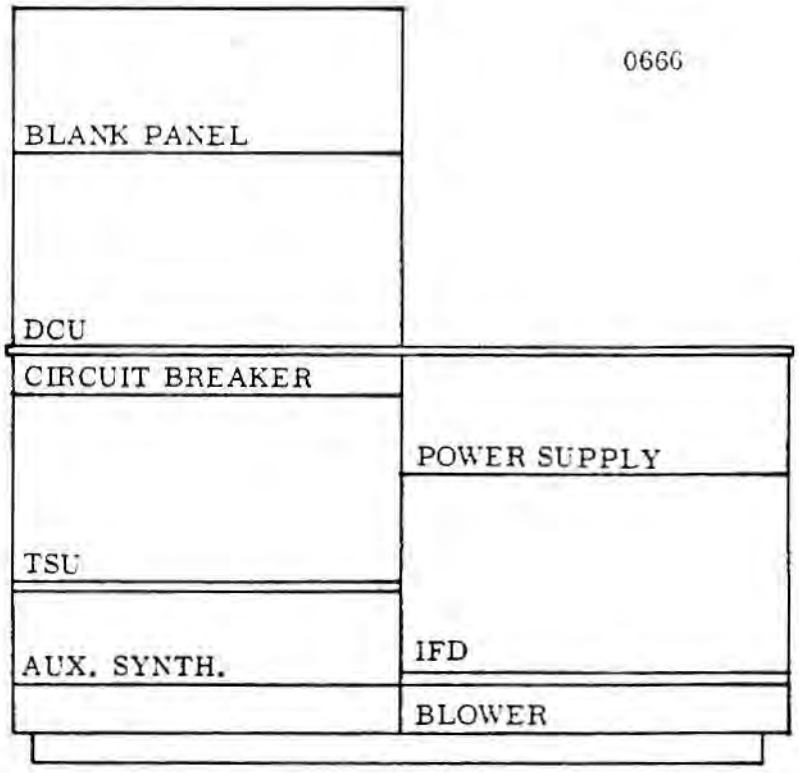

Figure 1-1. WJ-8940B System

1.1.4.3 When performing a repetitive scan, analog X, Y, Z outputs are available from the DCU for driving a storage oscilloscope. This allows immediate visual display of the activity in the scan spectrum.

1.1.4.4 In the remote mode, the DCU takes its commands from a host processor through a parallel interface; refer to Figures 1-2 and 1-3. In this mode, the DCU becomes an interface between the macro commands given through the parallel interface and the micro commands required by the units of the WJ-8940B Receiving System. All commands that can be entered by the operator in the local mode may also be selected remotely.

1.1.4.5 The DCU contains a non-volatile memory for storing receiving system setups. This allows the operator to retain the most commonly used scans in the system. A maximum of one fixed frequency setup and six scan setups may be stored in the DCU.

1.1.5 The Tuner Synthesizer Unit/(TSU) provides frequency coverage from 5 kHz to 999.999999 MHz. Signals inputed to the TSU enter as RF frequencies. Signals below 10 MHz are up converted to 21.4 MHz, and signals above 10 MHz are up converted to 2175 MHz then down converted to 160 MHz or 21.4 MHz. Tuning resolution across the entire frequency range is 1 Hz. The preselectors and calibration impulse generators are also housed in the TSU. A set of eleven fixed tuned and varactor tuned bandpass filters are used as preselectors. The preselectors may be bypassed, if desired, when receiving broadband signals. There are two calibration impulse generators, one is used for lowband (below 10 MHz) and the other is used for highband (above 10 MHz).

1.1.5.1 The TSU interfaces with the remainder of the system via connectors at the back panel. There are six sensor inputs for receiving RF signals within the tuning range of the TSU. Two RF reference signals are used as inputs to the TSU from the Auxiliary Synthesizer. These inputs are the 5 MHz Reference input, and a variable RF reference signal used by the synthesizers in the TSU. Digital control signals to the TSU are received from the Digital Control Unit/(DCU) along the digital TSU bus. The TSU accepts the required dc power supplied by the Power Supply/(PS) from the dc power cable. Ac power used by the TSU for its cooling fan is received from the Power Supply/(PS) along a separate cable. IF signals of 160 MHz and 21.4 MHz and the 1 MHz reference are output from the TSU to the IF Demodulator/(IFD) for detection and processing.

1.1.6 The IF Demodulator/(IFD) provides narrowband and broadband demodulation and measurement of IF Signals from the TSU. The IFD accepts IF signals of 160 MHz and 21.4 MHz. A third IF frequency of 100 kHz is derived from the 21.4 MHz inside the IFD. IF bandwidths in the IFD range from 200 Hz to 50 MHz. The IF filters with bandwidths from 200 Hz to 10 kHz are centered at 100 kHz. IF filters with bandwidths from 20 kHz to 2 MHz are centered at 21.4 MHz. IF filters with bandwidths ranging from 5 MHz to 50 MHz are centered at 160 MHz. All of the IF filters have a minimum shape factor of 4:1 and are either crystal filters or L-C five pole filters.

1.1.6.1 In the log detection mode, the video processor of the IFD provides calibrated measurement of the received signals. Signals passed through the IF filters are analyzed, sampled and converted into a digital form. The digital amplitude is sent to the Digital Control Unit/(DCU) where it is displayed on the front panel. Video processing in the log mode may be done in Peak, Average or Quasi-Peak mode.

1.1.6.2 The IFD interfaces with the remainder of the system via connectors on the back panel. The 160 MHz and 21.4 MHz IF signals used as inputs by the IFD are received from the Tuner Synthesizer Unit/(TSU). Digital control signals to the IFD are received from the Digital

Control Unit/(DCU) along the digital IFD bus. The IFD accepts the required dc power supplied by the Power Supply/(PS) from the dc power cable. Audio and video signals are outputed from the IFD to the Digital Control Unit/(DCU) where they are available to the operator on the front panel. Pan outputs of 160 MHz and 21.4 MHz are outputed from the IFD for use with a signal monitor if desired. IF outputs of 100 kHz, 21.4 MHz and 160 MHz are also provided.

1.1.7 The Auxiliary Synthesizer/(AS) provides a 5 MHz reference signal and a variable frequency RF reference signal to the Tuner Synthesizer Unit/(TSU). The Tuner Synthesizer Unit/(TSU) uses these signals to synthesize the local oscillators of the receiving system.

The AS interfaces to the remainder of the system via connectors at the back panel. The digital control signals to the AS are received from the Digital Control Unit/(DCU) along the digital AS bus. The reference signals are outputed from the AS to the Tuner Synthesizer Unit/(TSU).

1.1.8 The Power Supply/(PS) provides power to the Tuner Synthesizer Unit/(TSU) and the IF Demodulator/(IFD). The dc power supplied to the Tuner Synthesizer Unit/(TSU) and IF Demodulator/(IFD) is at +10, -10; +23, -23; +28, and +36, dc volts. These voltages are further regulated inside the units to insure noise free power. An ac line at 110 volts is provided to the Tuner Synthesizer Unit/(TSU) to power its cooling fan.

1.1.9 The Circuit Breaker Unit/(CB) supplies ac power and circuit protection to the entire WJ-8940B Receiving System and rack enclosure.

1.2 MECHANICAL CHARACTERISTICS

1.2.1 The six units which comprise the WJ-8940B Receiving System are designed for and mounted in a rack. The front panels are heavy machined plates overlaid with black anodized bezels with etched markings. The side and rear panels of the units are also machined plates. All internal subassemblies are mounted on either vertical panels or horizontal decks. The subassemblies are constructed on printed circuit boards, wire wrap planes, plated metal chassis and within machined modules.

1.2.2 All input and output connectors (except for audio and video of the DCU) are mounted on the rear panels of the units. The front panel of the Tuner Synthesizer Unit and IF Demodulator Unit have only green power indicators. The Power Supply and the Circuit Breaker Unit have only ON/OFF POWER switch/indicators. All other controls for the entire WJ-8940B Receiving System are mounted on the Digital Control Unit front panel.

1.3 EQUIPMENT SUPPLIED

1.3.1 The WJ-8940B Receiving System consists of six units: one WJ-8940B/TSU, one WJ-8940B/DCU, one WJ-8940B/IFD, one WJ-8940B/AS, one WJ-8940B/PS, and one WJ-8940B/CB. There is also a blower fan in the rack under the Power Supply. Also included in the cabinet that houses the entire system are interconnecting cables and cables for interface between the WJ-8940B Receiving System and the optional digital plotter. Mating connectors are also supplied for the Remote Control and terminal jacks on the back panel of the DCU.

1.4 RECOMMENDED ANCILLARY EQUIPMENT

Tektronix 4662 Digital Plotter
Teletype Unit with 20 MA current Loop
Headphones
Storage Oscilloscope

Table 1-1. Specifications for WJ-8940B Receiving System

Frequency Range	5 kHz to 999.999999 MHz
Reception Modes	Log, AM, AM/AGC, FM, CW
Sensor Selection:	
Inputs	Six
Isolation	60 dB
Switching Time	Less than 30 ms
Input Attenuator:	
Range	0 to 70 dB in 10 dB steps
Selection	Local, Remote or Automatic as function of RF or IF overload.
Switching Time	Less than 50 ms
RF Input Power:	
Average	2 watts, maximum
Peak	100 watts, 1 sec., 0.001 duty ratio, maximum
Input Impedance	50 ohms
Input VSWR	Less than 2.5:1
AM, FM, CW Sensitivity:	
CW Sensitivity	3 dB C+N/N
5 kHz, IF Bandwidth 200 Hz	23 dBuV
50 kHz, IF Bandwidth 200 Hz	29 dBuV
500 kHz, IF Bandwidth 1 kHz	26 dBuV
5 MHz, IF Bandwidth 5 kHz	19 dBuV
AM, and FM Sensitivity:	

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System Noise Figure	Receiver AM*, FM*, Sensitivity in dBm:																
	200	500	1K	2K	5K	10K	20K	50K	100K	200K	500K	1M	2M	5M	10M	20M	50M
11 dB	-121	-117	-114	-111	-107	-104	-101	-97	-94	-91	-87	-84	-81	-77	-74	-71	-67
13 dB	-119	-115	-112	-109	-105	-102	-99	-95	-92	-89	-85	-82	-79	-75	-72	-69	-65
15 dB	-117	-113	-110	-107	-103	-100	-97	-93	-90	-87	-83	-80	-77	-73	-70	-67	-63

*AM The input signal level in dBm, AM modulated 50% by a 1 kHz tone, will produce 10 dB (S + N)/N minimum when used with a tuner having a noise figure as specified in the Table.

*FM The input signal levels in dBm, FM modulated at a 1 kHz rate with a deviation equal to 30% of the IF bandwidth, will produce 17 dB (S + N)/N minimum when used with a tuner having a noise figure as specified in the Table. For the 5 kHz and 10 kHz IF bandwidths, the FM is modulated at a 400 Hz rate.

Table 1-1. Specifications for WJ-8940B Receiving System (Continued)

Noise Figure:	
10 MHz-50 MHz	11 dB
50 MHz-500 MHz	13 dB
500 MHz-1000 MHz	15 dB
Image Rejection	Greater than 90 dB
IF Rejection	Greater than 90 dB
LO Leakage at Input Port	Less than -90 dBm
Preselector:	
5 kHz-100 kHz	Fixed tuned
100 kHz-1 GHz	Varactor tuned
Bypass mode provided	B.W. approximately 25% of tuned frequency
Intermodulation Intercept Point:	
Third Order	-10 dBm
Second Order	+40 dBm
IF Bandwidths (6 dB points)	17, from 200 Hz to 50 MHz in 1, 2, 5 sequence

IF Center Frequency	Bandwidth	IF Center Frequency	Bandwidth
100 kHz	200 Hz	100 kHz	10 kHz
100 kHz	500 Hz	21.4 MHz	20 kHz
100 kHz	1 kHz	21.4 MHz	50 kHz
100 kHz	2 kHz	21.4 MHz	100 kHz
100 kHz	5 kHz	21.4 MHz	200 kHz
21.4 MHz	500 kHz	160 MHz	10 MHz
21.4 MHz	1 MHz	160 MHz	20 MHz
21.4 MHz	2 MHz	160 MHz	50 MHz
160 MHz	5 MHz		

IF Shape Factors	No greater than 4:1, 60 dB to 6 dB bandwidths
IF Outputs	100 kHz, 21.4 MHz, and 160 MHz
IF Output Level	-10 dBm 100 kHz, 21.4 MHz, -18 dBm 160 MHz IF C.F., into 50 ohms -35 dBm noise level
Signal Monitor Outputs	21.4 MHz and 160 MHz
Signal Monitor Output Level	10 dB greater than RF input level
Video Output Impedance	50 ohms
Video Output Level:	
LOG, AM, CW	
100 kHz IF	0.5 volts, peak-to-peak, minimum
21.4 MHz IF	0.5 volts, peak-to-peak, minimum
160 MHz IF	0.5 volts, peak-to-peak, minimum
FM 30%	1.0 volt peak-to-peak, minimum in 10 kHz, 2 MHz, 20 MHz or greater bandwidths
Audio Output Level	3 mW into 600 ohms at rear panel. 10 milliwatts into 2000 ohms at front panel PHONES jack.
Audio Gain Control Range	Greater than 40 dB

Table 1-1. Specifications for WJ-8940B Receiving System (Continued)

Audio Stretch	Stretches short pulses to increase the average audio power output.
Control Modes:	
Local	Full operation by front panel controls.
Remote	Automatic operation with external controller, TTL-compatible interface, I/O structured for 16 bit data words.
Remote Control Parameters	Frequency, IF Bandwidth. Preselector, Step Size, Detection Mode, Sensor, RF Attenuation, Detector Time Constant, AM IF Gain, Calibrate, Measurement Mode.
Frequency Tuning (Local Mode)	
Manual	Single knob tuning with selectable tuning speeds, keyboard entry
Scan	Single Sweep One Sector, Repetitive Sweep Single or Multiple Sectors
Scan Widths	Start & Stop frequencies presettable from front panel.
Step Size	(F stop-F start)/1000 for each sector; six sectors available
Frequency Resolution	1 Hz from 5 kHz to 999.999999 MHz
Frequency Accuracy	2×10^{-9} per 24 hrs.
Log Mode	Three logarithmic amplifiers. Dynamic Range: 100 kHz IF - 90 dB; 21.4 MHz - 80 dB; 160 MHz - 55 dB
AM Mode	Three linear amplifiers with IF gain control. Detector dynamic range, 30 dB
AM AGC Mode	Three linear amplifiers with 0.05 to 0.5 seconds time constants
FM Mode	Three discriminators, corresponding to maximum IF bandwidths for each channel. Driven via log amplifiers. 20 MHz maximum BW for 160 shelf.
CW Mode	AM mode with BFO (100 kHz and 21.4 MHz IF center frequencies only)
Video Measure:	
Peak	Sample times of .03, 3, 30, 60, 100 msec
Average	R-C time constants of 0.33, 3.3, and 33 msec.
Quasipeak	1 msec charge, 160 msec discharge.

DCU FRONT PANEL CONTROLS

Tuning Wheel
Manual Tuning Step Size
Sixteen Key Keyboard with Following Legends
0-9, - , .
Clear

Table 1-1. Specifications for WJ-8940B Receiving System (Continued)

Enter	
KHz	
MHz	
Fixed Freq	
Cal	
Start/Halt	
Rep Scan Setup	
Rep Scan Start	
Rep Scan Stop	
Rep Scan Resume	
Sector Scan Setup	
Next Sector	
Next Page	
Sector Scan Start	
Next Par	
Part Select	
Par Recall	
Remote/Local	
Reset	
Audio Gain	
AM/IF Gain-(Push to ADJ)	
BFO	
Audio Stretch - ON/OFF	
Video	
Phones	
Power-Push ON/OFF	
Operating Temperature Range**	0 to 40 C
Power Requirements	115/220 Vac, 48-62 Hz, 400 Hz available as an option

** Operation within published specification guaranteed at 25°C ±5°C.

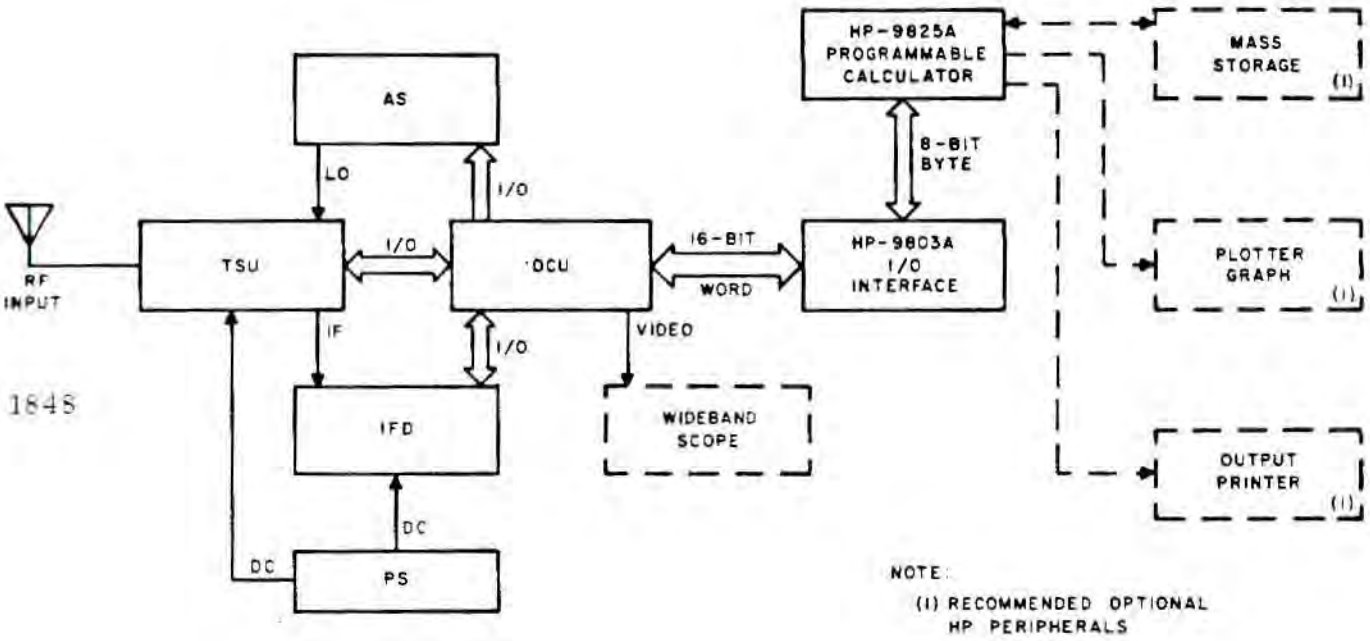
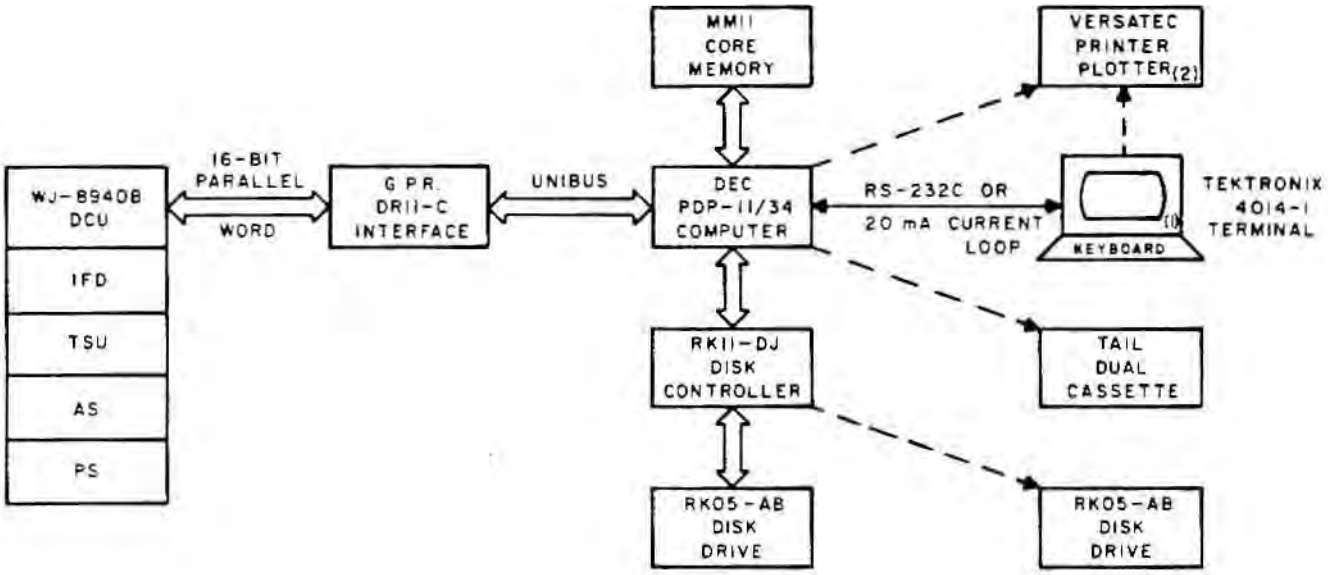


Figure 1-2. WJ-8940B Receiver Test System
Simplified Block Diagram



NOTE

(1) IN PLACE OF TEKTRONIX TERMINAL, USE TEK 4010-1

(2) IN LIEU OF VERSATEC PRINTER/PLOTTER A TEK 4662 DIGITAL PLOTTER CAN BE USED.

(3) OPTIONAL EQUIPMENT, PERIPHERAL, ARE SHOWN IN DOTTED LINES

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Figure 1-3. WJ-8940B Receiver System Simplified Block Diagram

SECTION II

INSPECTION AND INSTALLATION

2.1 INSTALLATION

A Watkins-Johnson Representative will be on hand to unpack, inspect and install the WJ-8940B Reveiving System. Watkins-Johnson ensures that the equipment is installed and in proper operating condition at the customer's facility.

When using the optional Tektronix 4662 digital plotter the 4 interface and option switches on the rear panel of the plotter must be set as follows:

Switch A = 1
Switch B = 1
Switch C = 3
Switch D = B

a

```
RF MHz:12,345678     AMPL:45 DBUV
SENSOR:1             RATE:SLOW
IF BW :200 kHz       NARROWBAND
MODE  :LOG
MEAS  :PEAK
DET TC:30 MS
ATTEN :30 DB AUTO
PRESEL:BYPASS
```

b

```
TUNED FREQUENCY:
ENTER VIA KEYBOARD OR
USE TUNING KNOB
```

c

```
SENSOR:
    ENTER SENSOR NUMBER (1-6)
```

d

```
DATA SAMPLING RATE:
    0-FAST
    1-SLOW
    2-EXTERNAL SYNC
```

e

```
IF BANDWIDTH: MUST BE ENTERED
0:200 Hz     6: 20kHz     12:  2MHz
1:500 Hz     7: 50kHz     13:  5MHz
2:  1kHz     8:100kHz     14: 10MHz
3:  2kHz     9:200kHz     15: 20MHz
4:  5kHz    10:500kHz     16: 50MHz
5: 10kHz    11:  1MHz
```

f

```
VIDEO MEASUREMENT BANDWIDTH:
    0-NARROWBAND
    1-BROADBAND
```

Figure 3-1 DCU Displays

DETECTION MODE:

0 - LOG

1 - AM

2 - AM/AGC

3 - FM

4 - CW

DETECTOR TIME CONSTANT
(AVERAGE)

0 - 30 US

1 - 3 MS

2 - 30 MS

VIDEO MEASUREMENT MODE:

0 - PEAK

1 - AVERAGE

2 - QUASI PEAK

RF ATTENUATOR:

0 - 0 DB

1 - 10 DB

2 - 20 DB

3 - 30 DB

4 - 40 DB

5 - 50 DB

6 - 60 DB

7 - 70 DB

8 - AUTOMATIC

DETECTOR TIME CONSTANT
(PEAK)

0 - 30 US

1 - 3 MS

2 - 30 MS

3 - 60 MS

4 - 100 MS

PRESELECTOR STATUS:

0 - BYPASS

1 - ENGAGED

SECTION III

OPERATION

3.1 GENERAL

3.1.1 The WJ-8940B Receiving System may be operated locally by using the digital control unit front panel controls and display, or remotely via a digital I/O bus located in the DCU. Outputs available from the system are: predetection IF, Video, Audio, Pan Outputs and X-Y-Z. The X-Y-Z output is intended to be used with a storage or variable persistance oscilloscope.

The following paragraphs present an overall description of the front panel controls of the DCU followed by step by step programming tables for the three operation modes in local operation and then a description of the remote control operation.

3.2 DCU CONTROL PANEL

The panel contains all the controls necessary to operate the WJ-8940B. The REMOTE/LOCAL switch at the top right of the controls places the receiver in the remote or local operate mode. In REMOTE the keyboards and tuning wheel are inoperative. The receiver can be controlled only through a computer and suitable interface. Refer to paragraph 3.5. In LOCAL the DCU controls are used to program the receiver.

3.2.1 PLASMA DISPLAY

The display is located directly above the two keyboards. All local programming and control operations are displayed for the operator as these operations are performed. The operator may request programming instructions, that appear on the display, with the PAR(ameter) SELECT key. The unit can also inform the operator when particular functions are in progress or have been completed. Signal amplitude measurements are displayed instantaneously in the Fixed Frequency mode of operation. Detailed explanation of displayed information will be given in the following paragraphs.

3.2.2 DCU KEYBOARDS

There are two keyboards at the center of the control panel (refer to Figure 3-2). The right hand keyboard is used for entering values and codes (in all three of the operating modes). The white digit keys are used for entering decimal values either positive or negative when used in conjunction with the decimal and minus (-) keys. The white keys are also used for entering selection codes. The four grey keys to the left of the white keys are used to enter the information into memory. The MHz and kHz keys enter frequency information into memory expressed in MHz or kHz, however, the frequency is always displayed in MHz. Only the significant digits and decimal point need be entered. When the number is entered into memory it is automatically displayed in MHz with the appropriate number of zeros. The ENTER Key is not used when entering frequencies. The ENTER key is used for entering into memory parameter selection codes of more than one digit, and the threshold levels. The CLEAR key clears incorrect entries from the display, not from memory; new entries are written over previous entries. The CLEAR key is only used in conjunction with frequency entries and threshold levels.

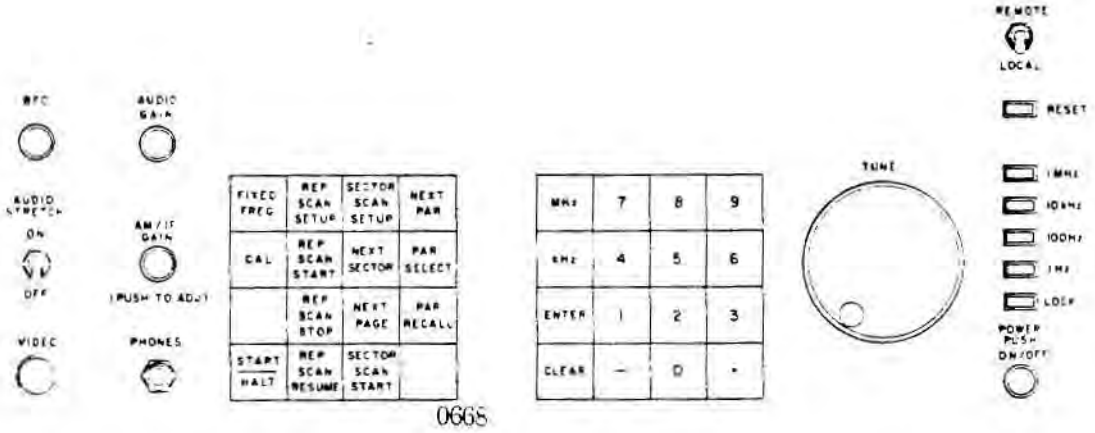


Figure 3-2. DCU Front Panel Controls

The left hand keyboard contains the keys used to command the receiver to perform certain functions. The receiver can be used in three basic operating modes. Reading from the top, left to right, the first three keys, FIXED FREQ, REP SCAN SETUP, and SECTOR SCAN SETUP, select one of the operation modes the receiver is to perform. The FIXED FREQ and CAL keys are used to control the receiver in the Fixed Frequency operation mode. The keys below REP SCAN SETUP are used to program and control the receiver in the Repetitive Scan mode. Similarly the keys below SECTOR SCAN SETUP are used to program and control the unit in the Single Sector scan mode. The three modes of operation are explained in greater detail in paragraph 3.3. The last row of keys is used in programming the three modes of operation. The START/HALT key is used in single sector scan and is described in paragraph 3.3.2.4.

3.2.3 TUNING WHEEL

The tuning wheel provides a manual means of tuning the receiver. It is used only in the Fixed Frequency operation mode. When the LOCK button, directly above the main power switch, is depressed the tuning wheel is disabled. The four buttons above the LOCK button select the tuning increment desired and release the LOCK button if the tuning wheel had been disabled. The receiver can be manually tuned up or down from the current frequency. The DCU memory is updated by the increment selected and displayed at RF MHz in the fixed frequency mode. The tuned frequency can be changed with the tuning wheel independently of the cursor position on the Fixed Frequency display.

3.2.4 RESET

Depressing the RESET button, located above the tuning wheel increment buttons, initiatizes the system and places the receiver in the "ready" state as indicated on the DCU display shown in Figure 3-3. The receiver remains in the "ready " state until one of the operation modes is selected. Resetting the receiver does not erase any of the program data entered for the three operation modes.

W J - 8 9 4 0 B

V E R S I O N X. X. X

R E A D Y

Figure 3-3. Reset Display Message

3.2.5 FRONT PANEL GAIN AND BFO CONTROLS

The AM/IF gain and beat frequency oscillator controls are located to the left of the keyboards. The BFO potentiometer adjusts the beat frequency oscillator when the receiver is being used in the CW detection mode, and the IF bandwidth selected is 2 MHz or less. The AM/IF GAIN control adjusts the IF gain in the AM, MAN, or LOG detection mode. AUDIO GAIN adjusts the audio level at the headphone jack (PHONES). The audio output level at the PHONES jack is 10 mW into 2000 ohms. The VIDEO output jack provides a detected output at 0.5 V peak-to-peak into 50 ohms for additional monitoring equipment.

The AUDIO STRETCH switch is used to lengthen short signal impulses in order to make them more audible.

3.3 OPERATION MODES

The three modes of operation in which the receiver can be used are described in the following paragraphs. A step by step programming chart is provided for each operation mode. Remote programming is described in paragraph 3.5.

3.3.1 FIXED FREQUENCY OPERATION

The Fixed Frequency mode is used when the operator wishes to monitor a specific point in the frequency spectrum of the receiver. This mode of operation is used for signal intelligence monitoring or for manually tuning to a precise area of the frequency band in conjunction with a signal monitor or other equipment.

The parameters programmed into the receiver for fixed frequency operation are shown in Figure 3-3 as they appear on the display when the FIXED FREQ key is depressed.

3.3.1.1 Fixed Frequency Program Keys

The following keys are used to program the receiver in the Fixed Frequency mode.

1. The right hand keyboard is used in all the operation modes as described in paragraph 3.2.2.

2. FIXED FREQ switches the receiver into the fixed frequency mode. The parameters for this mode are displayed.

3. NEXT PAR (next parameter) moves the cursor from one parameter to the next, left to right; top to bottom, on the display. The cursor position is part of the encoding of the programmable functions and must be opposite the parameter to be programmed through the keyboards. The RF MHz frequency can be adjusted with the tuning wheel independent of the cursor position but to use the right hand key board to enter this parameter the cursor must be at RF MHz. This key is used in all three operation modes.

4. PAR SELECT (parameter select) provides the operator with a display of instructions for entering the necessary values or codes for the parameter indicated by the cursor. This key is used in all three modes of operation.

5. PAR RECALL (parameter recall) is used only for recalling the tuned frequency (RF MHz) in this mode. If an error is made in the process of entering a new tuned frequency the previous tuned frequency may be recalled with this key, provided the MHz or kHz key has not been depressed.

6. CAL (calibrate) instructs the receiver to go through its calibration procedure at the current RF frequency. The receiver automatically goes through its calibration procedure when the

FIXED FREQ key is depressed. If however the fixed frequency mode is used for an extended length of time the CAL key should be used.

The tuning wheel and increment keys, BFO, AUDIO GAIN, AM/IF GAIN and head phones are also employed in this mode.

3.3.1.2 Fixed Frequency Parameters

The following is a list of the parameters for the fixed frequency mode as shown in Figure 3-1. A brief description of each parameter is given, including the PAR SELECT information contained in memory for that parameter.

1. RF MHz: is the tuned frequency of the receiver entered with the keyboard or tuning wheel. It is displayed as an eight digit number in MHz. From 5 kHz to 999.999999 MHz. Reference Figure 3-1(a) and (b).

2. AMPL: (amplitude) is a display of the RF signal amplitude being received. If the receiver is operating in the Log Detection mode in NARROWBAND the AMPL level is expressed in dB μV, in BROADBAND it is expressed in dB μV/MHz.

3. SENSOR: is the signal input source (from an RF antenna for example). There are six sensors available on the receiver. Codes 1 through 6 select the sensors. Reference Figure 3-1(c).

4. RATE: is the rate at which amplitude measurements are being taken. In FAST the receiving system will take measurements at a rate determined by the settling time of the selected IF bandwidth and the selected detector time constant. In SLOW the Digital Control Unit/(DCU) determines the measurement rate by taking the FAST rate and adding an extra 25 msec. In EXT the sample rate of the receiving system is controlled by an external TTL signal input to the EXT SYNC connector on the back panel of the DCU. A sample is taken on the leading edge of the TTL signal. If the EXTERNAL SYNC mode is selected with no EXTERNAL SYNC applied, the receiver will lock up and the reset button must be used to regain control of the system. Reference Figure 3-1(d).

5. IF BW: (IF Bandwidth) displays the bandwidth through which the receiver is processing signals. There are seventeen bandwidths shown in Figure 3-1(e) with their program codes.

6. NARROWBAND/BROADBAND: The receiver operates in either video measurement mode selectable by the codes shown in Figure 3-1(f). When the receiver is operating in the log detection mode the AMPL is expressed in dB μV in NARROWBAND and dB μV/MHz in BROADBAND.

7. MODE: displays the detection mode in which the receiver is operating. The five modes and selection codes are shown in Figure 3-1(g). The gain in the AM mode is adjusted with the

AM/IF gain control. The AM/IF Gain Control must be pushed in to engage the control. In the CW mode the BFO is adjusted with the BFO control. If the receiver is operating in any of the linear detection modes the AMPL level is not expressed in dB μV but is an uncalibrated relative measurement used for signal strength comparisons.

8. MEAS: (measurement) indicates the video measurement mode. The codes for the three measurement modes are shown in Figure 3-1(h). In the PEAK mode video processor measurements are taken within a time "window" as indicated in the next parameter, DET TC. There are five "windows" from 30 μsec to 100 msec. In the AVERAGE mode an equal attack and decay time established by RC time constants forms the measurement window. There are three time constants from 30 μsec to 30 msec. In QUASI-PEAK there is only one attack and decay time of unequal length where the attack time is shorter than the decay time, the resultant measurement falls between a peak and average measurement.

9. DET TC: (detector time constant) displays the time constant selected for the video measurement mode programmed to the previous parameter (8), as shown in Figures 3-1 (i) and (j).

10. ATTEN: (attenuation) displays the RF attenuator selected. The codes and levels are shown in Figure 3-1(k). The amplitude level is corrected relative to the attenuation selected. Code 8 selects automatic attenuation as a function of IF and RF overload.

11. PRESEL: (preselector) displays the status of the preselectors as shown in Figure 3-1(l). The frequency range of the receiver is divided into eleven preselector bands. The preselector bandwidth is approximately 25% of the tuned frequency of the tuner, and may be bypassed if the preselector bandwidth is less than the IF Bandwidth.

3.3.1.3 Programming Procedure; Fixed Frequency Operation

Table 3-1 tabulates the step by step programming procedure to set up the receiver for fixed frequency operation. Figures 3-1(a) through 3-1(l) illustrate the display for each step in the programming sequence. The PAR SELECT key is an optional step that need not be used when the operator is familiar with the procedure and selection codes. The step by step procedure is intended to help the operator become familiar with the DCU controls. In normal use the parameters may be selected and programmed in any order.

Table 3-1. Operation Mode: Fixed Frequency

(*optional not part of program)

STEP	KEY	DISPLAY	DESCRIPTION
1	FIXED FREQ.	Figure 3-1(a) Parameter for the fixed frequency mode. Cursor at RF MHz.	The FIXED FREQ key places the receiver in the fixed frequency mode of operation. If the display for this mode does not appear press RESET then FIXED FREQ.
2*	PAR SELECT	Instructions for entering tuned frequency.	Tuned frequency may be entered using the tuning wheel or digit keys in right hand keyboard. Entries made with digit keys require the operator to enter only the significant digits and decimal point. Additional zeros are added automatically. The tuning wheel tunes up or down from last frequency entered at increments selected by grey buttons (1 MHz, 10 kHz, 100 Hz, 1 Hz).
3	DIGIT KEYS	Figure 3-1(a) Tuned frequency displayed at RF MHz.	
4	kHz or MHz	Figure 3-1(a) Tuned frequency appears at RF MHz in MHz with necessary zeros.	These keys enter the tuned frequency into memory expressed in MHz. The ENTER Key is not used. Tuning with the tuning wheel may be done at any point in the program. Entry into memory is automatic at each increment selected.
5	NEXT PAR	Figure 3-1(a) Cursor moves to SENSOR.	
6*	PAR SELECT	Figure 3-1(c) Select sensor 1 thru 6	
7	DIGIT KEY	Figure 3-1(a) Sensor number selected is displayed.	Direct entry. ENTER key is not used.
8	NEXT PAR	Figure 3-1(a) Cursor moves to RATE.	
9*	PAR SELECT	Figure 3-1(d) Codes for RATE are displayed.	Code 1-3.

Table 3-1. Operation Modes: Fixed Frequency (Continued)

STEP	KEY	DISPLAY	DESCRIPTION
10	DIGIT KEY	Figure 3-1(a) Rate selected is displayed.	Direct entry. ENTER key is not used.
11	NEXT PAR	Figure 3-1(a) Cursor moves to IF BW.	
12*	PAR SELECT	Figure 3-1(e) Codes for the 17 IF bandwidths.	Code 0-16.
13	DIGIT KEYS	Figure 3-1(a) IF BW selected is displayed.	The bandwidth is displayed in MHz or kHz.
14	ENTER	Figure 3-1(a) IF BW selected is displayed.	IF BW is entered into memory.
15	NEXT PAR	Figure 3-1(a) The cursor moves to video BANDWIDTH (BROADBAND/ NARROWBAND).	
16*	PAR SELECT	Figure 3-1(f) Codes for video bandwidth.	Codes 0 or 1.
17	DIGIT KEY	Figure 3-1(a) NARROWBAND or BROADBAND is displayed.	Direct entry. ENTER key is not used.
18	NEXT PAR	Figure 3-1(a) Cursor moves to MODE (detection).	
19*	PAR SELECT	Figure 3-1(g) Codes for detection mode.	Codes 0-4.
20	DIGIT KEY	Figure 3-1(a) Detection mode displayed.	Direct entry. ENTER key is not used.

Table 3-1. Operation Modes: Fixed Frequency (Continued)

STEP	KEY	DISPLAY	DESCRIPTION
21	NEXT PAR	Figure 3-1(a) Cursor moves to MEAS (video measurement mode.)	
22*	PAR SELECT	Figure 3-1(h) Codes for video measurement mode.	Codes 0-2.
23	DIGIT KEY	Figure 3-1(a) Video measurement mode is displayed.	Direct entry. ENTER key is not used.
24	NEXT PAR	Figure 3-1(a) Cursor moves to DET TC (detector time constant).	
25*	PAR SELECT	Figures 3-1(i) & (j) Codes for detector time constant.	Codes 0-4 Peak Mode or 0-2 Average Mode
26	DIGIT KEY	Figure 3-1(a) DET TC is displayed.	Direct entry. ENTER key is not used.
27	NEXT PAR	Figure 3-1(a) Cursor moves to ATTEN (RF attenuation).	
28*	PAR SELECT	Figure 3-1(k) Codes for RF attenuation.	Code 0-7 and 8. Code 8 is for selecting automatic RF attenuation.
29	DIGIT KEY	Figure 3-1(a) Attenuation level is displayed with auto indication if selected.	
30	NEXT PAR	Figure 3-1(a) Cursor moves to PRESEL (preselector status).	
31*	PAR SELECT	Figure 3-1(l) Codes for preselector status.	
32	DIGIT KEY	Figure 3-1(a) Preselector status displayed.	Direct entry. ENTER key is not used. Fixed Frequency program completed.

3.3.2 SINGLE SECTOR SCAN OPERATION

In single sector scan operation the receiver is programmed to scan between points in the frequency spectrum. The portion of the frequency spectrum to be scanned is called a Sector. There is facility in the memory for storing the parameters of up to six Sectors. Once programmed into the receiver's DCU any one of the six Sectors may be recalled and scanned. The Sector scan must be at least 1 kHz. The spectrum is divided into a scan of 1000 points. All data for each point is corrected and stored in memory for a plot or data table. Calibration of the receiver occurs at the beginning of the scan and every 10% of the preselector bands through- out the range of the scan. The data is then corrected from calibration factors stored in the calibration memory.

A threshold level can be programmed into the receiver so that all signal levels above threshold are recorded and stored in memory until the completion of the scan. Upon completion of the scan the receiver asks the operator for a command to initiate a plot of the signal activity for the scan on a peripheral plotter. The threshold is included on the plot thus indicating all signals above threshold. Following the plot the receiver requests a command to print a data table via a peripheral TTY or line printer. Signals above threshold are indicated with an asterisk on the data table.

3.3.2.1 Single Sector Scan Program Keys

The following keys are used to program and operate the receiver in the Sector Scan mode.

1. The right hand keyboard is used in all operation modes. See paragraph 3.2.2.

2. SECTOR SCAN SETUP: switches the receiver into the Sector Scan mode. Page one of the sector scan parameters is displayed.

3. NEXT SECTOR: steps the receiver through the six sector programs stored in memory. Page 1 of the sector is displayed as each sector is selected.

4. NEXT PAGE: steps the display from page 1 to page 2. Depressing the key a second time returns the display to page 1. The SENSOR number appears on both pages, but may only be changed on page 1.

5. SECTOR SCAN START: initiates a scan of the sector selected.

6. START/HALT: aborts a plot or initiates and aborts a data table print out.

7. NEXT PAR, PAR SELECT, PAR RECALL: serve the same function as in the Fixed Frequency mode. See paragraph 3.3.1.1.

The tuning wheel and, increment keys are not used in this mode.

3.3.2.2 Single Sector Scan Parameters

The following is a list of the parameters for the Sector Scan mode. The parameters are displayed on two pages selectable by the NEXT PAGE key. Figure 3-4(a) shows the display for page 1, Figure 3-14(d) for page 2. The list starts from the top of page 1 with a brief description of each parameter including the PAR SELECT information contained in memory for that parameter.

1. SECTOR: displays the number of the sector in which the receiver is operating.

2. SENSOR: is the signal input source as in Fixed Frequency. There are six sensors available. Codes 1 through 6 select the sensors. Any sensor can be selected for each sector. The sensor can only be selected on page 1.

3. START: displays the RF frequency from which the receiver starts its scan. It is entered with the right hand keyboard and is displayed in MHz. The Start Frequency must be lower than the Stop Frequency by at least 1 kHz.

4. STOP: displays the RF Frequency to which the receiver scans. It is entered with the right hand keyboard and is displayed in MHz. The stop frequency must be greater than the Start Frequency by at least 1 kHz.

5. ACTUAL: displays the RF frequency as the receiver performs a scan.

6. INTERCEPT: displays the intercept status, ON or OFF, selectable by codes 0 or 1 shown in Figure 3-4b. If the intercept is ON, the threshold level is indicated on plots made after the scan and the inclusion of an asterisk against all signal levels above threshold on the data table.

7. THRESHOLD: displays the signal level at which interception takes place. It is entered through the right hand keyboard and can be set between -40 dB μV to 220 dB μV as shown in Figure 3-4c. The plotter range for any particular IF bandwidth may be found by depressing the PAR SELECT key.

8. PAGE 2: displays the IF BW, MODE, MEAS, NARROWBAND/BROADBAND, DET TC, ATTEN and PRESEL parameters identical to the Fixed Frequency mode. Described in paragraph 3.3.1.2. The Sector and Sensor number is also displayed on Page 2.

3.3.2.3 Programming Procedure: Single Sector Scan Operation

Table 3-2 tabulates the step by step programming procedure to setup the receiver for Sector Scan operation. Figures 3-1a through 3-41 illustrate the display for each step in the programming sequence. The PAR SELECT key is an optional step as in the Fixed Frequency setup procedure.

Table 3-2. Operation Mode: Single Sector Scan

(*optional not part of program)

STEP	KEY	DISPLAY	DESCRIPTION
1	SECTOR SCAN SETUP	Figure 3-4(a) Setup page 1. SECTOR 1. Cursor at SENSOR:	The SECTOR SCAN SETUP key places the receiver in the Sector Scan mode of operation. If the display for this mode does not appear press RESET key then SECTOR SCAN SETUP. Page 1 of the SECTOR SETUP is always displayed with this key.
2	NEXT SECTOR	Figure 3-4(a) Setup page 1 SECTOR 2 Cursor still at SENSOR:	The cursor does not appear opposite the SECTOR parameter. The NEXT SECTOR key steps the receiver and display through the 6 sectors. Sector selection can be made at any point in the setup independent of the cursor position and will always return display to page 1 of the selected Sector.
3*	PAR SELECT	Figure 3-1(c) Select Sensor 1 - 6	One of six may be selected for each Sector. The same Sensor may be used for more than one Sector. Selectable only on page 1.
4	NEXT PAR	Figure 3-4(a) Cursor moves to START: (frequency)	
5*	PAR SELECT	Figure 3-1(b) Instructions for entering START frequency.	The tuning wheel cannot be used. Enter via digit keys. This frequency is the starting point of the scan.
6	DIGIT KEYS	Figure 3-4(a) Start frequency appears at START:	Only significant digits and decimal point need be entered. Additional zeros are added automatically.
7	MHz or kHz	Figure 3-4(a) Start frequency appears in MHz with appropriate zeros.	These keys enter the start frequency into memory, expressed in MHz. The ENTER key is not used.
8	NEXT PAR	Figure 3-4(a) The cursor moves to STOP: frequency.	

Table 3-2. Operation Mode: Single Sector Scan (Continued)

STEP	KEY	DISPLAY	DESCRIPTION
9*	PAR SELECT	Figure 3-1(b) Instructions for entering Stop frequency.	The Stop frequency is entered in the same manner as the Start frequency steps 6 and 7. This frequency is the end of scan.
10	DIGIT KEYS	Figure 3-4(a) Stop frequency appears at STOP:	The Stop frequency must be greater than the Start frequency by at least 1 kHz.
11	MHz or kHz	Figure 3-4(a) Stop frequency appears in MHz with appropriate zeros.	
12	NEXT PAR	Figure 3-4(a) Cursor moves to INTERCEPT.	
13*	PAR SELECT	Figure 3-4(b) Codes for Intercept control.	Code 0 - NO is displayed as OFF Code 1 - Yes is displayed as ON
14	DIGIT KEY	Figure 3-4(a) Intercept status is displayed.	Direct entry. The ENTER key is not used.
15	NEXT PAR	Figure 3-4(a) Cursor moves to THRESHOLD	
16*	PAR SELECT	Figure 3-4(a) Instruction to enter Intercept Threshold level.	
17	DIGIT KEYS	Figure 3-4(a) THRESHOLD: level is displayed.	Enter significant digits, decimal and sign
18	ENTER	Figure 3-4(a) THRESHOLD level.	The threshold level in entered into memory.
19	NEXT PAGE	Figure 3-4(d) Setup page 2. Cursor at IF BW	

Table 3-2. Operation Mode: Single Sector Scan (Continued)

STEP	KEY	DISPLAY	DESCRIPTION
20*	PAR SELECT	Figure 3-1(e) Codes for the 17 IF bandwidths.	Codes 0-16
21	DIGIT KEY(s)	Figure 3-4(d) IF BW selected is displayed.	Select 0-16. The bandwidth is displayed in MHz or kHz.
22	ENTER	Figure 3-4(d) IF BW selected is displayed.	The IF bandwidth is entered into memory.
23	NEXT PAR	Figure 3-4(d) Cursor moves to MODE: (detection).	
24*	PAR SELECT	Figure 3-1(g) Codes for detection mode.	Codes 0-4
25	DIGIT KEY	Figure 3-4(d) Detection Mode displayed.	Direct entry. ENTER key is not used. Select code 0-4.
26	NEXT PAR	Figure 3-4(d) Cursor moves to MEAS: (video measurement mode).	
27*	PAR SELECT	Figure 3-1(h) Codes for video measurement modes.	Codes 0-2
28	DIGIT KEY	Figure 3-4(d) Video measurement mode is displayed.	Direct entry. ENTER key is not used. Select code 0-2.
29	NEXT PAR	Figure 3-4(d) Cursor moves to NARROWBAND or BROADBAND.	This is the Video bandwidth.
30*	PAR SELECT	Figure 3-1(f) Codes for Video bandwidth.	Codes 0 or 1.

Table 3-2. Operation Mode: Single Sector Scan (Continued)

STEP	KEY	DISPLAY	DESCRIPTION
31	DIGIT KEY	Figure 3-4(d) NARROWBAND or BROADBAND is displayed.	Direct entry. ENTER key is not used. Select code 0 or 1.
32	NEXT PAR	Figure 3-4(d) Cursor moves to DET TC (detector time constant).	
33*	PAR SELECT	Figures 3-1(i), 3-1(j) Codes for detector time constant.	Codes 0-4 (Peak) Codes 0-2 (Average).
34	DIGIT KEY	Figure 3-4(d) Detector time constant is displayed.	Direct entry. ENTER key is not used. Select code 0-4 or 0-2.
35	NEXT PAR	Figure 3-4(d) Cursor moves to ATTEN. (RF attenuator).	
36*	PAR SELECT	Figure 3-1(k) Codes for RF Attenuation.	Codes 0-7 and 8. Code 8 places selected attenuation in auto mode.
37	DIGIT KEY	Figure 3-4(d) Attenuation level is displayed with AUTO indication if selected.	Enter direct. ENTER key is not used. Select code 0-7 and 8.
38	NEXT PAGE	Figure 3-4(a) Setup page 1 of selected Sector.	This key changes the display back to page 1. It does not change the Sector number.
			Sector Scan program completed.

3.3.2.4 Single Sector Scan: X/Y Plots and Data Tables

Any one of the six sectors may be selected and scanned once all the parameters are programmed into the DCU memory. Upon completion of the scan the operator is asked if an X/Y plot is desired as shown in Figure 3-4(e). If a plot is requested the display indicates that a plot is in progress as Figure 3-4f. When the plot is completed, as shown in Figure 3-4(g), the operator is asked if a data table is desired in Figure 3-4(h).

To initiate a data table the operator must first enter the Start and Stop frequencies for the table. These are shown on the display as in Figure 3-4(i). Upon completion of the table the operator is given the option to request another as shown in Figure 3-4(j). If a second table is desired the Start and Stop frequencies must again be entered.

The program for requesting X/Y plots and data tables is shown, step by step, in Table 3-3. The START/HALT key is used to abort the plot or data table in progress or initiate the data table after the start and stop frequencies have been entered.

Table 3-3. Single Sector Scan: Plot and Data Table Program

(*optional not part of program)

STEP	KEY	DISPLAY	DESCRIPTION
1	SECTOR SCAN START	Figure 3-4(a) ACTUAL FREQ: Will count thru scan.	Receiver scans sector from START frequency to STOP frequency. Data is stored in memory. Completion of scan will be indicated on display.
2		Figure 3-4(e) Scan complete. Do you want an X/Y plot?	
3	DIGIT KEY	Figure 3-4(e)	Direct Entry. ENTER key is not used. Select 1 for YES or 0 for NO.
4		Figure 3-4(f) Plot in progress.	
5*	HALT		START/HALT key depressed if operator wishes to terminate a plot in progress.
6		Figure 3-4(g) X/Y plot completed.	The sector number is also displayed.
7		Figure 3-4(h) Do you want a data table?	
8	DIGIT KEY	Figure 3-4(h)	Direct Entry. ENTER key is not used. Select YES or NO.

Table 3-3. Single Sector Scan: Plot and Data Table Program (Continued)

STEP	KEY	DISPLAY	DESCRIPTION
9		Figure 3-4(i)	If yes START and STOP frequencies must be entered. Cursor is at START frequency on display. ENTER with digit keys and MHz or kHz keys.
10	NEXT PAR	Figure 3-4(i) Cursor moves to STOP frequency	Enter STOP frequency using digit keys and MHz or kHz.
11	START	Figure 3-4(i)	Initiate data table printout.
12		Figure 3-4(j) Data table complete. Do you want another?	If another data table is required steps 8 thru 11 must be repeated.

NOTE: Once scan is run data table frequencies can be selected from plotter.

3.3.3 REPETITIVE SCAN OPERATION

The Repetitive Scan operation mode is used to scan one or more sectors cyclically until either REP SCAN STOP is depressed or until a signal is received that exceeds the threshold level for that Sector. The receiver then switches to the Fixed Frequency mode at the frequency to which it is tuned at that instant. All the parameters for the sector in which the tuned frequency falls are displayed including the tuned frequency. If REP SCAN STOP is depressed and then the operator wishes to return to repetitive scan, REP SCAN RESUME returns the receiver to the repetitive to the repetitive scan mode and scanning is continued from that frequency at which it had been stopped.

3.3.3.1 Repetitive Scan Program Keys

The following keys are used to program the receiver in the Repetitive Scan mode.

1. The right hand keyboard is used in all the operation modes as described in paragraph 3.2.2.

2. REP SCAN SETUP: (repetitive scan setup) places the receiver in the repetitive scan mode. The repetitive scan range is displayed as shown in Figure 3-4k.

3. REP SCAN START: initiates the scanning cycle after the first and last sectors have been entered into memory. The sector being scanned and the actual frequency are displayed throughout the scanning. Reference Figure 3-4(i).

4. REP SCAN STOP: stops the scanning at any point and the receiver switches to the fixed frequency mode.

5. REP SCAN RESUME: switches the receiver back to repetitive scan and sector scanning is resumed from the frequency at which it was stopped + 1 step size.

6. NEXT PAR: serves the same function as in the fixed frequency mode. See paragraph 3.3.1.1.

7. PAR SELECT and PAR RECALL: are not used in the repetitive scan mode.

The tuning wheel, increment keys and head phones are not used in this mode.

3.3.3.2 Repetitive Scan Parameters

The following is a list of the parameters for the repetitive scan mode. The parameters to be programmed for the mode itself are displayed when the setup key is depressed. When the REP SCAN START key is depressed the number of the sector being scanned is displayed together with the Start and Stop frequencies programmed for that sector in the Sector Scan mode. The following list covers only those parameters that form the program for the repetitive scan mode.

1. ENTER FIRST SECTOR: is the Sector number at which the operator wishes the receiver to start its scan cycle.

2. ENTER LAST SECTOR: is the Sector number at which the operator wishes the receiver to recycle starting again from the First Sector. The receiver can only scan through consecutive sectors or through one sector if both the first and last sectors are entered as the same number.

3.3.3.3 Programming Procedure, Repetitive Scan Operation

Table 3-4 tabulates the step by step programming procedure to setup the receiver for repetitive scan operation. Figures 3-4(k) and 3-4(i) illustrate the display for each step in the programming sequence.

Table 3-4. Operation Mode: Repetitive Scan

STEP	KEY	DISPLAY	DESCRIPTION
1	REP SCAN SETUP	Figure 3-4(k) Repetitive scan RANGE. Cursor at FIRST SECTOR.	
2	DIGIT KEY	Figure 3-4(k) First sector No. is displayed.	Direct Entry. First sector must be a lower number than last. All sectors chosen must be correctly programmed.

Table 3-4. Operation Mode: Repetitive Scan (Continued)

STEP	KEY	DISPLAY	DESCRIPTION
3	NEXT PAR	Figure 3-4(k) Cursor moves to LAST SECTOR.	
4	DIGIT KEY	Figure 3-4(k) Last sector No. is displayed.	Direct Entry. Last sector must be a higher number than first.
5	REP SCAN START	Figure 3-4(l) Actual Freq. counts thru scans. SECTOR No. indicates sector being scanned.	The receiver will scan continuously through sectors selected until either REP SCAN STOP is depressed, or a threshold level is exceeded. Receiver will then automatically switch to the fixed freq. mode at that frequency and sector parameters.
6	REP SCAN STOP	Figure 3-1(a) Fixed freq. mode freq. at time scan was stopped. Parameters for sector being scanned.	Sector scan mode may be selected at this time if plot or data table is required. If so REP SCAN RESUME is void.
7	REP SCAN RESUME	Figure 3-4(l) Actual freq. continues count.	Repetitive scan resumes from where it was stopped.

3.4 DISPLAY MESSAGES

3.4.1 SYSTEM ERROR MESSAGES

The DCU memory stores six error messages which are displayed, under certain conditions, to inform the operator of an abnormal system condition. They remain in display until the system is reset. If they recur the system must be checked for loose interconnect cables and that all modules in the system have AC power. If the fault continues to cause an error message the problem must be located and corrected. The following is a list of the error messages and a brief description of each.

1. SYSTEM FAILURE: is displayed if the IFD or TSU fails, within a fixed time period, to respond to commands from the DCU. RESET clears the display and cancels the operation and re-initializes the system. The operator may then initiate a new operation cycle.

2. AMPLITUDE DATA NOT RECEIVED: is displayed if the IFD fails to respond to a DCU command for calibration data or

signal amplitude data. RESET clears the display and cancels the operation and reinitializes the system.

3. ILLEGAL ATTENUATION REQUEST: is displayed if, for any reason, the IFD or TSU indicates that it is saturated and low simultaneously. RESET clears the display and cancels the operation and reinitializes the system.

4. INCOMPLETE ATTENUATION CYCLE: is displayed if the TSU fails to respond to a command from the DCU to change or correct the attenuation level within a fixed time period. RESET clears the display and cancels the operation and reinitializes the system.

5. SYNTHESIZER UNLOCKED: is displayed if the 1st LO Synthesizer fails to lock causing erroneous LO frequencies. RESET clears the display and reinitializes the system.

6. CALIBRATION DATA INVALID: is displayed if the calibration data and corresponding references produce an excessive error signal. RESET clears the display and cancels the operation.

3.4.2 IN PROCESS MESSAGES

The following messages are displayed at certain times in the normal operation of the equipment. They are momentarily displayed and then followed by a display for the next operation step.

1. PLOT ABORTED: is displayed when the START/HALT key is depressed to cancel a plot.

2. OUTPUT ABORTED: is displayed when the START/HALT key is depressed to cancel a data table.

3. SCAN STOPPED: is displayed when the REP SCAN STOP key is depressed.

4. SCAN STOPPED THRESHOLD EXCEEDED: is displayed if the received signal exceeds the threshold level in the repetitive scan operation mode. The receiver then switches into fixed frequency.

5. INPUT ERROR: a displayed if an invalid entry is made by the operator when using the keyboards to program the receiver.

3.5 REMOTE OPERATION

3.5.1 Remote control of the Digital Control Unit is through J3 on the rear panel of the DCU. The mating connector is a JT606RT16-55P (Bendix). The pin assignments in this connector are described in Table 3-5.

d

```
X/Y PLOT COMPLETE:      SECTOR:1
```

g

```
DATA TABLE COMPLETED

DO YOU WANT ANOTHER DATA TABLE?

0-NO

1-YES
```

j

e

```
DO YOU WANT A DATA TABLE?

0-NO

1-YES
```

h

```
REPETITIVE SCAN RANGE:

ENTER FIRST SECTOR:

ENTER LAST SECTOR:
```

k

f

```
ENTER START FREQ: 123.345678 MHz

STOP FREQ: 345.345678 MHz

START/HALT CONTROLS OUTPUT

SECTOR 1:

    STARTED AT 123.345678 MHz

    STOPPED AT 345.345678 MHz
```

i

```
REPETITIVE SCAN RUNNING

SECTOR:1

START:          MHz

ACTUAL:         MHz

STOP:           MHz
```

l

Figure 3-4 DCU Displays

a

```
SCAN SETUP-PAGE1          SECTOR:1

                          SENSOR:1

START   :100.000000MHz

STOP    :200.000000MHz

ACTUAL:150.000000MHz

INTERCEPT:ON

THRESHOLD:100DBUV/MHz
```

b

```
INTERCEPT CONTROL:

    WILL STOP THE SCAN IF THE

    THRESHOLD IS EXCEEDED

    0-NO

    1-YES
```

c

```
INTERCEPT THRESHOLD:

    ENTER THRESHOLD IN THE RANGE

    FROM -  +10 DBUV

    TO      190 DBUV
```

d

```
SCAN SETUP-PAGE2          SECTOR:1

                          SENSOR:1

IF BW   :200 kHz

MODE    :LOG

MEAS    :PEAK             NARROWBAND

DET TC  :30 MS

ATTEN   :30 DB AUTO

PRESEL:BYPASS
```

e

```
SECTOR   SCAN COMPLETE

DO YOU WANT AN X/Y PLOT?

0-NO

1-YES

HAVE YOU CHANGED THE PAPER?
```

f

```
PLOT

IN

PROGRESS
```

Table 3-5. J3 Pin Assignments

PIN # J3	DCU SIGNAL NAME		FUNCTION
30	GROUND		SIGNAL GROUND
31	CSR0	(OUTPUT)	DCU ACCEPTS DATA
32	REQB	(INPUT)	EXTERNAL DEVICE ACCEPTS DATA
33	IN 00		DATA BIT 0 (LSB) To DCU
34	IN 01		DATA BIT 1 To DCU
35	IN 02		DATA BIT 2 To DCU
36	IN 03		DATA BIT 3 To DCU
37	IN 04		DATA BIT 4 To DCU
38	IN 05		DATA BIT 5 To DCU
39	IN 06		DATA BIT 6 To DCU
40	IN 07		DATA BIT 7 To DCU
41	IN 08		DATA BIT 8 To DCU
42	IN 09		DATA BIT 9 To DCU
43	IN 10		DATA BIT 10 To DCU
44	IN 11		DATA BIT 11 To DCU
45	IN 12		DATA BIT 12 To DCU
46	IN 13		DATA BIT 13 To DCU
47	IN 14		DATA BIT 14 To DCU
48	IN 15		DATA BIT 15 (MSB) To DCU
12	FREQ A	(INPUT)	EXT DEVICE DATA READY
13	CSR 1	(OUTPUT)	DCU DATA READY
14	OUT 00		DATA BIT 0 (LSB) To EXT DEV
15	OUT 01		DATA BIT 1 To EXT DEV
16	OUT 02		DATA BIT 2 To EXT DEV
17	OUT 03		DATA BIT 3 To EXT DEV
18	OUT 04		DATA BIT 4 To EXT DEV
19	OUT 05		DATA BIT 5 To EXT DEV
20	OUT 06		DATA BIT 6 To EXT DEV
21	OUT 07		DATA BIT 7 To EXT DEV
22	OUT 08		DATA BIT 8 To EXT DEV
23	OUT 09		DATA BIT 9 To EXT DEV
24	OUT 10		DATA BIT 10 To EXT DEV
25	OUT 11		DATA BIT 11 To EXT DEV
26	OUT 12		DATA BIT 12 To EXT DEV
27	OUT 13		DATA BIT 13 To EXT DEV
28	OUT 14		DATA BIT 14 To EXT DEV
29	OUT 15		DATA BIT 15 (MSB) To EXT DEV

3.5.2 HANDSHAKE PROTOCAL DATA

A transmission in either direction uses a full handshake. The protocol is described in detail in the following paragraphs.

3.5.2.1 Data Transmission from External Device to the DCU

3.5.2.1.1 Place data on the DATA TO DCU Lines (Pins 33-49). Set "EXTERNAL DEVICE DATA READY" (Pin 12) to Logic 1. The DCU will take the data and respond by setting "DCU ACCEPTS DATA" (Pin 31) to Logic 1. Clear (Set to Logic 0) EXTERNAL DEVICE DATA READY (Pin 12). DCU will respond by clearing (Set to Logic 0) "DCU ACCEPTS DATA" (Pin 31) completing the transaction.

3.5.2.2 Data Transmission from the DCU to the External Device

3.5.2.2.1 As soon as the DCU has placed data on DATA TO EXTERNAL DEVICE LINES (Pins 14-29), it will set DCU DATA READY (Pin 13) to Logic 1. The EXTERNAL DEVICE takes data then responds by setting EXTERNAL DEVICE ACCEPTS DATA (Pin 32) to Logic 1. The DCU will clear (Set to Logic 0) DCU DATA READY (Pin 13). THE EXTERNAL DEVICE responds by clearing (set to Logic 0) EXTERNAL DEVICE ACCEPTS DATA (Pin 32) completing the transaction.

3.5.3 COMMAND STRUCTURE

3.5.3.1 Command Structure - The 16 bit data word is subdivided into two bytes. The most significant byte (data bits 8-15) is used as a command field; while the least significant byte (data bits 0-7) is used as a data field. Amplitude data is returned as a single 16 bit word.

3.5.3.2 The command field defines the type of operation to be executed and can be subdivided into 4 groups.

1.	STATIC SETUP Commands:	See paragraph 3.5.3.3.
2.	PARAMETER RECALL Commands:	See paragraph 3.5.4.
3.	OPERATIONAL Commands:	See paragraph 3.5.5.
4.	CONTROL Commands:	See paragraph 3.5.6.

3.5.3.3 Static Set Up Commands - these commands provide the means to set up the WJ-8940B Receiving System operating parameters. They are detailed in Table 3-6 through 3-11.

3.5.3.3.1 Frequency - a 32 bit binary frequency word is transmitted to the WJ-8940B one byte at a time where it is assembled and stored in a temporary buffer prior to actual use.

Table 3-6. Static Setup Commands - Frequency

Command Field	Data Field	Frequency
0 0 0 0 0 0 1 0	Byte 0	Least significant byte
0 0 0 0 0 0 1 1	Byte 1	
0 0 0 0 0 1 0 0	Byte 2	
0 0 0 0 0 1 0 1	Byte 3	Most significant byte

3.5.3.3.2 Step Size - 32 bit binary step size is transmitted to the WJ-8940B, one byte at a time, where it is assembled and stored in a temporary buffer prior to use.

Table 3-7. Static Setup Commands - Step Size

Command Field	Data Field	Step Size
0 0 0 0 0 1 1 0	Byte 4	Least significant byte
0 0 0 0 0 1 1 1	Byte 1	
0 0 0 0 1 0 0 0	Byte 2	
0 0 0 0 1 0 0 1	Byte 3	Most significant byte

3.5.3.3.3 Sensor Select - one of six sensor inputs may be selected.

Table 3-8. Static Setup Commands - Sensor Select

Command Field	Data Field	Sensor Select
0 0 0 0 1 0 1 0	0 0 0 0 0 0 0 1	Sensor 1
0 0 0 0 1 0 1 0	0 0 0 0 0 0 1 0	Sensor 2
0 0 0 0 1 0 1 0	0 0 0 0 0 0 1 1	Sensor 3
0 0 0 0 1 0 1 0	0 0 0 0 0 1 0 1	Sensor 5
0 0 0 0 1 0 1 0	0 0 0 0 0 1 1 0	Sensor 6

3.5.3.3.4 Attenuation - RF attenuation may be selected in the range from 0 to 70 dB in 10 dB steps. The automatic attenuation mode may also be selected.

Table 3-9. Static Setup Commands - Attenuation

Command Field	Data Field	Attenuation
0 0 0 0 1 0 1 1	0 0 0 0 0 0 0 0	0 dB
0 0 0 0 1 0 1 1	0 0 0 0 0 0 0 1	10 dB
0 0 0 0 1 0 1 1	0 0 0 0 0 0 1 0	20 dB
0 0 0 0 1 0 1 1	0 0 0 0 0 0 1 1	30 dB
0 0 0 0 1 0 1 1	0 0 0 0 0 1 0 0	40 dB
0 0 0 0 1 0 1 1	0 0 0 0 0 1 0 1	50 dB
0 0 0 0 1 0 1 1	0 0 0 0 0 1 1 0	60 dB
0 0 0 0 1 0 1 1	0 0 0 0 0 1 1 1	70 dB
0 0 0 0 1 0 1 1	0 0 0 0 1 x x x	Automatic

3.5.3.3.5 Preselectors - The front end preselector filters may be used or bypassed.

Table 3-10. Static Setup Commands - Preselectors

Command Field	Data Field	Preselector
0 0 0 0 1 1 0 0	0 0 0 0 0 0 0 0	Preselector Bypassed
0 0 0 0 1 1 0 0	0 0 0 0 0 0 0 1	Preselector in use

3.5.3.3.6 IF Bandwidth - Any one of the 17 IF Bandwidths tabulated below may be selected.

Table 3-11. Static Setup Commands - IF Bandwidths

Command Field	Data Field	IF Bandwidth
0 0 0 0 1 1 0 1	0 0 0 0 0 0 0 0	200 Hz
0 0 0 0 1 1 0 1	0 0 0 0 0 0 0 1	500 Hz
0 0 0 0 1 1 0 1	0 0 0 0 0 0 1 0	1 kHz
0 0 0 0 1 1 0 1	0 0 0 0 0 0 1 1	2 kHz
0 0 0 0 1 1 0 1	0 0 0 0 0 1 0 0	5 kHz
0 0 0 0 1 1 0 1	0 0 0 0 0 1 0 1	10 kHz
0 0 0 0 1 1 0 1	0 0 0 0 0 1 1 0	20 kHz
0 0 0 0 1 1 0 1	0 0 0 0 0 1 1 1	50 kHz
0 0 0 0 1 1 0 1	0 0 0 0 1 0 0 0	100 kHz
0 0 0 0 1 1 0 1	0 0 0 0 1 0 0 1	200 kHz
0 0 0 0 1 1 0 1	0 0 0 0 1 0 1 0	500 kHz
0 0 0 0 1 1 0 1	0 0 0 0 1 0 1 1	1 MHz
0 0 0 0 1 1 0 1	0 0 0 0 1 1 0 0	2 MHz
0 0 0 0 1 1 0 1	0 0 0 0 1 1 0 1	5 MHz
0 0 0 0 1 1 0 1	0 0 0 0 1 1 1 0	10 MHz
0 0 0 0 1 1 0 1	0 0 0 0 1 1 1 1	20 MHz
0 0 0 0 1 1 0 1	0 0 0 1 0 0 0 0	50 MHz

3.5.3.3.7 Detection Mode - One of the 5 detection modes tabulated below may be selected. The Signal Amplitude Data is only valid in the log mode.

Table 3-12. Detection Mode

Command Field	Data Field	Detection Mode
0 0 0 0 1 1 1 0	0 0 0 0 0 0 0 0	Log
0 0 0 0 1 1 1 0	0 0 0 0 0 0 0 1	AM
0 0 0 0 1 1 1 0	0 0 0 0 0 0 1 0	AM/AGC
0 0 0 0 1 1 1 0	0 0 0 0 0 0 1 1	FM
0 0 0 0 1 1 1 0	0 0 0 0 0 1 0 0	CW

3.5.3.3.8 Detection Time Constant - One of 5 detection time constants may be selected. If "AVERAGE" Video Measurement Mode is selected, only 30 μsec, 3 ms and 30 ms are valid. If a longer time constant is selected the Digital Control Unit will force this parameter to 30 ms.

Table 3-13. Detection Time Constant

Command Field	Data Field	Detector Time Constant
0 0 0 0 1 1 1 1	0 0 0 0 0 0 0 0	30 µsec
0 0 0 0 1 1 1 1	0 0 0 0 0 0 0 1	3 msec
0 0 0 0 1 1 1 1	0 0 0 0 0 0 1 0	30 msec
0 0 0 0 1 1 1 1	0 0 0 0 0 0 1 1	60 msec
0 0 0 0 1 1 1 1	0 0 0 0 0 1 0 0	100 msec

3.5.3.3.9 Video Measurement Mode - One of 3 measurement modes may be selected.

Table 3-14. Video Measurement Mode

Command Field	Data Field	Viedo Measurement Mode
0 0 0 1 0 0 0 0	0 0 0 0 0 0 0 0	Peak
0 0 0 1 0 0 0 0	0 0 0 0 0 0 0 1	Average
0 0 0 1 0 0 0 0	0 0 0 0 0 0 1 0	Quasi-Peak

3.5.3.3.10 Video Measurement Bandwidth - Either mode may be selected.

Table 3-15. Video Measurement Bandwidth

Command Field	Data Field	Video Measurement Bandwidth
0 0 0 1 0 0 0 1	0 0 0 0 0 0 0 0	Narrowband-Data units are dB above 1µV (dB µV)
0 0 0 1 0 0 0 1	0 0 0 0 0 0 0 1	Broadband - Data units are dB above 1 µV/MHz (dB µV/MHz)

3.5.3.3.11 AM IF Gain - When the AM Detection Mode has been selected this command provides the means to control the AM IF gain. Minimum gain is 255; Maximum gain is 0.

Table 3-16. AM IF Gain

Command Field	Data Field	AM IF Gain
0 0 0 1 0 0 1 1	x x x x x x x x	Relative IF Gain

3.5.4 PARAMETER RECALL COMMANDS

These commands provide the means to examine the current operating parameters of the WJ-8940B Receiving System.

3.5.4.1 Parameter Recall Commands - The Digital Control Unit responds to this command group with the requested data unless a command or data field error is detected, in which case the eror code is returned.

Table 3-17. Requested Parameter

Command Field	Data Field	Requested Parameter
0 0 0 0 0 0 0 0	0 0 0 0 0 0 1 0	Binary Frequency Byte 0 (Least Significant Byte)
0 0 0 0 0 0 0 0	0 0 0 0 0 0 1 1	Binary Frequency Byte 1
0 0 0 0 0 0 0 0	0 0 0 0 0 1 0 0	Binary Frequency Byte 1
0 0 0 0 0 0 0 0	0 0 0 0 0 1 0 1	Binary Frequency Byte 3 (Most Significant Byte)
0 0 0 0 0 0 0 0	0 0 0 0 0 1 1 0	Binary Step Size Byte 0 (Least Significant Byte)
0 0 0 0 0 0 0 0	0 0 0 0 0 1 1 1	Binary Step Size Byte 1
0 0 0 0 0 0 0 0	0 0 0 0 1 0 0 0	Binary Step Size Byte 2
0 0 0 0 0 0 0 0	0 0 0 0 1 0 0 1	Binary Step Size Byte 3 (Most Significant Byte)
0 0 0 0 0 0 0 0	0 0 0 0 1 0 1 0	Sensor
0 0 0 0 0 0 0 0	0 0 0 0 1 0 1 1	Attenuation
0 0 0 0 0 0 0 0	0 0 0 0 1 1 0 0	Preselected Status
0 0 0 0 0 0 0 0	0 0 0 0 1 1 0 1	IF Bandwidth
0 0 0 0 0 0 0 0	0 0 0 0 1 1 1 0	Detection Mode
0 0 0 0 0 0 0 0	0 0 0 0 1 1 1 1	Detection Time Constant
0 0 0 0 0 0 0 0	0 0 0 1 0 0 0 0	Video Measurement Mode
0 0 0 0 0 0 0 0	0 0 0 1 0 0 0 1	Video Measurement Bandwidth
0 0 0 0 0 0 0 0	0 0 0 1 0 0 1 0	AM IF Gain

3.5.4.2 The requested data is read from the operating buffer and returned in a format identical to the Static Setup Commands paragraph 3.5.3.3.1 through 3.5.3.3.11. The command and data fields tabulated below may be selected.

3.5.5 OPERATIONAL COMMANDS

These commands provide the means for tuning, stepping, calibrating and the acquisition and transmission of amplitude data. The data field contains the data or a subset of the command field.

3.5.5.1 Each command and its associated data field parameters is described below.

3.5.5.2 Measure - This causes an amplitude measurement to be taken and the result stored for subsequent transfer to the External Device.

Table 3-18. Measure

Command Field	Data Field	Measure
0 1 0 0 0 0 0 0	0 0 0 0 0 0 0 0	

3.5.5.3 Amplitude Data Request - This command transfers the 16 bit - 2's complement binary Amplitude Data word to the External Device.

Table 3-19. Amplitude Data Request - External Device

Command Field	Data Field	
0 1 0 0 0 0 0 0	0 0 0 0 0 0 0 1	Request least significant byte of Amplitude Data

Table 3-20. Amplitude Data Request - DCU Response

Command Field	Data Field	
x x x x x x x x	x x x x x x x x	16 Bit 2's compliment Amplitude Date

3.5.5.4 Tune and Measure - This command initiates the following sequence.

1. Move assembled frequency from Input Buffer to the Operational Buffer.
2. Tune the Receiving System.
3. Measure and Store Amplitude Data.

Table 3-21. Tune and Measure

Command Field	Data Field	
0 1 0 0 0 0 0 0	0 0 0 0 0 0 1 1	Tune and Measure

3.5.5.5 Setup, Tune and Measure - This command initiates the following sequence.

1. Add assembled step size to the Current Operating Frequency.
2. Tune the Receiving System.
3. Measure and Store Amplitude Data.

Table 3-22. Setup, Tune and Measure

Command Field	Data Field	
0 1 0 0 0 0 0 0	0 0 0 0 0 1 0 0	Setup, Tune and Measure

3.5.5.6 Calibration - This command calibrates the system using current operating parameters. This calibration data is internally applied to all subsequent measurements until another calibration is preformed.

Table 3-23. Calibrate

Command Field	Data Field	
0 1 0 0 0 0 0 0	0 0 0 0 0 1 0 1	Calibrate

3.5.5.7 Calibrate Data Disable - This command disables the application of internal calibrate data to all measurements, allowing the host to do the necessary calibration externally if desired.

Command Field	Data Field	
0 1 0 0 0 0 0 0	0 0 0 0 0 1 1 0	Calibrate Data Disable

3.5.5.8 Calibrate Data Enable - This command enables the application of internal calibrate data, acquired by the calibrate command to all measurements. This is the initialize/default condition.

Command Field	Data Field	
0 1 0 0 0 0 0 0	0 0 0 0 0 1 1 1	Calibrate Data Enable

3.5.6 CONTROL COMMANDS -

3.5.6.1 Request System Status Word

External Device		WJ-8940B Responses	
Command Field	Data Field	Command Field	Data Field
0 0 1 0 0 0 0 0	Request Status 0 0 0 0 0 0 0 0	0 0 1 0 0 0 0 0	0 0 x x x x x x See Status Description Below (Table 3-24 and paragraph 3.5.7.1)

3.5.6.2 Request System Error Codes

Command Field	Data Field	Command Field	Data Field
	Request ERROR CODE		
0 0 1 0 0 0 0 0	0 0 0 0 0 0 0 1	0 0 1 0 0 0 0 1	x x x x x x x x See Error code Description Below (Table 3-25 and paragraph 3.5.7.2)

3.5.6.3 Clear Power Fail Status Bit in System Error Code

Command Field	Data Field
0 0 1 0 0 0 0 0	0 0 0 0 0 0 1 0

3.5.6.4 Clear Reset Status Bit in System

Command Field	Data Field
0 0 1 0 0 0 0 0	0 0 0 0 0 0 1 1

3.5.6.5 Disable Automatic Status Response

Command Field	Data Field
0 0 1 0 0 0 0 0	0 0 0 0 0 1 0 0

3.5.6.6 Enable Automatic Status Response

Command Field	Data Field
0 0 1 0 0 0 0 0	0 0 0 0 0 1 0 1

3.5.7 DIGITAL CONTROL UNIT (DCU) RESPONSES

Following each command from the external device, except as noted below, the WJ-8940B Receiving System will initiate a one word transfer to the External Device.

This response will contain:

1. DATA - If it was requested.
2. STATUS - If no data was requested.
3. An Error Code - If either:
   (a) The field received from the external device is invalid.

(b) If frequency or step size exceeds system limits.

(c) If power fails or manual reset occurs.

(d) If remote/local switch is placed in local.

(e) If a system failure occurs.

NOTE

The "Status - if no data was requested" response may be optionally enabled or disabled using control commands 4 and 5 described in paragraph 3.5.6.5 and 3.5.6.6 above.

Table 3-24. Status Bits.

Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 2	Bit 0
CAL/ DATA DIS- ABLED	RF or IF LOW	RF or IF SATURATED	NARROW BAND WIDE BAND	AMPLITUDE DATA AVAILABLE	CALIBRATE COMPLETE	READY FOR COMMAND

3.5.7.1 Status Bits Description

Bit 0 = 1 WJ-8940B, Ready to receive new command from External Device.

Bit 0 = 0 WJ-8940B is BUSY

Bit 1 = 1 Calibration cycle completed.

Bit 1 = 0 Calibration cycle in progress.

Bit 2 = 1 Amplitude data available.

Bit 2 = 0 New data not available - previous data value remains in the buffer.

Bit 3 = 1 Wideband data (units are dB/ μv/MHz)

Bit 3 = 0 Narrowband data (units are dB/ μv)

Bit 4 = 1 RF or IF saturation has been detected - it is desirable to add attenuations.

Bit 4 = 0 signals in optimum measuring range.

Bit 5 = 1 RF or IF at or below minimum optimum level - if attenuation is not zero it is desirable to remove attenuation.

Bit 5 = 0 Signals in optimum measuring range.

Bit 6 = 1 Internal calibration data is excluded from measurment data - data should be corrected by host machine.

Bit 6 = 0 Default condition - measurement data corrected with internal calibration data.

Table 3-25. Error Code Bits

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
SYSTEM ERROR	DATA FIELD INVALID	COMMAND FIELD INVALID	STEP SIZE INVALID	FREQ INVALID	RESET	PWR FAIL	LOCAL REMOTE

3.5.7.2 Error Code Description

Bit 0 = 0 System in REMOTE mode
Bit 0 = 1 System in LOCAL mode

Bit 1 = 0 Normal
Bit 1 = 1 Power Fail has occurred. System has been initiatized to default conditions.

Bit 2 = 0 Normal
Bit 2 = 1 Manual reset button has been pressed. System has been initiatized to default conditions.

Bit 3 = 0 Normal
Bit 3 = 1 The frequency entered or the sum of the current frequency and the step size exceeds the system operating range.

Bit 4 = 0 Normal
Bit 4 = 1 The step size entered exceeds the operating range of the system.

Bit 5 = 0 Normal
Bit 5 = 1 The command field of the most recent command could not be decoded.

Bit 6 = 0 Normal
Bit 6 = 1 The data field of the most recent command either could not be decoded or was out of range for the specified parameter.

Bit 7 = 0 Normal
Bit 7 = 1 A system failure has occurred. The system must be manually reset. This will initialize the system to the default conditions.

SECTION IV

MAINTENANCE AND CALIBRATIONS

4.1 GENERAL

The WJ-8940B Receiving System has been conservatively designed to operate for extended periods of time with minimum routine maintenance. Cleaning, inspection and performance tests should be performed at regular intervals, consistant with the facility's normal scheduling. No routine adjustments are required. Reference should also be made to the functional block diagrams Figures 4-1 through 4-5 and to the schematic diagrams found in Section VI. A complete parts list can be found in Section V.

4.2 CLEANING AND LUBRICATION

The WJ-8940B Receiving System should be kept free of dust, moisture, grease and foreign matter, to ensure trouble-free operation. If available, use low pressure compressed air to blow accumulated dust from the interior and exterior of the Receiving System. A clean dry cloth, a soft bristled brush or a cloth saturated with cleaning compound may also be used. The WJ-8940B Receiving System does not require lubrication. Air filters are located on the rear panels of the DCU, TSU and Power Supply. These filters should be removed and cleaned at regular intervals.

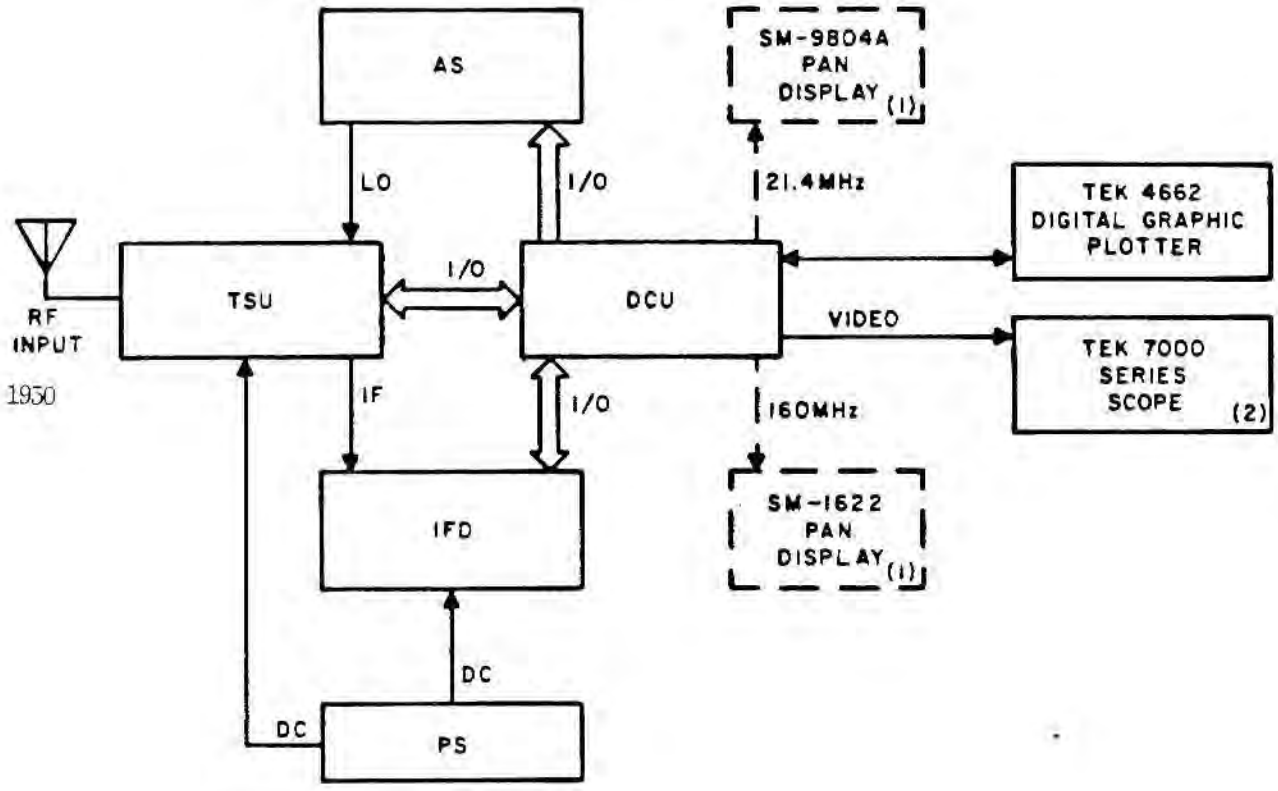
4.3 INSPECTION FOR DAMAGE OR WEAR

Many potential or existing troubles can be detected by a visual inspection of the Receiving System. For this reason, a complete visual inspection should be made for indications of mechanical and/or electrical defects on a periodic basis, or whenever the unit is inoperative. Electronic components that show signs of deterioration such as overheating should be checked and a thorough investigation of the associated circuitry should be made to verify proper operation. Damage to parts due to heat is often the result of other less apparent troubles in the circuit. It is essential that the cause of overheating be determined and corrected before replacing the damaged parts. Plug-in modules should be firmly mounted in their sockets and connectors on cables should make secure contact. Mechanical parts such as pin connectors, chassis wiring, front panel controls and switches should be inspected for excessive wear, looseness, misalignment, corrosion and other signs of deterioration. Terminating connectors in the IFD should be in place.

4.4 FUNCTIONAL DESCRIPTION

A functional description of the WJ-8940B Receiving System is included here to assist in understanding how the various units of the WJ-8940B work.

4.4.1 The WJ-8940B Receiving System tunes over a range of 5 kHz to 999.999999 MHz in a variety of modes and provides self-calibrated measurement of received signals in dB μV or dB μV/MHz. Readout of the signal measurement is provided by a front panel plasma display and a digital output via the digital I/O. Six units comprise the basic receiving system; a Digital Control Unit/(DCU), a Tuner Synthesizer Unit/(TSU), an IF Demodulator (IFD), an Auxiliary Synthesizer Unit/(AS), a Power Supply Unit/(PS) and a Circuit Breaker/(CB). Refer to Figure 4-1.



NOTE:

(1) RECOMMENDED OPTIONAL PERIPHERAL EQUIPMENT ARE SHOWN IN DOTTED LINES.

(2) IN PLACE OF TEKTRONIX 7000 SERIES OSCILLOSCOPE, A DIGITALY REFRESHED DISPLAY COULD BE USED.

Figure 4-1. Manual/Semi-Automatic Controlled WJ-8940B Receiver Test System, Functional Block Diagram

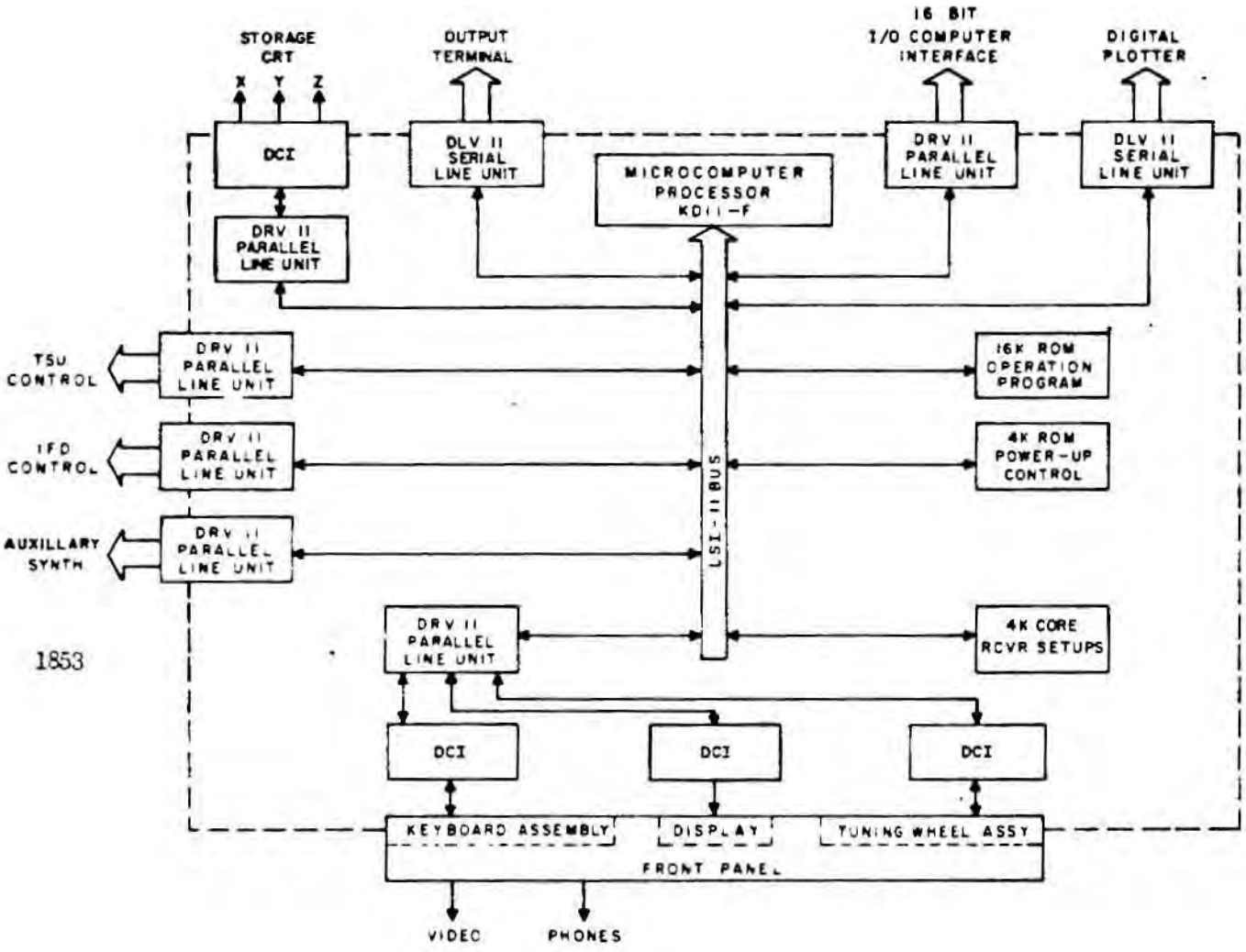


Figure 4-2. WJ-8940B Digital Control Unit Block Diagram

4.4.1.1 Figure 4-2 shows the structure of the WJ-8940B Digital Control Unit. The Digital Control Unit is centered around the LSI-11 Micro-Computer. The LSI-11 consists of a KD11-F Micro-Processor and an assortment of memory and interface boards. All memory and interfaces communicate with the KD11-F Micro-Processor along the LSI-11 bus.

4.4.1.1.1 The KD11-F Micro-Processor executes a 128 command instruction set with both single and double operand instructions. With the optional expanded instruction set ROM, which is included, the KD11-F can perform hardware multiplication and division. The KD11-F board also includes a 4k MOS RAM which is used for variable and program storage.

4.4.1.1.2 The computer boards listed below plug into the LSI-11 back-plane and interface with the KD11-F Micro-Processor.

(a) 1-MMV11-A 4k Core Memory Board

(b) 1-MRV11-A 4k Read Only Memory Board
1-MRV11-A 16k Read Only Memory Board

(c) 6-DRV11 Parallel Line Units

(d) 2-DLV11 Serial Line Units

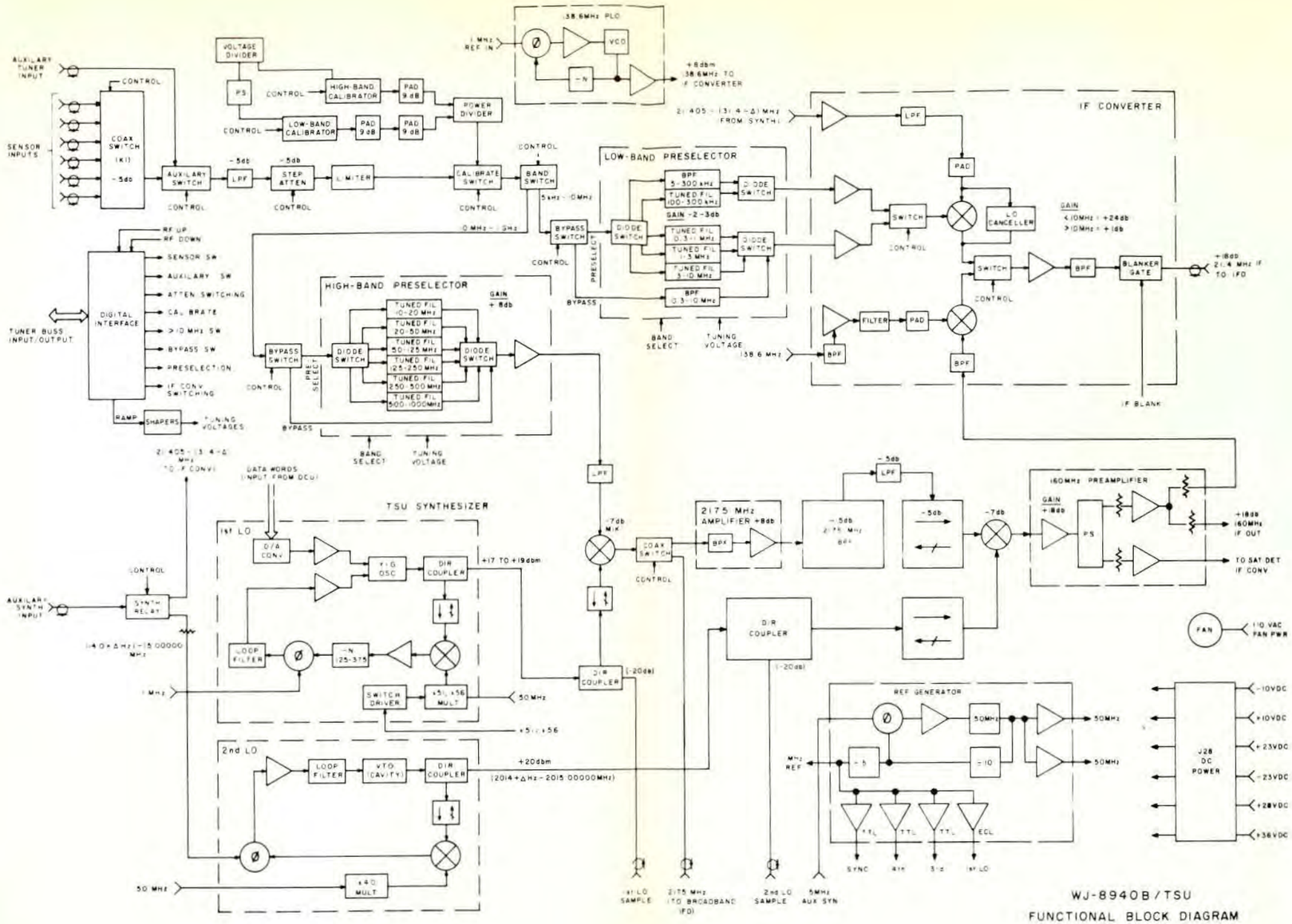
4.4.1.1.2.1 The 4k CORE MEMORY BOARD stores the WJ-8940B Receiving System parameters and scan setups. The Power Up and Power Down programs are also stored in this memory.

4.4.1.1.2.2 The 16k ROM BOARD holds the operating program that controls the different units in the WJ-8940B Receiving System. The operating program accepts commands and parameters from the operator or under remote control, processes the data and sends it to the Tuner Synthesizer, IF Demodulator and the Auxiliary Synthesizer Units.

4.4.1.1.2.3 There are six DRV11 PARALLEL LINE UNITS in the WJ-8940B Digital Control Unit. Two of the DRV11 interfaces are required to control the Tuner Synthesizer and IF Demodulator Units of the receiving system. The input control and display of the front panel of the Digital Control Unit connect to another of the DRV11 interfaces, through a special wirewrapped control interface board. Another DRV11 is used to output the analog X, Y, Z signals for a storage scope and the frequency information to the Auxiliary Synthesizer via the control interface board, where the data is put in the format required by these devices. The remaining DRV11 PARALLEL LINE UNIT is needed for the remote control of the WJ-8940B Receiving System. The software of the operating program has been written to transfer the data to the other units through the sixteen bit input/output buffers of this DRV11.

4.4.1.1.2.4 The DLV11 SERIAL LINE UNITS are used in the Digital Control Unit to interface to a Tektronix 4662 Digital Plotter and an output terminal for listing the frequency and amplitude table. The DLV11 sends eleven bit words consisting of eight data bits, one start bit and two stop bits. The DLV11 associated with the output terminal is setup for a 110 BAUD Rate and 20 ma current loop operation. The DLV11 for the Tektronix 4662 is setup for a 1200 BAUD Rate and operates in the Block Mode. The graphics software of the WJ-8940B is written to output the plot data in the format required by the Tektronix 4662. Due to the preculiarity of the data format, the Tektronix 4662 is the only digital plotter that is directly compatible with the WJ-8940B Receiving System.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	RELEASED FOR PRODUCTION	10-16-79	



WJ-8940B/TSU
FUNCTIONAL BLOCK DIAGRAM

Figure 4-3
Page 4-5

-1 QTY REQD	VENDOR OR CODE IDENT	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	NOTE	ITEM/FIND NO.

PARTS LIST

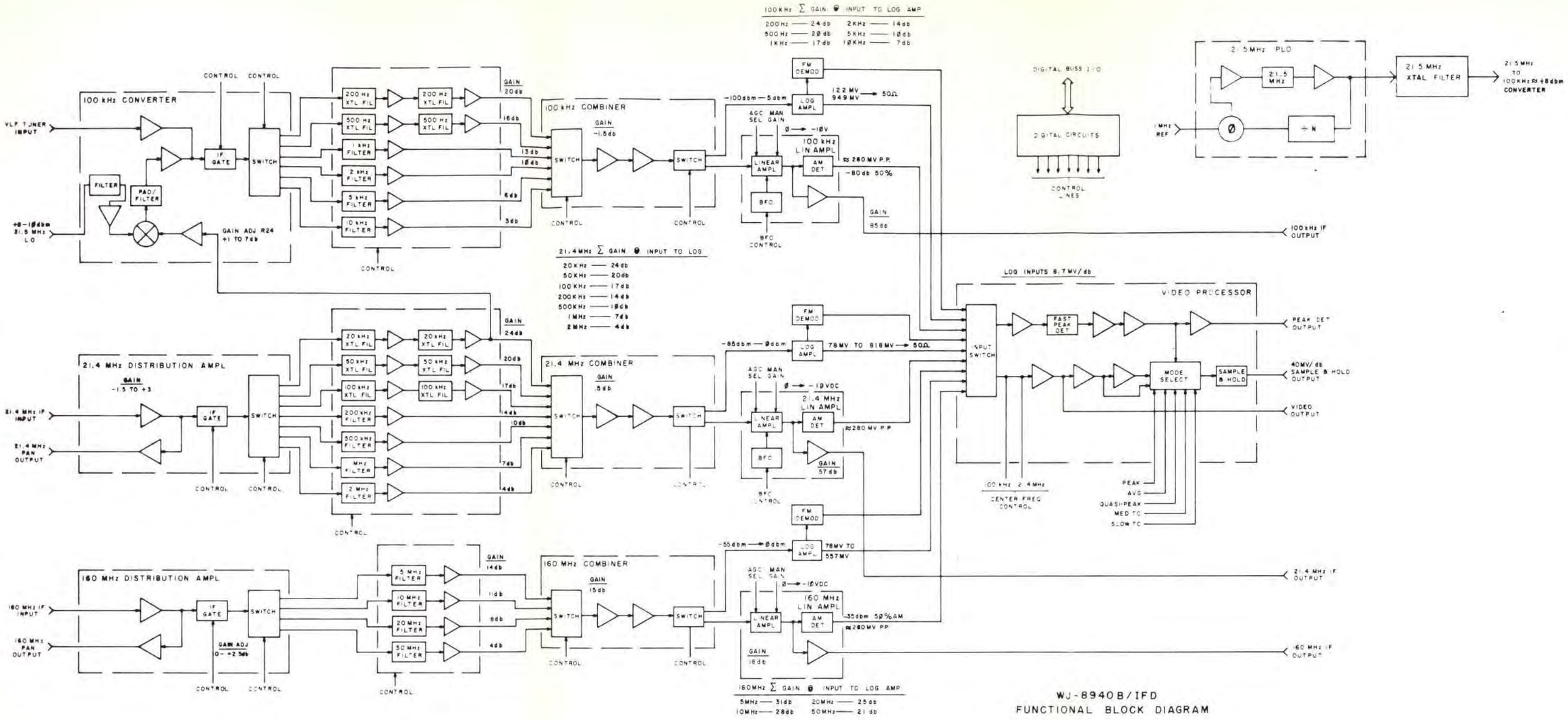
		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± 2 PLACE DECIMALS ± 3 PLACE DECIMALS ± ANGLES ±	CONTRACT NO.
		MATERIAL	DATE
			PREPARED A.C. Il Roy 9-27-79
			CHECKED W.C. Evans 9-28-79
		FINISH	ENGINEER KLEPNER 9-28-79
	WJ-8940B/TSU		
NEXT ASSY	USED ON		
APPLICATION			

WATKINS-JOHNSON
GAITHERSBURG, MARYLAND USA

WJ-8940/TSU
FUNCTIONAL BLOCK DIAGRAM

SIZE	CODE IDENT NO.	DRAWING NO.	
D	14632	490107	A
SCALE NONE		SHEET 1 OF 1	REV

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROV
	A	RELEASED FOR PRODUCTION		



WJ-8940B/IFD
FUNCTIONAL BLOCK DIAGRAM

Figure 4-5
Page 4-9

ITEM NO	QTY REQD	VENDOR OR CODE IDENT	PART NO OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTE

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONS ± DECIMALS .X ± .XX ± ANGLES ±

MATERIAL

FINISH

WJ-8940B/IFD

NEXT ASSY | USED ON

APPLICATION

CONTRACT NO

DATE

PREPARED		9-27-80
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ENGINEER		

WATKINS-JOHNSON
GAITHERSBURG, MARYLAND, USA

WJ-8940/IFD
FUNCTIONAL BLOCK DIAGRAM

SIZE	CODE IDENT NO	DRAWING NO
D	14632	490108

SCALE NONE | SHEET 1 OF 1

4.4.1.2 The TSU tunes the range of 5 kHz to 999.999999 MHz and provides a 160 MHz and a 21.A MHz IF output for the IFD. Figure 4-3 is a functional block diagram of the TSU. Any of six sensor inputs may be selected by coaxial switches and connected to the TSU input circuitry. In the TSU, the selected sensor signal is passed through a low pass filter. The filter attenuates signals above 1200 MHz and its output is applied to a programmable attenuator. A 70 dB attenuator, programmable in 10 dB steps is used to increase the system dynamic range. From the attenuator, the signal path is through a peak limiter used to protect the input circuitry from high level energy. Additional coaxial switches route the signal to one of two preselector assemblies, directly to the high band preselector or through a 15 MHz low pass filter to the low band preselector. This switch assembly also selects the appropriate calibrator impulse signal when the system is in the calibrated mode. The calibrator provides a single impulse output which has precisely known amplitude and pulse width. All RF switching circuitry has been carefully designed to provide known VSWR and low insertion loss characteristics. In order to provide superior intermodulation performance from the TSU, signals below 10 MHz are up converted to 21.4 MHz, and signals above 10 MHz are up converted to 2175 MHz. Tuning resolution across the entire frequency range is 1 Hz.

4.4.1.2.1 The low band preselector consists of fixed bandpass filters and varactor diode tuned balanced filters. The high band preselector assembly consists of six tunable balanced filters. The tuned filters are designed to provide optimum performance features such as constant insertion loss, constant percentage bandwidth, and high second order and third order intercept points. The filters exhibit less than 2 dB insertion loss variation across the band. The 3 dB bandwidth of the filters is a constant 25% of the tuned frequency. Second order intercept points are typically +60 dBm while third order intercept points are +30 dBm. The low band preselector is similar, except that two fixed bandpass filters are used in the bypass mode and only four varactor tuned filters are used. Bypass modes are provided for both preselectors to provide increased RF to IF bandwidth ratios which may be as great as 2 to 1. Slightly higher system sensitivity is also provided in the bypass modes.

4.4.1.2.2 High Band Signal Path - Assembled signals from the high band preselector are amplified by a high performance RF stage before application to the first mixer. The RF amplifier is a low noise high intercept point device and sets the high band noise figure. A Relcom MIK double balanced mixer converts the input signals to 2.175 GHz first IF. This mixer features high power level capability, high intercept point and low noise figure. A synthesized LO output to this mixer tunes from 2.17 to 3.6 GHz in 1 MHz steps. Synthesized conversion-signals are used throughout the system to provide tuning accuracy, tuning speed and LO purity. The difference output signals at 2175 MHz are amplified, filtered and drive a second MIK mixer for conversion to 160 MHz. A 2.014 - 2.015 2nd LO signal is mixed with the 2175 MHz IF and the 160 MHz difference is amplified and applied to the IF converter assembly. It is then buffered and provided as an output to the IFD at 160 MHz, or applied to a mixer for conversion to 21.4 MHz.

4.4.1.2.3 Low Band Signal Path - The low band preselector output is amplified inside the IF converter assembly. This amplifier sets the low band noise figure and drives a mixer for conversion to 21.4 MHz. The Auxiliary Synthesizer operating in 1 Hz steps from 21.405 to 31.4 MHz provides the conversion to 21.4 MHz for the low band signals. All mixers in the IF converter assembly are selected for their signal handling, intermodulation and noise figure performance. The above output and the 21.4 MHz obtained from the high band path are applied to an RF switch which selects the appropriate 21.4 MHz signal and applies it to a filter and amplifier. The amplifier provides the 21.4 MHz IF signal to the IFD.

Refer to Figure 6-0 on page 6-1

WJ-8940 Multi-Purpose System Simplified Block Diagram

4.4.1.2.3 Digital interface circuitry within the tuner synthesizer receives control logic inputs from the DCU and decodes these signals to provide the appropriate control voltages to the TSU circuitry and frequency commands to the synthesized local oscillators.

4.4.1.3 Figure 4-5 is the funtional block diagram of the IF Demodulator. The IF Demodulator receives IF inputs from the TSU, filters, demodulates and provides several IF, video and audio output signals. Three different center frequency inputs are accepted by the IFD; 160 MHz, 21.4 MHz and 100 kHz. Intermediate frequency signals of 160 MHz and 21.4 MHz are applied to the IFD from the TSU. These inputs are amplified and distributed to the appropriate IF filters. In the distribution amplifiers are gating circuits which permit disabling of the IF input to the filters at certain times in the system signal measurement operation. This prevents spurious energy from reaching the IF filters during relay switching and synthesizer tuning times. A low IF center frequency of 100 kHz is used for the narrowest IF filter bandwidths. Down conversion of the 20 kHz bandwidth, 21.4 MHz IF signal is used to provide the 100 kHz center frequency signal. This signal is amplified and distributed to the appropriate 100 kHz center frequency filters. The synthesized conversion oscillator signal is provided by a 21.5 frequency PLO in the IFD. Seventeen IF bandwidths are provided in the IFD ranging from 200 Hz to 50 MHz in a 1, 2, 5 numerical sequence. The IF filters are distributed across the three IF center frequencies. Crystal filters are used for the narrow bandwidths in the 100 kHz and 21.4 MHz IFs. The remaining bandwidth filters are Chebishev LC types. These filters have excellent skirt selectivity, low ripple, high ultimate rejection and 6 dB to 60 dB shape factors better than 4:1. Modular plug-in construction is used for each filter. Gain bandwidth normalization is provided at the filter outputs.

4.4.1.3.1 Incorporated into the design are three different types of detectors at each IF center frequency: log-amplifiers, linear and FM. The log-amplifier outputs are used in the amplitude measurement process. These amplifiers are high performance devices. One is provided for each of the three center frequency channels. Each of these amplifiers is tailored to the individual IF channel and is carefully temperature compensated. The 100 kHz center frequency log amplifier has 90 dB dynamic range from system noise to the point of 1 dB divergence from the log characteristic in a 10 kHz bandwidth. Similarly, the 21.4 MHz center frequency log-amplifier provides 80 dB of dynamic range and 2 MHz bandwidth while the 160 MHz log-amplifier provides 55 dB of dynamic range and 50 MHz bandwidth.

4.4.1.3.2 AM and FM detectors are also provided for each IF center frequency channel. The linear detectors provide 30 dB of dynamic range and are used for AM and CW modes. The FM demodulators are designed for the widest bandwidth encountered in the three individual IF center frequency channels except 20 MHz is widest in 160 MHz channel. Outputs from the appropriate detectors are switch selected and applied to a video amplifier having a 50 MHz 3 dB bandwidth, fast rise time and fast or slow decay capability. This amplifier drives the audio and video output amplifiers. Three detector functions are also driven from the wideband video amplifier. These provide quasi-peak, average and peak weighting to the video. The output from one of these weighting circuits is switch selected and drives the system A/D converter providing the measured amplitude data output. The peak detector circuit performance enables the capture of a single impulse for any bandwidth. The peak detector function can also be synchronized to an external synchronizing source when in the fixed frequency mode. This function is useful when attempting to measure or correlate periodically occuring signals in a crowded spectrum. Digital control of the IF demodulator functions is provided by the DCU.

4.4.1.4 The Auxiliary Synthesizer is used with the Tuner Synthesizer Unit to provide a 1 Hz tuning resolution across the entire frequency range of the receiving system. In the low band frequency range, from 5 kHz to 10 MHz, the Auxiliary Synthesizer is used directly to up convert the TSU input to the 21.4 MHz IF center frequency. To accomplish this, the Auxiliary Synthesizer is commanded by the DCU to tune the range from 21.405 MHz to 31.4 MHz. In the high band, above 10 MHz, the Auxiliary Synthesizer is used by the second local oscillator to synthesizer the 2.014 MHz - 2.015 MHz signal needed to down convert the 2175 MHz to the 160 MHz IF center frequency. For this range the Auxiliary Synthesizer is tuned between 14.000001 MHz and 15.0 MHz.

The Auxiliary Synthesizer also provides the 5 MHz reference signal used by the receiving system. All the local oscillators of the receiving system are phase locked to this reference. The 5 MHz reference signal of the Auxiliary Synthesizer is extremely stable having an accuracy of 2 parts in 10 per 24 hours.

4.4.1.5 The Power Supply provides the dc power to the Tuner Synthesizer Unit and IF Demodulator. Regulated supplies inside the Power Supply provide voltages of +36, +28 V, +23 V, -23 V, +10 V, -10 V to each of the units. The +23 V, -23 V, +10 V, -10 V are regulated second time inside the TSU and IFD to further reduce any noise on the supplies and obtain the +15 V, -15 V, +5 V, -5 V required by the RF circuitry in the units. The Power Supply also supplies 110 V ac power to the TSU for its cooling fan.

4.4.1. The Power Supply Unit provides the dc power to the Tuner Synthesizer Unit and the IF Demodulator. The Power Supply Unit also supplies ac to the TSU to drive a cooling fan.

4.4.1.7 The Circuit Breaker Panel distributes the ac power to the entire WJ-8940B Receiving System and provides protection in the event of unusual power surge from the ac power source and 220/115 V switching for the rack fan.

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 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 parenthesis within the figure titles.

5.3 LIST OF MANUFACTURERS

Mfr. Code	Name and Address
00103	Hydro Borer Company Los Angeles, CA
00779	AMP, Incorporated P.O. Box 3608 Harrisburg, PA 17105
01037	Pyroferric-New York, Inc. 621 E 216th Street Bronx, NY 10467
01121	Allen-Bradley Company 1201 South 2nd Street Milwaukee, WI 53204
01295	Texas Instruments, Inc. Semiconductor-Components Div. 13500 North Central Expressway Dallas, Texas 75231
02114	Ferroxcube Corp. P.O. Box 359 Mt. Marion Road Saugerties, N.Y 12477

Mfr. Code	Name and Address
02735	RCA Corporation Solid State Division Route 202 Somerville, NJ 08876
04013	Taurus Corporation 1 Academy Hill Lambertville, NJ 08530
04099	Capco, Incorporated Foresight Industrial Park P.O. Box 2164 Grand Junction, CO 81501
04239	General Electric Company Chemical & Metallurgical Ventures Opn. Magnetic Mtls. Product Sec. P.O. Box 72 Edmore, MI 49928
04713	Motorola, Incorporated Semiconductor Products Division 5005 East McDowell Road Phoenix, AZ 80058
05397	Union Carbide Corporation Materials Systems Division 11901 Madison Avenue Cleveland, OH 44101
07263	Fairchild Camera & Instr. Corp. Semiconductor Division 464 Ellis Street Mountain View, CA 94040
07388	Torotel, Inc. 13402 S. 71 Highway Grandview, MO 64030
07982	Borden, Inc. 350 Madison Avenue New York, NY 10017
08108	Lamp industry for use with industry designations and abbreviations for lamps.
11139	Deutsch Company Electronic Component Div. 700 South Hathaway Municipal Airport Banning, CA 92220
12498	Teledyne Crystalonics 147 Sherman Street Cambridge, MA 02140
12633	Fifth Dimension, Inc. 707 Alexander Road Princeton, NJ 08540
13103	Thermalloy Company 2021 W. Valley View Lane Dallas, TX 75234
13619	RF Interonics, Inc. Division of KDI Navcor, Inc. 100 Pine Aire Drive Bayshore, Long Island, NY 11706
14482	Watkins-Johnson Company 3333 Hillview Avenue Palo Alto, CA 94304
14632	Watkins-Johnson Company 700 Quince Orchard Road Gaithersburg, Maryland 20878
15454	Rodan Industries, Inc. 2905 Blue Star Street Anaheim, CA 92806

Mfr. Code	Name and Address
15818	Teledyne Semiconductor 1300 Terra Bella Avenue Mountain View, CA 94040
16179	Omni-Spectra, Inc. 24600 Hallwood Ct. Farmington, MI 48024
16428	Belden Corporation P.O. Box 1101 Richmond, IN 47374
17856	Siliconix, Inc. 2201 Laurelwood Road Santa Clara, CA 95050
18324	Signetics Corporation 811 East Arques Avenue Sunnyvale, CA 94086
18480	Crossworld Co., Inc. 100-8th Passaic, NJ 07055
18612	Vishay Resistor Prod. Intertechn. Div. of Vishay Intertechn. Inc. 68 Lincoln Highway Malvern, PA 19355
21847	Aertech 825 Stewart Drive Sunnyvale, CA 94086
22526	Berg Electronics, Inc. Youk Expressway New Cumberland, PA 17070
23934	Power/Mate Corp. 514 S. River Street Hackensack, NJ 07601
24022	Teledyne Microwave 1290 Terra Della Avenue Mountain View, CA 94040
24211	Grigsby-Barton, Inc. 3800 Industrial Drive Rolling Meadows, IL 60008
24355	Analog Devices, Inc. P.O. Box 280 Norwood, MA 02062
24602	E.M.C. Technology, Inc. 1300 Arch Street Philadelphia, PA 19107
25088	Siemens America, Inc. 186 Wood Avenue S. Iselin, NJ 08830
26287	Optical Electronics, Inc. 3150 E. 46th Street P.O. Box 11140 Tucson, AZ 85734
26805	American Microwave Ind., Inc. 87 Rumford Avenue Waltham, MA 02154
27014	National Semi-Conductor Corp. 2950 San Ysidro Way Santa Clara, CA 95051

Mfr. Code	Name and Address
27956	Relcom 3333 Hillview Avenue Palo Alto, CA 94340
28480	Hewlett-Packard Co. Corporate Headquarters 1501 Page Mill Road Palo Alto, CA 94304
28875	IMC Magnetics Corp. New Hampshire Division Route 16 Rochester, NH 03867
30890	California Microwave, Inc. 455 W. Maude Avenue Sunnyvale, CA 94086
31433	Union Carbide Corp. Highway 276, S.E. Greenville, SC 29606
31597	Anaren Microwave, Inc. 185 Ainsley Drive Syracuse, NY 13205
32421	Microwave Semicond. Corp. 100 School House Road Somerset, NJ 08873
32897	Erie Tech. Prod., Inc. Erie Freq. Control Div. 453 Lincoln Street Carlisle, PA 17013
33095	Spectrum Control, Inc. 152 E. Main Street Fairview, PA 16415
34078	Midwest Microwave, Inc. 3800 Packard Road Ann Arbor, MI 48104
34335	Advanced Micro Devices 901 Thompson Place Sunnyvale, CA 94086
37942	P. R. Mallory and Co., Inc. 3029 E. Washington Street Indianapolis, IN 46206
44655	Ohmite Manufacturing Co. 3601 W. Howard Street Skokie, IL 60076
49956	Raytheon Co. 141 Spring Street Lexington, MA 02173
50140	K and L Microwave, Inc. 203 Newton Street Salisbury, MD 21801
50721	Datel Systems, Inc. 1020 Turnpike Street Canton, MA 02021
51398	Mupac Corporation 646 Summer Street Brockton, MA 02402
51651	Kennedy MS Corporation Pickard Drive Syracuse, NY 13211

Mfr. Code	Name and Address
52648	Plessey Memories, Inc. DBA Plessey Semiconductors 1674 McGraw Avenue Santa Ana, CA 92705
53719	LH Research, Inc. 1821 Langley Avenue Irvine, CA 92714
54407	Power-One 531 Dawson Drive Camarillo, CA 93010
56289	Sprague Electric Co. Marshall Street North Adams, MA 01247
71279	Cambridge Thermionic Corp. 445 Concord Avenue Cambridge, MA 02138
71400	Bussman Manufacturing Division of McGraw-Edison Co. 2536 W. University Street St. Louis, MO 63107
71785	TRW Electronic Components Cinch Connector Operations 1501 Morse Avenue Elk Grove Village, IL 60007
72136	Electro Motive Mfg. Co., Inc. South Park & John Streets Willimantic, CT 06226
72982	Erie Tech. Products, Inc. 644 West 12th Street Erie, PA 16512
73138	Beckman Instr., Inc. Helipot Division 2500 Harbor Blvd. Fullerton, CA 92634
73899	JFD Electronics Co. 15th at 62nd Street Brooklyn, NY 11219
74545	Harvey Hubbell, Inc. State Street & Bostwick Ave. Bridgeport, CT 06602
74868	Bunker Ramo Corp. The Amphenol RF Div. 33 East Franklin Street Danbury, CT 06810
75042	TRW Electronic Components IRC Fixed Resistors 401 North Broad Street Philadelphia, PA 19108
75915	Littlefuse, Inc. 800 E. Northwest Highway Des Plaines, IL 60016
76055	Mallory Controls Div. P.R. Mallory and Co., Inc. P.O. Box 327 State Road 28 W Frankfort, IN 46041
76541	Monsanto Company, Inc. 800 N. Lindbergh Blvd. St. Louis, MO 63166
77820	Bendix Corporation The Electrical Comp. Div. Sherman Avenue Sidney, NY 13838

Mfr. Code	Name and Address
79405	Wood Electric Operations Potter & Brumfield Div. AMF, Inc. Danvers Industrial Park Danvers, MA 01923
80031	Electra-Midland Corp. MEPCO Division 22 Columbia Road Morristown, NY 07960
80058	Joint Electronic Type Designation System
80131	Electronic Industries Association 2001 Eye Street, N.W. Washington, D.C. 20006
80294	Bourns, Incorporated Instrument Division 6135 Magnolia Avenue Riverside, CA 92506
81312	Winchester Electronics Div. Litton Industries, Incorp. Main Street & Hillside Avenue Oakville, CT 06779
81349	Military Specifications
81350	Joint Army-Navy Specifications
82152	Transco Products Inc. 4241 Glencoe Avenue Venice, CA 90291
82389	Switchcraft, Inc. 5555 North Elston Avenue Chicago, IL 60630
83954	Air Filters Company 32 E. 4th Street New York, NY 10003
84411	TRW Electric Components TRW Capacitors 112 W. First Street Ogallala, NE 69153
87034	Marco-Oak Industries, Div. of Oak Electro/Netics Corporation 207 South Helena Street Anaheim, CA 92803
89110	AMP, Inc. 155 Park Street Elizabethtown, PA 17022
91293	Johanson Mfg. Company P.O. Box 329 Boonton, NJ 07005
91418	Radio Materials Company 4242 West Bryn Mawr Avenue Chicago, IL 60646
91506	Augat, Incorporated 33 Perry Avenue Attleboro, MA 02703
91637	Dale Electronics, Inc. P.O. Box 609 Columbus, NE 68601

Mfr. Code	Name and Address
92702	IMC Magnetics, Corp. Eastern Division 570 Main Street Westbury, Long Island, NY 11591
92825	Whitso Incorporated 9330 Bryon Street Schiller Park, IL 60176
94696	Magnecraft Electric Company 5575 N. Lynch Avenue Chicago, IL 60630
95121	Quality Components, Inc. P.O. Box 113 St. Mary's, PA 15857
95140	Ramsco Corporation P.O. Box 2098 Holleydale Station South Gate, CA 90280
95146	Alco Electronics Prod. Inc. P.O. Box 1348 Lawrence, MA 01842
91682	Master Specialties Company 1640 Monrovia Costa Mesa, CA 92627
97263	American Cord and Webbing Co. 505 8th Avenue New York, NY 10018
98978	Intl Elec. Research Corp. 135 West Mangolia Blvd. Burbank, CA 91502
99800	American Precision Industries Delevan Electronics Division 270 Quaker Road East Aurora, NY 14052
99848	Wilco Corporation 4030 West 10th Street P.O. Box 22248 Indianapolis, IN 46222

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 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 list and schematic diagrams of this manual. However, the semiconductors designated in the manual may be substituted in every case with satisfactory results.

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