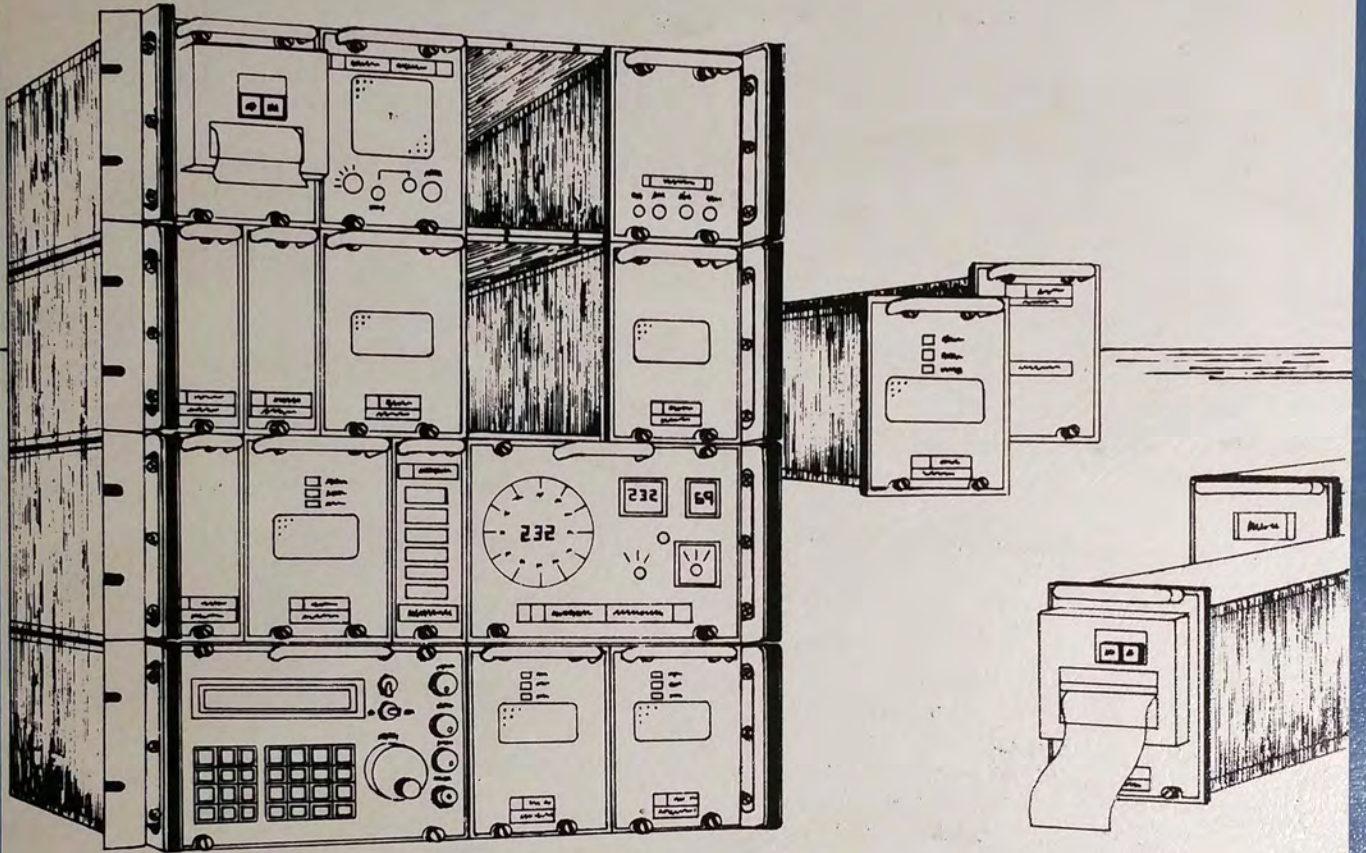


WJ-9040

MODULAR RECEIVING SYSTEM



DESIGNER'S HANDBOOK



**WJ-9040 MODULAR
RECEIVING SYSTEM
DESIGNER'S HANDBOOK**

TABLE OF CONTENTS

		<u>Page</u>
Section 1	INTRODUCTION	
	Scope	1
Section 2	SYSTEM GENERAL DESCRIPTION	
	System Design Concept	1
	Capabilities and Features	3
	System Hardware	4
	Typical System Configuration	6
	Applications	7
Section 3	SYSTEM HARDWARE	
	Common Equipment	
	Demodulators	
	Displays	
	Receivers	
	Signal Monitors	
	Tuners	
	DF Antenna Used with WJ-9040 System	
Section 4	SYSTEM SOFTWARE	
	Software Structure	1
	Module Level Software	1
	Frame Level Software	5
	Zone Level Software	5
Section 5	SYSTEM DESIGN GUIDELINES	
	Mission vs. Configuration	1
	Configuration Examples	1
	Operational Scenarios	7
	HF Master/Slave Subsystem	9
	System Expansion	11
Section 6	SYSTEM DESIGN WORKSHEETS	
	System Weight and Power Worksheets	1
	Module Stick-ups (In back pocket of handbook)	
	Rack Elevation Stick-ups (In back pocket of handbook)	
	Instructions for Using Stick-ups (In back pocket of handbook)	
Section 7	NOTES	

WJ-9040

INTRODUCTION

The **WJ-9040 Modular Receiving System Designer's Handbook** provides the user with the range of data necessary to understand the system concept, its capabilities, features and specifications; and to use this information to configure a receiving system in both hardware and software terms to satisfy a specific requirement.

SCOPE

The **WJ-9040 Modular Receiving System Designer's Handbook** is a technically oriented "User Cookbook" which completely addresses:

- System Design Concept
- Capabilities and Applications
- Matching the Configuration to the Requirement
- Hardware Functions, Use and Specifications
- Software Description and Implementation
- System I/O Interface and Control
- System Design Guides

Design aid worksheets are provided to facilitate user design of a system using basic parameters of size, weight, power consumption and human engineering factors. More-over, all facets of system interface, control, software implementation, module electrical/mechanical inter-connections, system architecture and system operation are provided.

The **WJ-9040 Modular Receiving System Designer's Handbook** enables the system designer to easily specify particular configurations for:

- Use of module components only in a customer designed system.
- Stand-alone, complete receiving subsystems.
- Large scale, computer-driven receiving systems.

This Handbook may be used in part or in its entirety to facilitate the generation of technical proposals and also as an effective tool in conducting maintenance and operation training courses.

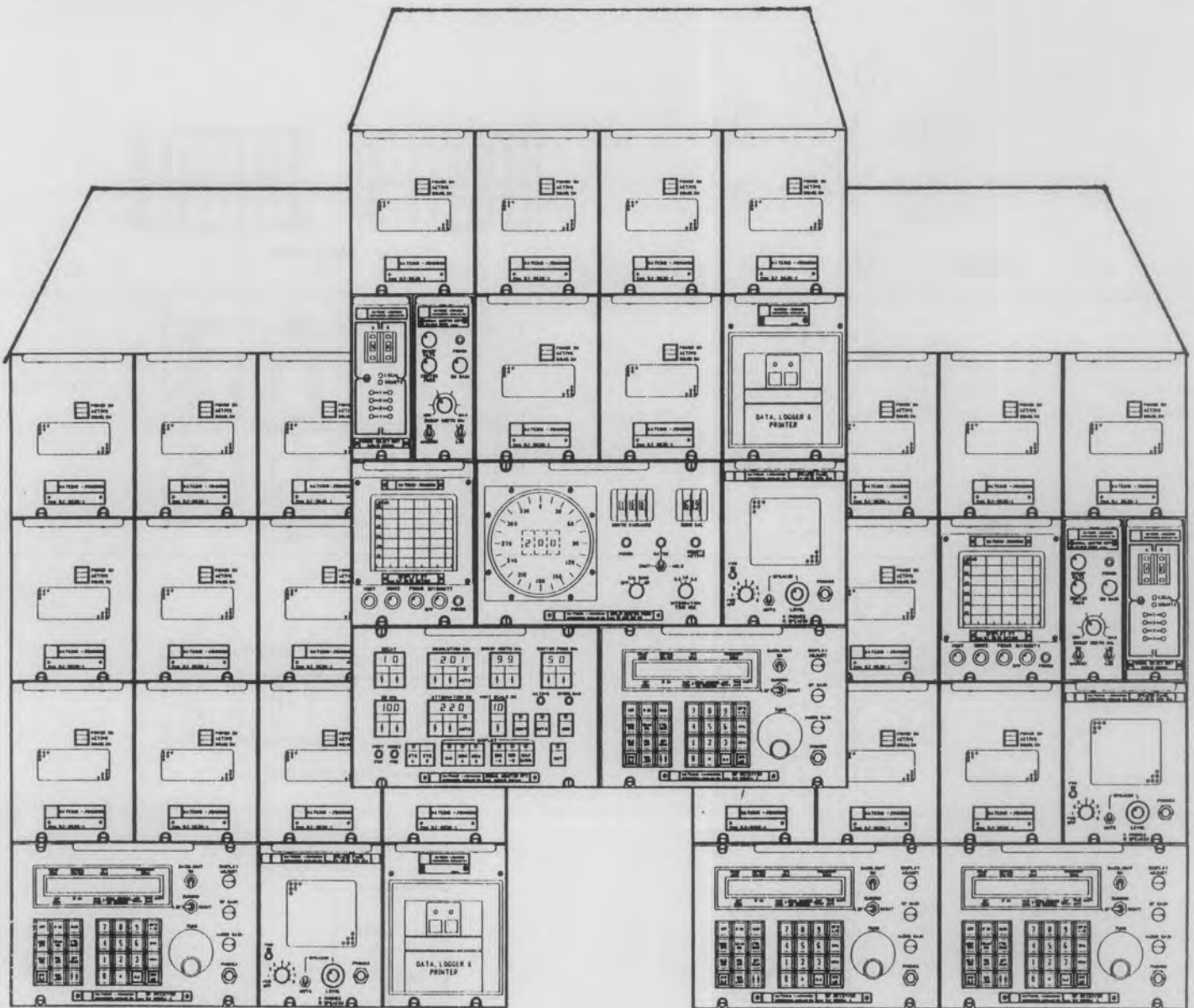
WJ-9040

SYSTEM GENERAL DESCRIPTION

Rev. A, 8/84

SYSTEM GENERAL DESCRIPTION

The WJ-9040 Modular Receiving System was developed under a design philosophy to provide a simple, yet flexible system concept, high performance, small size versus capability, and low power consumption. The resulting design is a unique system which can be quickly configured to meet either general purpose or special HF/VHF/UHF/Microwave signal acquisition, monitoring and analysis requirements.



WJ-9040 Modular Receiving System Typical Configuration
Figure 2-1.

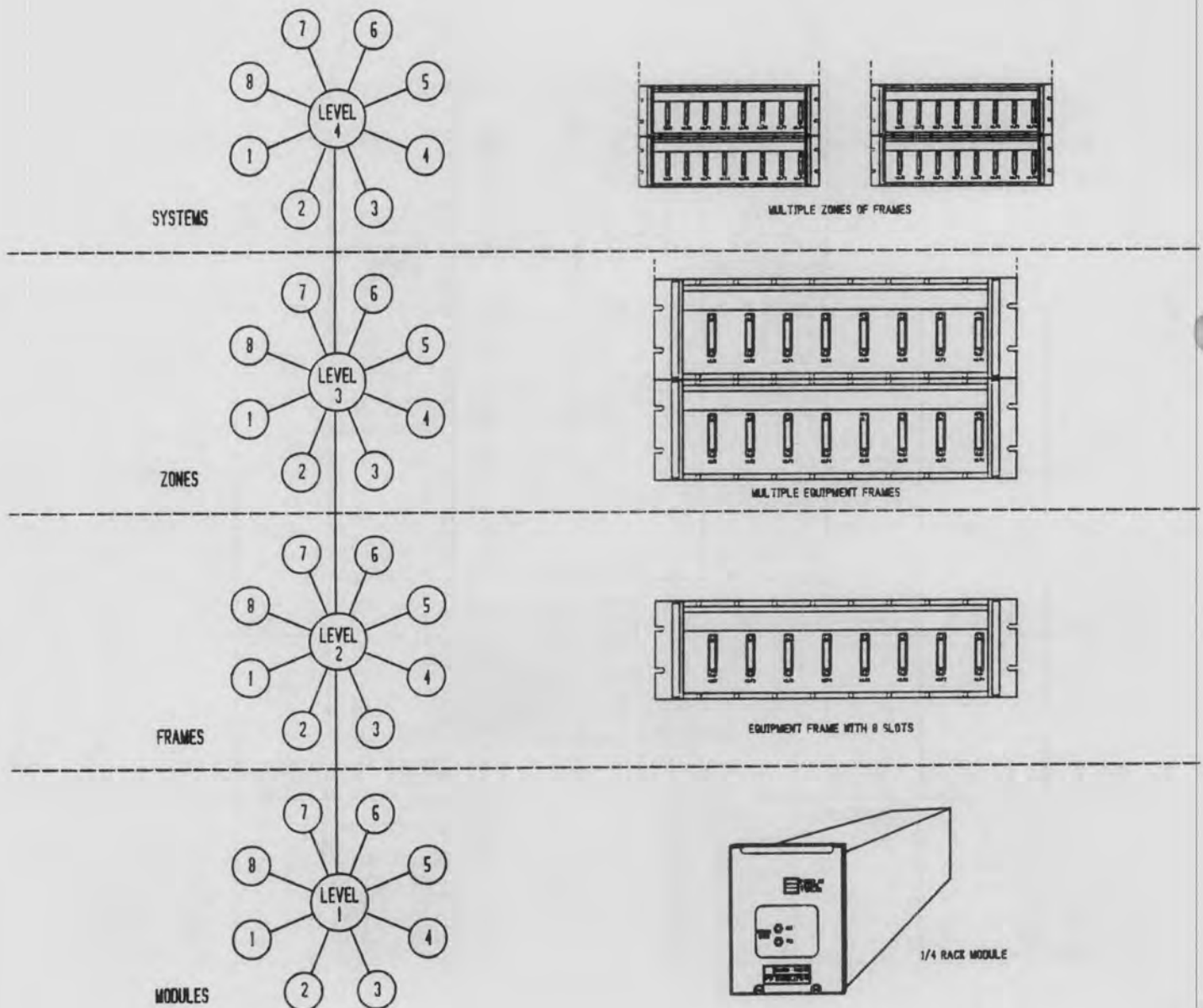
SYSTEM DESIGN CONCEPT

The system design was conceived to provide a compatible family of functional modules which may be configured into a variety of specific system designs. These modules are all designed to be compatible in size, power and control thus resulting in a totally interchangeable and expandable system. That is, a given collection of modules forms a unified architecture where a systematic hierarchy of module, equipment frame, zone and system levels of control are established.

This architecture permits a system level controller to

control and monitor throughout the system down to the module level. This feature also enables the user to configure single equipment frame/module complements for limited tasks or large, multi-frame systems to satisfy complex requirements.

The concept facilitates system design, since control and monitor functions are "smart" at the lower tier of components with equipment frames containing embedded microprocessors capable of being down-loaded by the local, manual controller or the external computer.



**WJ-9040 Modular Receiving System Architectural Concept
Figure 2-2.**

SYSTEM GENERAL DESCRIPTION

Rev. A, 8/84

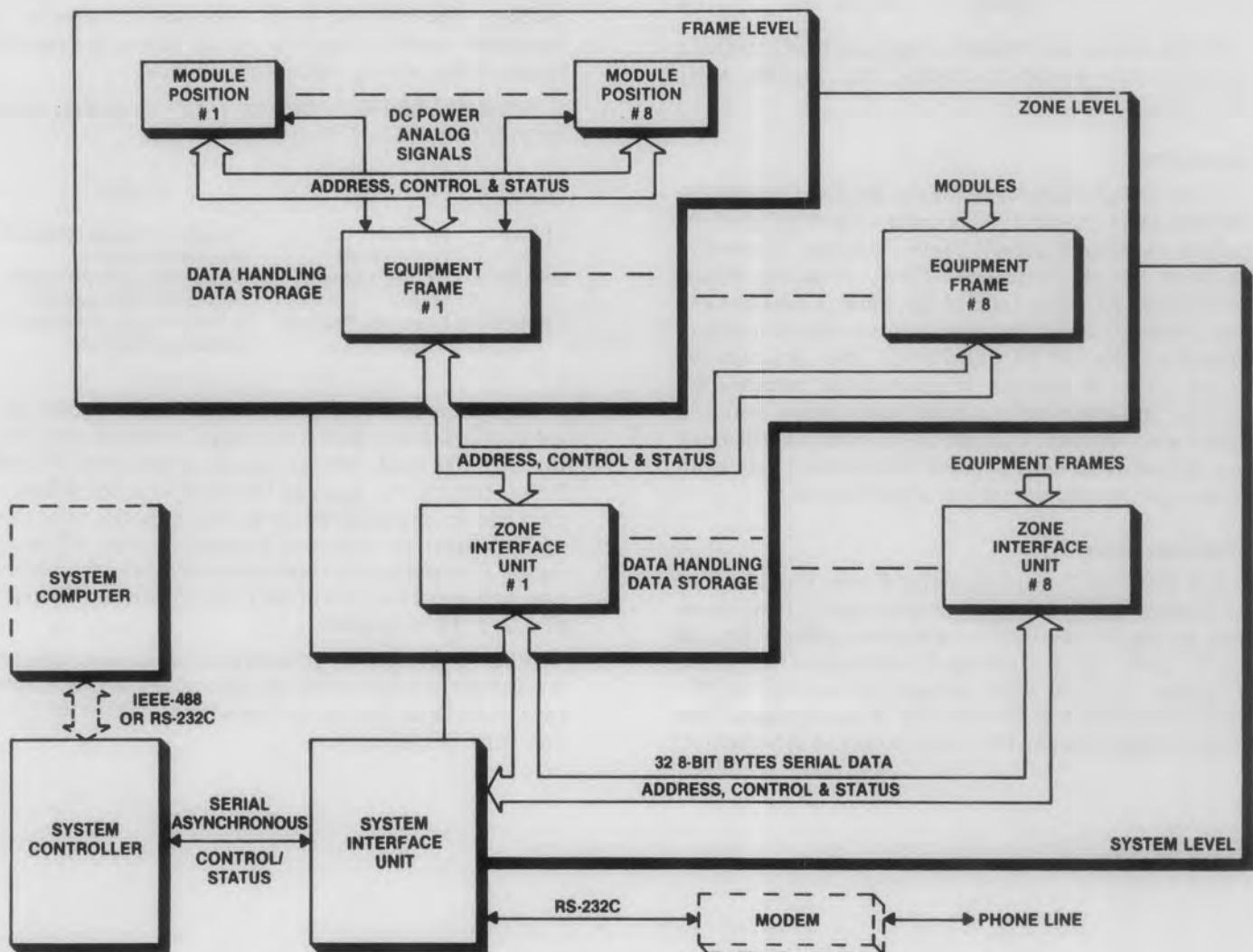
CAPABILITIES AND FEATURES

The WJ-9040 Modular Receiving System covers a standard frequency range of 5 kHz to 512 MHz with extension options to cover up to 1100 MHz or 12 GHz. A full range of ancillary functions are provided which include: RF, IF, video and audio signal distribution, direction finding, signal spectrum display, signal and system status hard copy printout, data storage and signal demodulation.

System control is effected by a local, manually operated controller or by an external remote computer over RS-232C or IEEE-488 interface format. Two primary modes of operation are provided: (1) local or remote control of any module within the system in a "dial-up" mode where a command gives real-time access to the selected module, (2) simultaneous and independent control and monitoring of all modules under program con-

trol. An example of mode 2 is either an F1-F2 SCAN or channel STEP for a number of receivers. This mode down-loads particulars from a system controller or master receiver to the respective zone, equipment frame or module. Local microprocessor action then directs control and reports back results of a selected operational task.

The modules are the key functional elements of a system. They consist of HF through microwave receivers, direction finder units, signal select units, signal displays, hard copy printers and demodulators. These modules are in 1/2, 1/4 or 1/8 rack plug-in units. Modules mount in a universal equipment frame which also contains support equipment common to all modules within a frame. Up to 8 modules can occupy a single frame. Up to 8 frames then constitute a zone, and up to 8 zones define a system.



WJ-9040 Modular Receiving System Command, Control & Data Distribution
Figure 2-3.

SYSTEM GENERAL DESCRIPTION

Rev. A, 8/84

SYSTEM HARDWARE

The WJ-9040 System hardware is a compatible family of functional units in modular form. These modules are supported by common equipment to effect the necessary control interface, power and signal routing.

Receivers

A variety of receivers is available to cover a wide range of frequency bands and operational modes. These consist of 1/4 rack and 1/2 rack receivers for signal intercept, monitoring and hand-off roles.

<u>Receiver Category</u>	<u>Model No.</u>	<u>Frequency Range</u>	<u>Rack Size</u>
HF Signal Intercept	WJ-8626A-4	5 kHz - 30 MHz	1/2
HF Monitor/ Hand-off	WJ-8626A-1	5 kHz - 30 MHz	1/4
VHF Intercept,	WJ-8627-2	20 - 100 MHz	1/4
Monitor or Hand-off	WJ-8627-4	100 - 180 MHz	1/4
	WJ-8627-5	180 - 300 MHz	1/4
	WJ-8627-6	220 - 440 MHz	1/4

Search receivers with built-in step and F1-F2 fast scan functions are available covering the 20-1000 MHz spectrum.

Controller

A WJ-8626A-4 half-rack Master Receiver/Controller features LCD readouts with a unique "operator prompt" feature to enhance orderly control routines. Controller readouts include frequency, IFBW, Detection Mode, BFO offset, RF Gain, Gain Mode, Fault indications and unit (module), frame and zone address. Metering is provided for audio and RF signal levels. The Controller has access to a 99 channel programmable memory for receiver parameter storage, recall, and channel scan and sector scan routines. Control and monitor handshaking is a coaxial serial asynchronous bidirectional data word to the zone, or equipment frame I/O module.

Direction Finder

The DDF100 Display Direction Finder provides Line of Bearing (LOB) information to within 3° RMS accuracy for signals received by the system receivers over the 20 - 512 MHz frequency range. Extension to 1100 MHz is available. The DDF100 is designed for use with the WJ-9871A, WJ-9872A or WJ-9873 DF Antenna arrays. (See technical data sheet on DF Antennas at end of Section 3.)

The Display Direction Finder functions as the controlling unit for the DF Subsystem. It controls the element switching at the antenna and processes signal information obtained from the receiver FM video output. Since the Display Direction Finder uses the FM video output of the receiver and thus sees a baseband signal, it is not RF frequency limited. Derived bearing data is displayed by a 3 digit LED display, supplemented by a circular array of LEDs. A built-in calibrator enhances accuracy and a north variance bearing offset feature enables either manual or automatic (with associated digital compass) entry of true north or magnetic north deviation relative to antenna positioning.

Common Equipment

Each system contains equipment common to all configurations. The primary unit is the EFR100 Equipment Frame which houses the various system functional modules. The EFR100, with its associated modules provides data transfer, signal routing, DC power and control compatibility among major system blocks.

A typical EFR100 Equipment Frame configuration to support four WJ-8627 Series Receivers is:

<u>Model No.</u>	<u>Unit</u>	<u>Function</u>
EPS100	AC to DC Power Supply	Furnishes DC power to equipment frame receivers
IOM108	I/O and Interface Module	Microprocessor based bidirectional digital data transfer
FRM150	Frequency Reference Module	50 MHz Frequency Reference generation (4-outputs)

For system ancillary items such as demodulators, signal displays, audio panels and signal selection modules, the EFR100 need only be furnished with the EPS100 Power Supply. An optional FRM180 Frequency Reference can be furnished which has a 1:8 splitter to enable multiple receiver drive from a master 50 MHz reference signal. This unit also has built-in dividers to enable operation via a master station or site reference with a frequency of 1, 2, 5, 10 or 50 MHz.

Where direct control of receivers and accessory devices is required from an external device, optional I/O modules, the DIO232 and the DIO488 can be provided for RS232C and IEEE488 formats.

SYSTEM GENERAL DESCRIPTION

Rev. A, 8/84

System Ancillary Equipment

Ancillary equipment from a family of compatible modules may be selected to perform particular system functions.

SYSTEM ANCILLARY EQUIPMENT			
<u>Model</u>	<u>Unit</u>	<u>Function</u>	<u>Rack Size</u>
DLP100	Data Logger and Printer	Provides hard copy alpha-numeric printout of system receiver status and received signal parameters	1/4
DXY100	X-Y Display	With supporting modules can be used as IF Pan Signal Monitor, Alpha-Numeric Graphics display or digital refreshed display	1/4
MVU104	VHF/UHF Multicoupler	Provides IX4 RF distribution	Mounts on EFR100 Equip. Frame
SMF455	FFT Signal Monitor Unit	Generates Fast Fourier Transform of 455 kHz IF input signal to provide an amplitude vs. frequency display for presentation on an external CRT such as DXY100	1/2
SMU120	Signal Monitor Unit	Processes 21.4 MHz IF to generate X, Y, Z inputs for DXY100 when used as signal monitor	1/8
SPN108	Speaker Panel	Audio switch and audio power amplifier selects one of 8 inputs and provides 2 watts audio output to built-in speaker	1/4
SSU106	Signal Select Unit	Pushbutton switches enable 1 of 6 audio, video, IF or RF signals to be selected and routed to other system modules	1/8
SSU228	Signal Select Unit	8X1 Signal switching MATRIX	1/4
WJ-9073	VHF/UHF Preselector	Voltage Tuned Tracking Preselector with high performance, flat gain vs. frequency amplifier	Full-rack, 1.75 inches high
WJ-9310	VHF/UHF Multicoupler	Provides system RF distribution; 1 input, 12 outputs	Full-rack, 1.75 inches high

SYSTEM GENERAL DESCRIPTION

Rev. A, 8/84

Demodulators

The IFD120 IF Demodulator is used to provide additional demodulation capability for any receiver or RF Tuner which has a 21.4 MHz low level IF or SM output. The IFD120 is a one quarter unit. It provides FM, AM and Pulse demodulation of the input signal. Optional IF bandwidths are available from 4 kHz to 4 MHz. These IF bandwidths are easily changed in the field, with a maximum of five (5) IF bandwidths per unit.

Optional IF filters can be provided which yield relatively flat group delay and Gaussian amplitude response for good NPR (Noise Power Ratio) performance.

Special purpose demodulators are also available to meet specific system requirements.

System Software

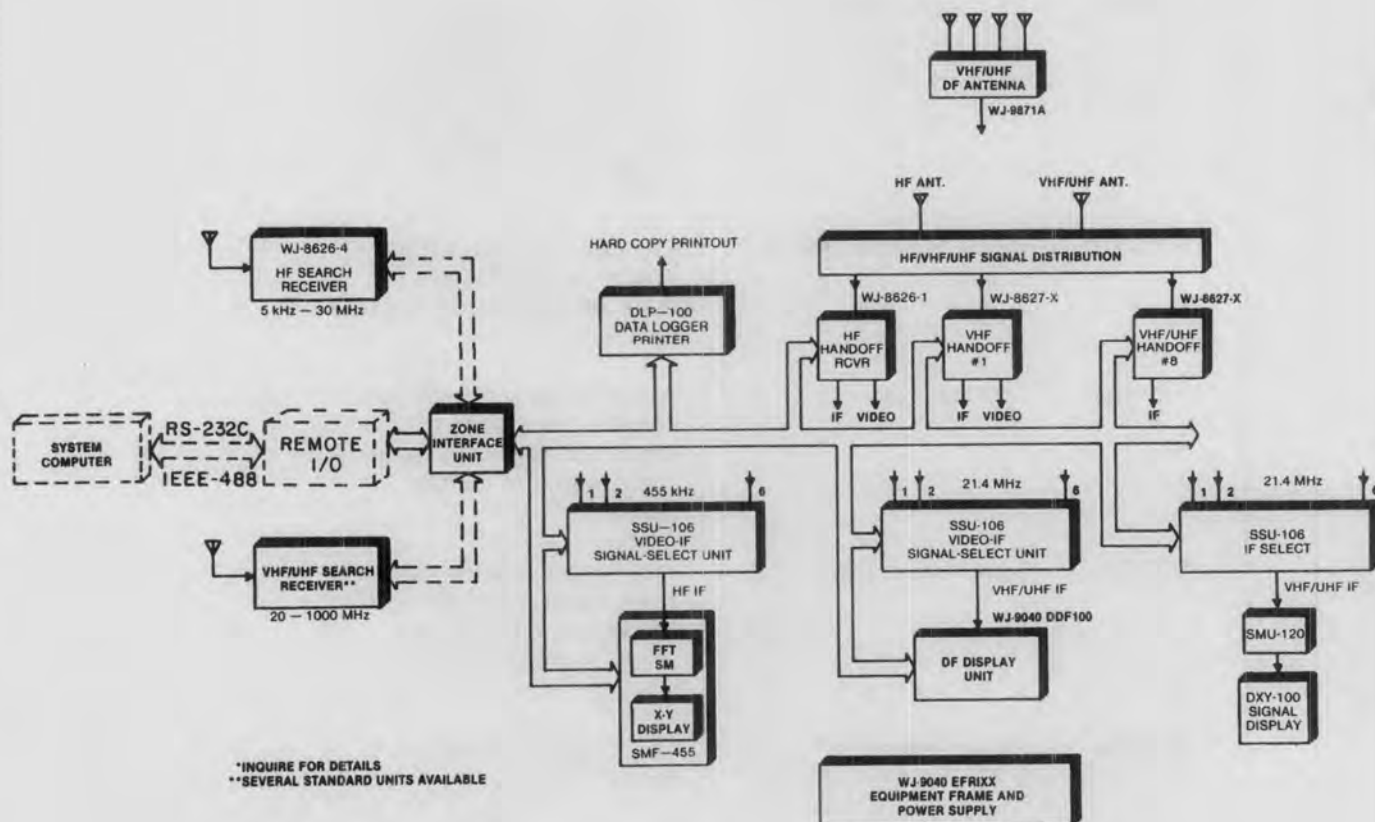
The WJ-9040 System Software is distributed within

the system at the module, equipment frame, and zone level, thus resulting in intelligence and memory throughout the system.

The basic system software is identical for all systems. However, software for particular applications or user defined functions is available. Software is further defined in Section 4 (System Software) of this handbook.

TYPICAL SYSTEM CONFIGURATION

Figure 2-4 depicts an example of a typical WJ-9040 Modular Receiving System configuration. The example given illustrates a system configured as an HF/VHF/UHF signal collection and monitor system. The system performs HF signal acquisition and hand-off; FFT spectrum analysis; VHF/UHF signal acquisition and hand-off; channel scan and F1-F2 routines; direction finding over the 20-1000 MHz range; and comprehensive signal display, printout and system control scenarios.



WJ-9040 Receiving System Configuration Example

Figure 2-4

APPLICATIONS

The WJ-9040 is a rugged system designed for employment over a wide range of strategic requirements. Ruggedized construction permits its use in airborne, ship and submarine platforms, as well as fixed-site or mobile ground installations. With operating temperatures of 0° to 50° C and operating altitudes to 15,000 feet, the system is suitable for a variety of environmental conditions. Design emphasis on providing lightweight, yet strong structures, coupled with modest input power requirements, makes the system particularly suitable for mobile or airborne applications. These applications may be:

- Signal Intelligence
- Determining Electronic Order of Battle (EOB)
- Real-Time Signal Collection and Analysis
- Protecting Ships and Aircraft
- Frequency Management
- Operations Security
- Monitoring Training & Exercise Range Activity
- Maritime Patrol
- Direction Finding (LOB)

WJ-9040

DEMODULATORS

Rev. 1, 9/84

IFD 160 IF DEMODULATOR



Weight - 9 lbs (4 kg)
Power - 14 watts

FEATURES

- 3 Selectable IF Bandwidths (3 to 50 MHz)
- Simultaneous AM and FM Video Outputs
- 160 MHz Predetection Output
- Remotely Controlled
- AM, FM and PULSE Demodulation

MODULE SIZE:

Quarter-Rack

AVAILABLE OPTIONS:

IF Bandwidth selection from 3 MHz to 40 MHz
Video output response to 25 MHz

MODULE I/Os:

160 MHz IF Input	} SMA Female Connectors
160 MHz SM Output	
160 MHz Predetection IF Output	
AM Video Output	
FM Video Output	
160 MHz Auxiliary IF Output	
RF AGC Output	

WJ-9040 System Connector (25 Pin, Type "D") (see page four for pinouts)

REQUIRED ADDITIONAL EQUIPMENT:

EFR100 Series Equipment Frame
EPS100 Series Power Supply
IOM108 I/O Module

COMPATIBLE ACCESSORY EQUIPMENT:

DIO232, DIO488 Interface
SSXXXX Series Signal Switching Units
SPN108 Speaker Panel
IFT100 IF Tuner
MDCXXX Series Microwave Down Converters

DESCRIPTION

The IFD160 IF Demodulator provides AM, FM and PULSE demodulation of 160 MHz input signals with demodulation bandwidths from 3 to 50 MHz. These IF bandwidths are easily changed in the field, with a maximum of 3 IF bandwidths per unit. The IF filters are designed to yield relatively flat group delay (over 80% of IF bandwidth) and amplitude response for good Noise Power Ratio performance. Other filter designs are available at customer request. The 160 MHz predetection IF Output is provided for user processing of the IF signal. The unit has front panel adjustments of AM and FM video output levels and provides simultaneous AM and FM video outputs. The unit can be operated in a manual or AGC gain mode and provides a RF AGC output to gain control of a RF unit (i.e., IFT100).

The IFD 160 occupies a one-quarter rack of an EFR100 Equipment Frame and is powered by an EPS100 Power Supply. The unit is controlled through an IOM108 I/O Module.

CAPABILITIES AND APPLICATIONS

The IFD160 is intended to be used with the IFT100 IF Tuner but can be used as a demodulator for any 160 MHz source. When used with an IFT100 and a microwave down converter from the MDCXXX series, it is a cost-effective demodulator of microwave signals. With IF bandwidths of 3 MHz to 50 MHz, the user can configure the demodulator for a particular signal environment.

**IFD 160
IF DEMODULATOR****DEMODULATORS**

Rev. 1, 9/84

SPECIFICATIONS

Input Frequency	160 MHz
IF Bandwidths	3 to 50 MHz (WJ-9925-XXXX IF Bandwidth Series)
Input Impedance	50 Ω nominal, unbalanced
Detection Mode	AM, FM and PULSE
Gain Control Modes	Manual and AGC
Noise Figure	18 dB maximum
160 MHz Output	-13 dBm, 160 MHz at input level for AGC Threshold
SM Output	160 MHz, 10 dB down from IF input level
AM Video Output	0.35 V rms into 75 Ω at AGC threshold
FM Video Output	0.35 V rms into 75 Ω at AGC threshold
Video Amplifier Response	dc to 1/2 IF Bandwidth (18 MHz maximum, 25 MHz optional)
Audio Output	10 mW into 600 Ω at AGC threshold
RF AGC Output	0 to -10 Vdc for 40 dB change of IF input level
160 MHz Auxiliary IF Output	-66 dBm
Group Delay	Approx. reciprocal of (IF BW x 15) over 80% of BW
Signal Strength Output	0 to 10 V
Signal Presence Output	TTL high for signal presence
Digital Control	72 bit serial word (WJ-9040 System compatible)
Temperature:	
Operating	0 $^{\circ}$ C to 50 $^{\circ}$ C
Storage	-40 $^{\circ}$ C to 70 $^{\circ}$ C
Power Consumption	Approx. 14 watts
Weight	9 pounds (4 kg)
Size	5.2 inches high (132 mm) 4.0 inches wide (102 mm) 14.38 inches deep (365 mm) (one-quarter rack WJ-9040)

IF BW OPTIONS

<u>IF BW</u>	<u>Input Level for AGC Threshold</u>
3 MHz	-68 dBm
11 MHz	-62 dBm
22 MHz	-59 dBm

Bandwidths from 3 MHz to 50 MHz are available. AGC threshold for other bandwidths is determined by the following:

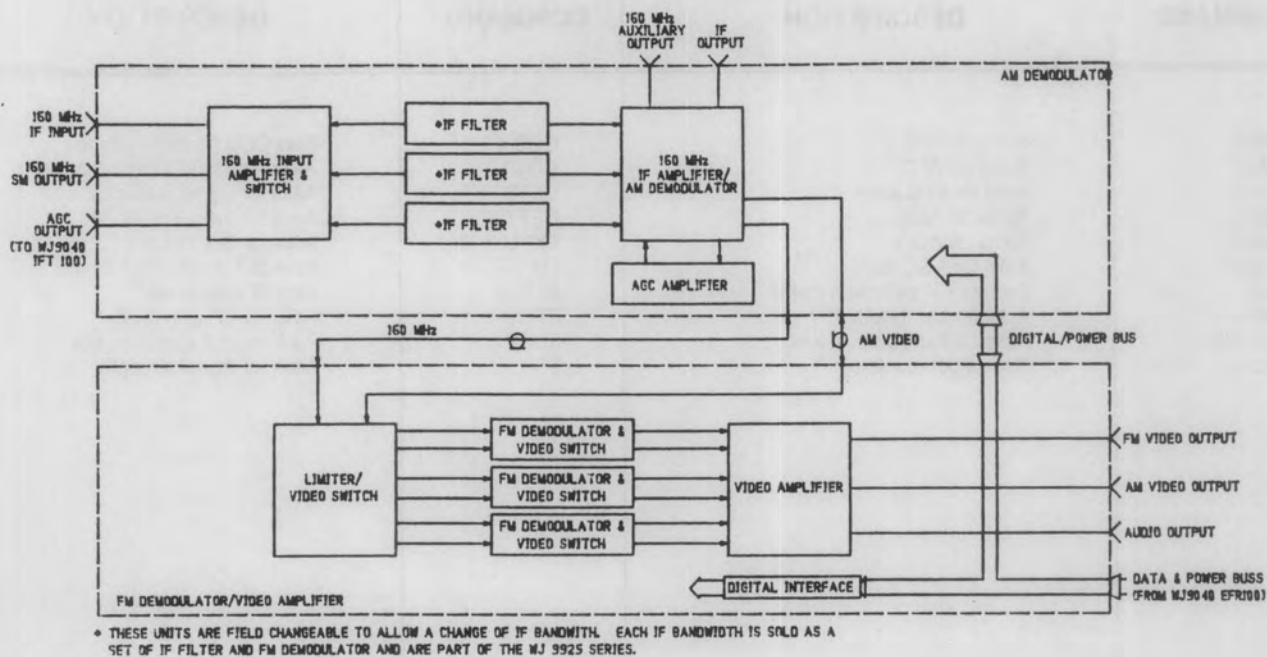
$$\text{AGC Threshold (dBm)} = -133 \text{ dBm} + 10 \log (\text{BW in Hz})$$

**IFD160
IF DEMODULATOR**

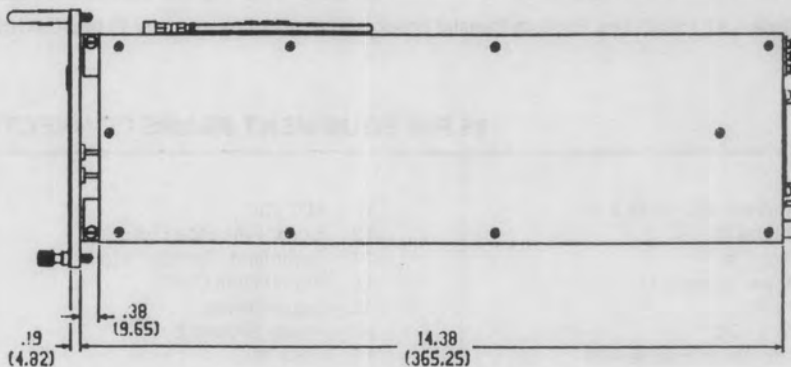
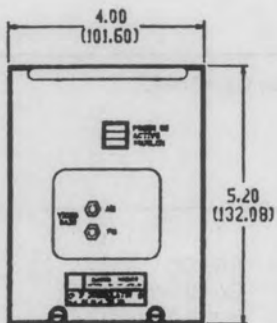
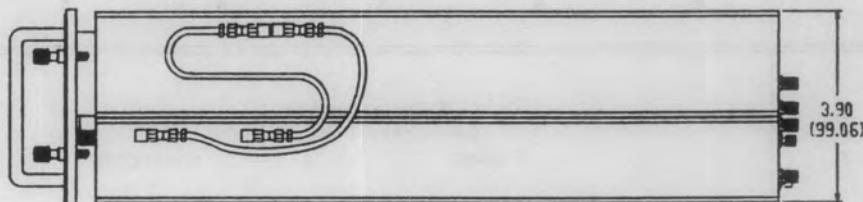
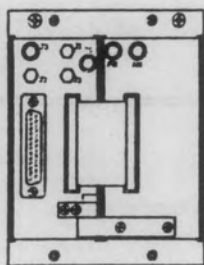
DEMODULATORS

Rev. 1, 9/84

BLOCK DIAGRAM



OUTLINE DRAWING



XX INCHES
(XXX) MM

**IFD 160
IF DEMODULATOR**

DEMODULATORS

Rev. 1, 9/84

IEEE-488/RS-232 COMMANDS

COMMAND	DESCRIPTION	COMMAND	DESCRIPTION
AFC	Turns on AFC	COS n	Sets COS Control Voltage
AFC/	Turns off AFC	COS?	Asks for COS Control Voltage
AFC?	Asks for AFC state	CST?	Asks for signal presence
AGC	Turns on AGC	DET?	Asks for detection mode
AGC/	Turns off AGC	EXAM n	Asks for slot status
AGC?	Asks for AGC state	FM	Selects FM detection mode
AM	Selects AM detection mode	RFG n	Sets RF gain level
BW?	Asks for bandwidth #	RFG?	Asks for RF gain level
BWC?	Asks for bandwidth in kHz	SLOT n	Addresses a specified slot
CLR	Resets demodulator	SS?	Asks for signal strength

* Optional Commands

COMMAND/CONTROL SERIAL BIT STREAM

BYTE	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
0			COS Control Voltage					AFC select
1			Gain Control Voltage					AGC select
2		IF select		unassigned				Detection mode

Effective Bit Rate = 17.1 Kbit/sec. For data transfer timing and protocol please refer to the IOM108 I/O Module Data Sheet.

25 PIN EQUIPMENT FRAME CONNECTOR

1. Addressed Enable B In	12. AFC Out	20. 8.2 VDC
2. Strobe In	13. Signal Presence Out	21. Signal Ground
3. Clock In	14. Command/Control Data In	22. Signal Strength
5. Power Ground 1	15. Report Data Out	23. Module Fault Indicator
6. 29 VDC	16. Logic Ground	24. Selected Audio Out
7. 18.3 VDC	18. Power Ground 2	25. Not Assigned
9. Addressed Enable A In	19. -18.3 VDC	

**DXY100
XYZ DISPLAY**

WJ-9040

DISPLAYS
Rev. A, 8/84



Weight - 5 lbs (2 kg)
Power - 8 watts

MODULE SIZE:

Quarter-Rack

AVAILABLE OPTIONS:

None at this time

MODULE I/Os:

(J2) Horizontal	(X) Input	} SMA Female Connector
(J3) Vertical	(Y) Input	
(J4) Intensity	(Z) Input	
(J1) WJ-9040 System Connector -25 Pin, Type "D" (see page four for pinouts)		

REQUIRED ADDITIONAL EQUIPMENT:

EFR100 Series Equipment Frame
EPS100 Series Power Supply

COMPATIBLE ACCESSORY EQUIPMENT:

SMU12X Series Signal Monitors
SMFXXX Series FFT Signal Monitors
SSUXXX Series Signal Switching Unit
ANG100 Alphanumeric Graphics Generator

FEATURES

- Small, compact quarter rack unit
- X, Y and Z (blanking) inputs
- Large 2.25 inch by 2.5 inch CRT Display
- Standard 60 dB log scale markings

DESCRIPTION

The WJ-9040 DXY100 is a quarter-rack XYZ Display which utilizes a 2.25-inch high by 2.5-inch wide CRT Display. The unit accepts horizontal (X), vertical (Y) and intensity or blanking (Z) type inputs and displays these input on the CRT.

Power is supplied through the WJ-9040 EFR 100 series equipment frame in which the unit is mounted. Local control is provided via the following front panel controls: vertical position adjustment, horizontal position adjustment, focus and intensity.

The standard CRT overlay supplied includes 10 horizontal graticules and 6 vertical graticules. The vertical scale is labeled in 10 dB increments for a 60 dB LOG scale.

CAPABILITIES AND APPLICATIONS

The WJ-9040 DXY100 Display is capable of accepting X, Y and Z D.C. inputs from a variety of sources. These include analog or FFT type signal monitors, alphanumeric graphics generators, and refreshed display outputs from receivers. The unit may be used in conjunction with the SSUXXX series of signal switching units to provide multi-source operation.

**DXY100
XYZ DISPLAY****DISPLAYS**

Rev. A, 8/84

SPECIFICATIONS**Input Requirements:**

Horizontal (X) 1 V peak-to-peak
Vertical (Y) 1 V peak-to-peak
Intensity (Z) 0 V full intensity
2.5 V blanked

Input Impedance (X,Y,Z) 10 k Ω

CRT Display Area 2.25 in. (57.2 mm) high by 2.5 in (63.5 mm) wide

Front Panel Controls Vertical Position
Horizontal Position
Focus
Intensity

CRT Overlay 10 Horizontal Divisions

6 Vertical Divisions
Labeled in 10 dB increments

Power Consumption Approx. 8 watts

Power Requirements ± 18.3 Vdc supplied by WJ-9040

Size Equipment Frame
5.2 inches (132 mm) high
4.0 inches (101 mm) wide
14.38 inches (365 mm) deep

Weight Approx. 5 lbs. (2 kg)

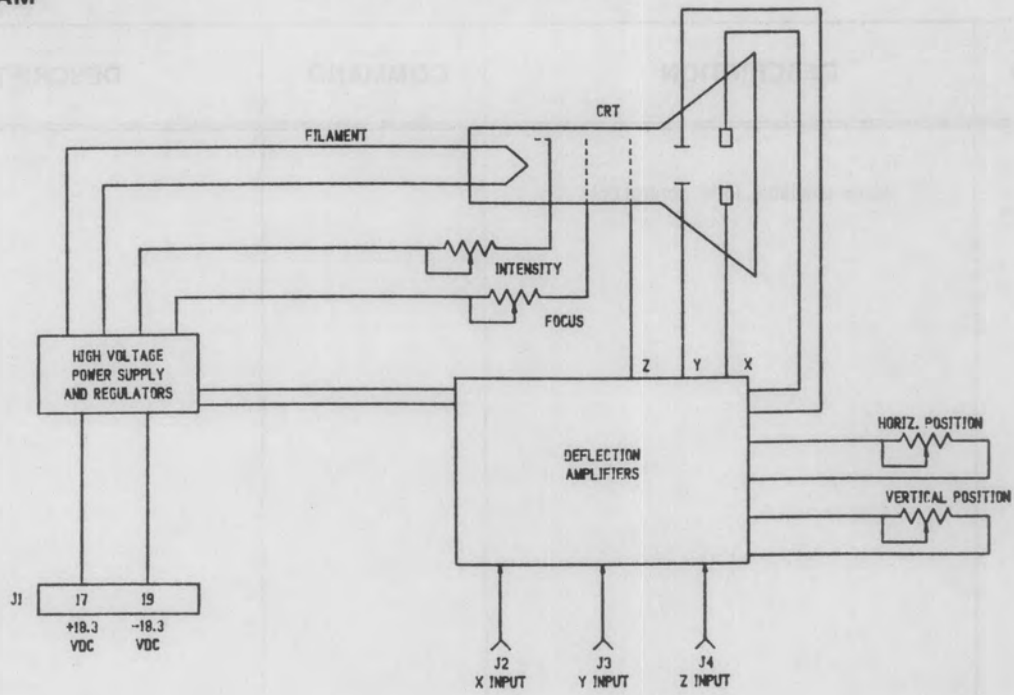
Operating Temperature Range 0 $^{\circ}$ C to 50 $^{\circ}$ C

**DXY100
XYZ DISPLAY**

DISPLAYS

Rev. A, 8/84

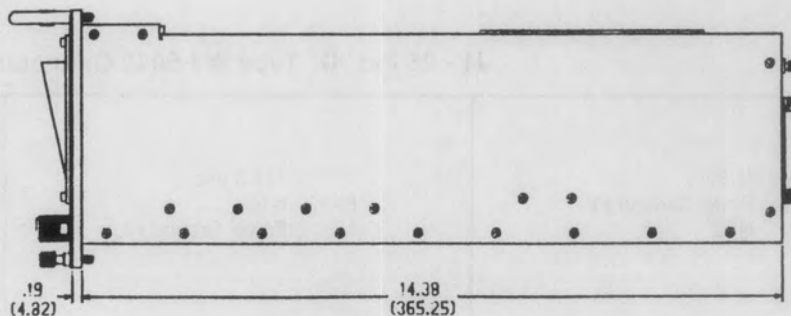
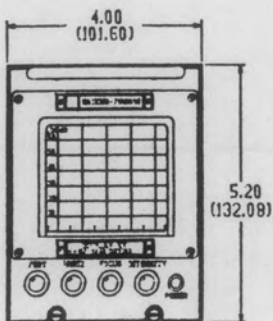
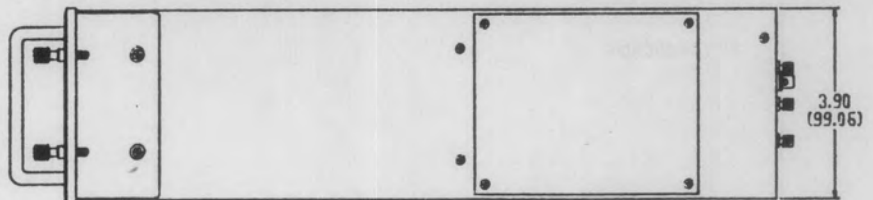
BLOCK DIAGRAM



OUTLINE DRAWING



REAR VIEW



XX INCHES
(XXX) MM

IEEE-488/RS-232 COMMANDS

COMMAND	DESCRIPTION	COMMAND	DESCRIPTION
	None available, local control only.		

COMMAND/CONTROL SERIAL BIT STREAM

BYTE	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
	Not applicable.							

J1 - 25 Pin "D" Type WJ-9040 Connector

1.-4. N/C 5. Power Ground #1 6. N/C	7. +18.3 Vdc 8.-17. N/C 18. Power Ground #2	19. -18.3 Vdc 20.-25. N/C
---	---	------------------------------

WJ-8626A-1
5 kHz - 30 MHz
HF RECEIVER

WJ-9040

RECEIVERS

Rev. A, 6/84



Weight - 10 lbs (4.5 kg)
 Power - 13 watts

FEATURES

- 5 kHz to 30 MHz Frequency Coverage
- Tuning Resolution of 10 Hz Using Low Phase Noise, High Speed Synthesizers
- AM, FM, CW, USB and LSB Detection Modes
- ± 8 kHz BFO Tunable in 100 Hz Steps
- One Quarter-Rack Size
- Remote Controllable
- Up to five customer selectable IF Bandwidths
- Master/Slave function with WJ-8626A-4 HF Receiver and Controller.
- Consistent with WJ-9040 Low Power, Modular construction and high performance standards.

MODULE SIZE:

Quarter-Rack

AVAILABLE OPTIONS:

PHF-10X HF Preselector available in separate quarter-rack unit.

MODULE I/Os:

- (A2J1) RF Input
- (J3) SM Output
- (J5) Selected Video Output
- (J4) IF Output
- (J2) 50 MHz Reference Input
- (J6) Auxiliary I/O (9 Pin SRE Female Connector)

SMA Female Connector

Pin Assignments:

- A - Ground
- B - FM Audio Output
- C - AM Audio Output
- D - Signal Strength Output (Analog 0 to 10V)
- E - Carrier Operated Relay Control (open collector, 30 mA sink to ground for switching +24 V maximum external voltage)
- F - Carrier Operated Squelch (0 or 5 V)
- H - CW/SSB Audio Output
- J - Squelched Audio Output
- K - AFC Output
- (J7) Control Output for Optional Preselector 7 Pin SRE Female Connector
- (J1) WJ-9040 System Connector (25 Pin, Type "D") (see page four for pinouts)

REQUIRED ADDITIONAL EQUIPMENT:

- EFR100 Series Equipment Frame
- EPS100 Series Power Supply
- FRM/SRM-1XX Series Site or Frequency Reference Module
- IOM108 I/O Module

COMPATIBLE ACCESSORY EQUIPMENT:

- DIO232, DIO488 Interface
- SSU1XX Series Signal Switching Units
- SMF455 FFT Signal Monitor
- PHF10X HF Preselector
- SPN108 Speaker Panel
- WJ-8626A-4 HF Receiver and Controller

DESCRIPTION

The WJ-8626A-1 HF Receiver is a fully synthesized, digitally controlled, modular receiver, covering the 5 kHz to 30 MHz frequency range in 10 Hz steps. This surveillance and monitoring receiver is designed to conform with WJ-9040 System characteristics and occupies only one quarter of a standard 19 inch equipment frame.

The WJ-8626A-1 features high dynamic range, low noise amplifiers in the tuner section and fully synthesized, low noise local oscillators. Additionally, the receiver offers a synthesized BFO, tunable in 100 Hz steps.

The WJ-8626A-1 detection modes include AM, FM, CW, USB and LSB. Up to five IF Bandwidth filters can be installed in the receiver. The IF Bandwidths fall in a 200 Hz to 16 kHz range and are selected from the WJ-9926-XX Series of filter sets.

SSB detection is achieved with either USB and LCB Filters (leaving three remaining bandwidths) or with a special 2.85 kHz filter used in conjunction with offset local oscillators (leaving four remaining bandwidths in addition to 2.85 kHz).

Tuning, detection mode selection, gain control, audio output, COR functions, BFO, signal strength, and bandwidth selection are operating parameters remotely accessed through a serial data stream provided by the Equipment Frame IOM108, I/O Module.

WJ-8626A-1
5 kHz - 30 MHz
HF RECEIVER

RECEIVERS

Rev. A, 6/84

CAPABILITIES AND APPLICATIONS

The WJ-8626A-1 may be used as either a scanning, remotely controlled HF Receiver or as a handoff receiver controlled by the WJ-8626A-4 HF Receiver and Controller.

The unit operates in conjunction with an IOM108 I/O Module which will store up to 99 channels or 8 sectors and perform either channel or F1-F2 scans. Threshold and dwell are adjustable for each channel or sector.

The handoff mode of operation utilizes a WJ-8626A-4 Master Receiver and results in extremely compact hand-off systems due to the small size of the WJ-8626A-1 Receiver.

Preselection is available through a separate quarter-rack switched sub-octave HF Preselector. This unit (PHF10X) houses up to three preselectors and when used in conjunction with the WJ-8626A-1 Receivers, results in three HF Receivers with preselection in a single 19 inch frame.

SPECIFICATIONS

Tuning Frequency	5.0 kHz to 30.00000 MHz
Tuning Resolution	10 Hz
Synthesizer Tuning Speed	15 ms, typical
Antenna Conducted Local Oscillator Radiation	-87 dBm, maximum
Antenna Input Protection	The antenna input will withstand the effects of RF power to 27 dBm and static build-up. The protection circuit automatically resets.
Input Impedance	50 ohms, unbalanced, nominal
IF Bandwidths (3 dB)	Standard: 2.85 kHz Optional: any four of the following: 0.2, 0.5, 1, 2, 3, 4, 6, 8, 12 or 16 kHz; USB, LSB
Detection Modes	Standard: FM, AM, CW, LSB and USB
Gain Control Modes	Manual, AGC
AGC and Manual Range	90 dB, minimum
AGC Threshold	3.2 microvolt, typical
AGC Attack Time	15 ms, maximum
AGC Release Time	AM, FM = 100 ms, maximum CW, SSB = 2-4 Sec., nominal
Synthesized BFO	±8.0 kHz in 100 Hz steps
IF Rejection	Greater than 90 dB
Image Rejection	Greater than 90 dB
Sensitivity	See IF Options and Sensitivity Table
IF Output	455 kHz, 20 mV into 50Ω, minimum, at 3.2 microvolt input level, IF BW limited
Signal Monitor Output	455 kHz, center frequency, 17 kHz bandwidth, 50Ω, output impedance
Third Order Input Intercept Point	+20 dBm, minimum for signals separated by 30 kHz minimum.
Video Amplifier Response	Within 3 dB from 20 Hz to 1/2 IF Bandwidth

Video Output Level	350 mV rms into 75 ohms
Video Distortion	Less than 5% total Harmonic Distortion in AGC or Manual Gain Modes
Signal Strength Output	Shaped DC AM Detector output, 0 to +10 Vdc
Squelch/COR	Adjustable threshold from noise level to 80 dB above noise. COR holds a nominal 4 seconds after carrier disappears.
Digital Control	72 Bit Serial Word (WJ-9040 System compatible)
Environmental Conditions:	
Temperature, Operating	0° to 50°C
Temperature, Non-operating	-40°C to 70°C
Power Consumption	Approximately 13 Watts
Weight	Approximately 10 lbs (4.5 kg)
Size	5.2 inches (132 mm) high, 4.0 inches (102 mm) wide and 14.38 inches (365 mm) deep

WJ-8626A-1
5 kHz - 30 MHz
HF RECEIVER

RECEIVERS

Rev. A, 6/84

IF OPTIONS AND SENSITIVITY LEVELS

	3 DB IF Band- width	IF Shape Factor (Typical) 50dB:3dB	RF Input Level	
			Micro- volts	dBm
WJ-9926/200	200 Hz	10:1	0.50	-113
WJ-9926/500	500 Hz	7:1	0.64	-111
WJ-9926/1K	1 kHz	5:1	0.80	-109
WJ-9926/2K	2 kHz	3:1	1.0	-107
WJ-9926/3K	3 kHz	3:1	1.4	-104
WJ-9926/4K	4 kHz	3:1	1.6	-103
WJ-9926/6K	6 kHz	3:1	2.0	-101
WJ-9926/8K	8 kHz	3:1	2.2	-100
WJ-9926/12K	12 kHz	3:1	2.9	-98
WJ-9926/16K	16 kHz	2:1	3.2	-97
WJ-9926/USB	2.85 kHz	1.8:1	0.7	-110
WJ-9926/LSB	2.85 kHz	1.8:1	0.7	-110
WJ-9926/SSB	2.85 kHz	1.8:1	0.7	-110

(uses offset L.O.)

SENSITIVITY

Over the frequency range of 0.2 to 30 MHz, the RF input levels and IF Bandwidths specified above will:

1. Produce a minimum AM (S+M)/N ratio of 10 dB at the audio for 50% AM modulation at a 400% Hz rate, (kHz and wider IF Bandwidths).
2. Produce a minimum CW (S+N)/N ratio of 16 dB at the audio output.
3. Produce a minimum FM (S+N)/N ratio of 17 dB at the audio output (10 kHz and wider IF Bandwidth).
4. Produce a minimum USB/LSB (S+N)/N ratio of 10 dB at the audio output (SSB Filters only).

Over the frequency range of 5 kHz to 200 kHz, the following applies:

CW Sensitivity (1 kHz
IF Bandwidth)

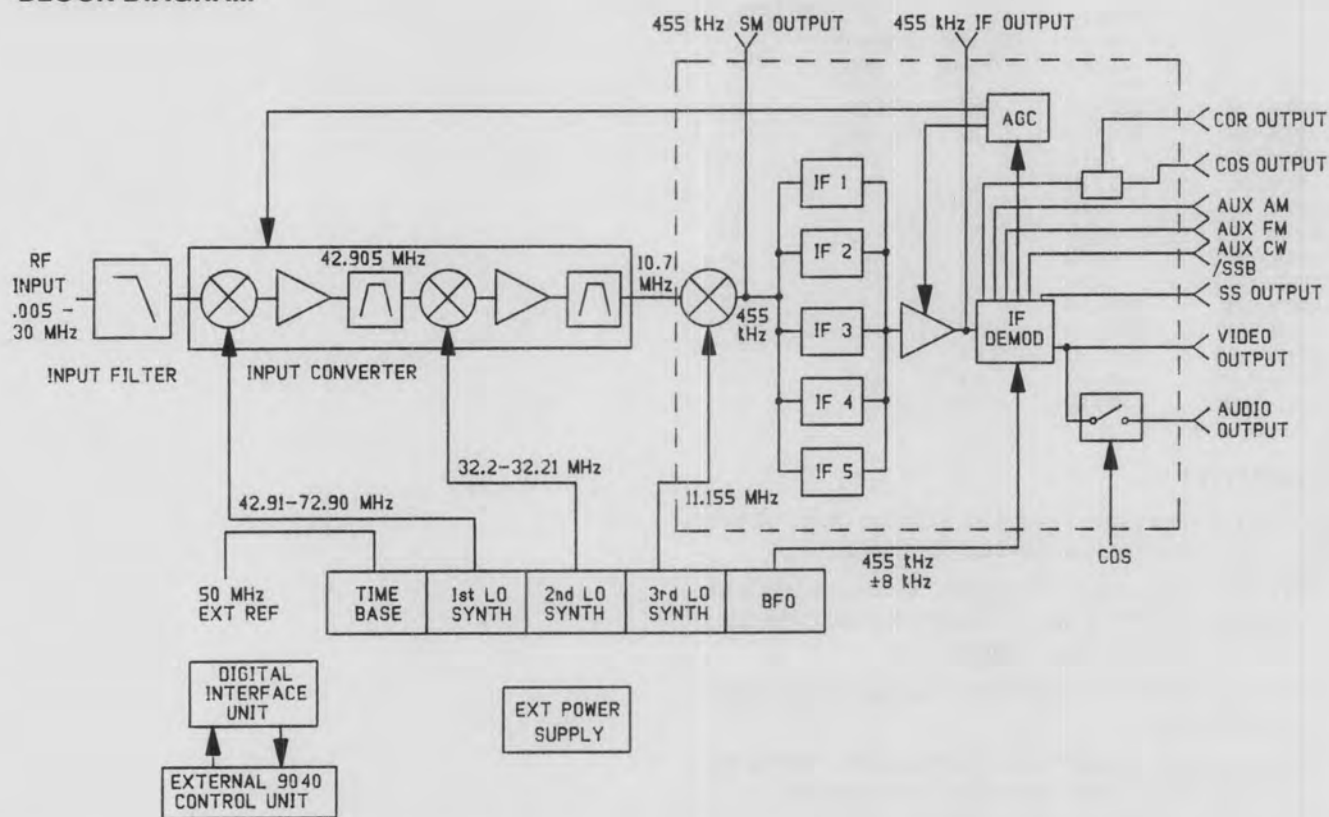
200 kHz - 30 MHz	A 0.8 microvolt signal will produce at least a 16 dB (S+N)/N ratio at the audio output.
50 kHz - 200 kHz	A 1.8 microvolt signal will produce at least a 16 dB (S+N)/N ratio at the audio output.
15 kHz - 50 kHz	A 7.1 microvolt signal will produce at least a 16 dB (S+N)/N ratio at the audio output.
5 kHz - 15 kHz	A 128 microvolt signal will produce at least a 16 dB (S+N)/N ratio at the audio output.

WJ-8626A-1
5 kHz - 30 MHz
HF RECEIVER

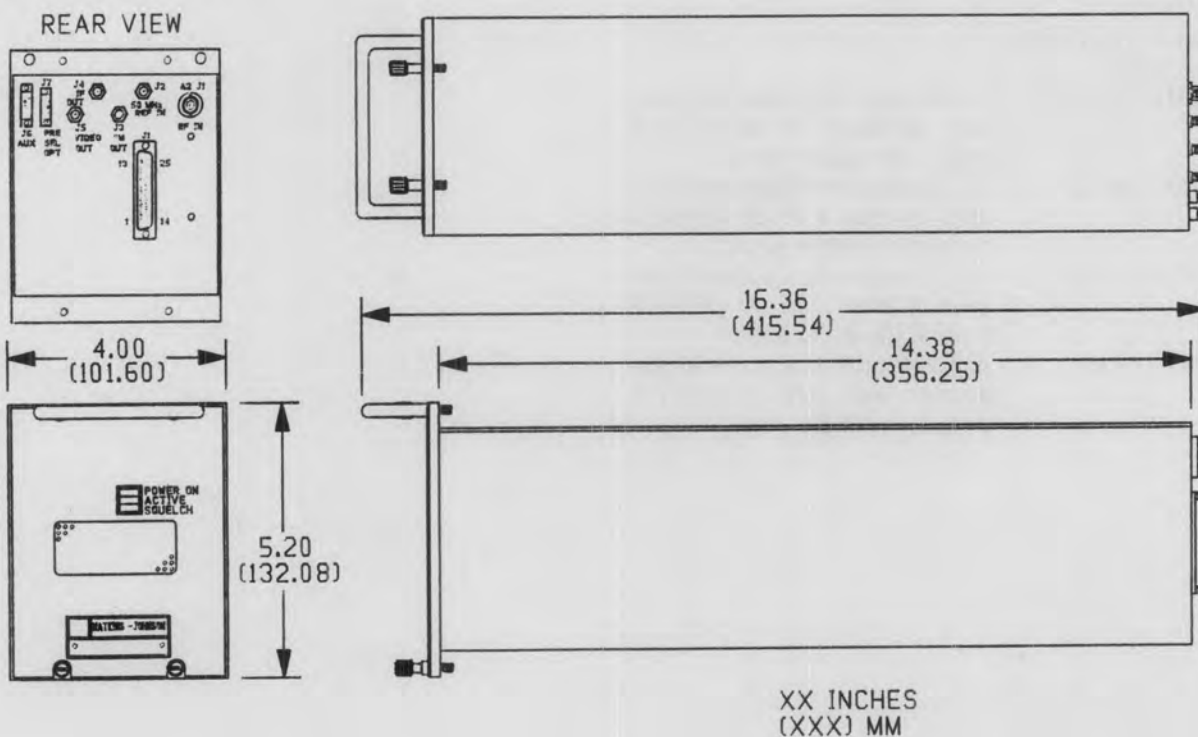
RECEIVERS

Rev. A, 6/84

BLOCK DIAGRAM



OUTLINE DRAWING



XX INCHES
 (XXX) MM

WJ-8626A-1
5 kHz - 30 MHz
HF RECEIVER

RECEIVERS

Rev. A, 6/84

IEEE-488/RS-232 COMMANDS

COMMAND	DESCRIPTION	COMMAND	DESCRIPTION
AFC	Turns on AFC	*F1 n,f	Sets start frequency of sector
AFC/	Turns off AFC	*F1 n?	Asks stop frequency of sector
AFC?	Asks for AFC state	*F2 n,f	Sets stop frequency of sector
AGC	Turns on AGC	*F2 n?	Asks for stop frequency of sector
AGC/	Turns off AGC	FM	Selects FM detection mode
AGC?	Asks for AGC state	FRQ?	Sets tuned frequency
AM	Selects AM detection mode	FRQ?	Asks for tuned frequency
BFO (+/-)f	Sets BFO frequency	INL n,m-p	Includes channels for channel scan
BFO?	Asks for BFO frequency	LCK n,m-p	Locks channels out of channel scan
BW n	Sets receiver bandwidth	LSB	Selects LSB detection mode
BW?	Asks for bandwidth #	MAN n	Stops specified a scan
BWC?	Asks for bandwidth in kHz	RCL n	Recalls a memory channel
CLR	Resets receiver	RFG n	Sets RF gain level
COS n	Sets COS threshold level	RFG?	Asks for RF gain level
COS?	Asks for COS threshold level	SCN	Starts channel scan
CST?	Asks for COS state	SLOT n	Starts channel scan
CW	Selects CW detection mode	SS?	Addresses a specified slot
DET?	Asks for detection mode	SS?	Allocates a memory channel
DWL n,m	Sets sector & channel dwell time	*STP n	Starts a sector scan
DWL?	Asks for dwell times	USB	Selects USB detection mode
EXAM n	Asks for slot status		

*Optional Commands

COMMAND/CONTROL SERIAL BIT STREAM

BYTE	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
0		10 Hz BFO			BFO sign			unassigned
1		1 kHz BFO						
2		100 Hz Frequency				100 Hz BFO		
3		10 kHz Frequency				10 Hz Frequency		
4		1 MHz Frequency				1kHz Frequency		
5		unassigned				100 kHz Frequency		
6						10 MHz Frequency		
7					COS Threshold Level			
8	AFC select				Manual Gain Control Level		Detection mode	
9	AGC select				unassigned			
	IF BW select							

Effective Bit Rate = 17.1 Kbit/sec. For detailed data transfer timing, please refer to the IOM108 I/O Module Data Sheet.

25 PIN EQUIPMENT FRAME CONNECTOR

1.	Addressed Enable B In	15.	Report Data Out
2.	Strobe In	16.	Logic Ground
3.	Clock In	18.	Power Ground 2
5.	Power Ground 1	19.	-18.3 VDC
6.	+29 VDC	20.	+8.2 VDC
7.	+18.3 VDC	21.	Signal Ground
9.	Addressed Enable A In	22.	Signal Strength Out
12.	AFC Out	23.	Synthesizer Unlock Out
13.	COS Status Out	24.	Squelched Audio
14.	Command/Control Data In	25.	Not Assigned

WJ-8626A-4
5KHz - 30 MHz
HF MASTER RECEIVER

WJ-9040

RECEIVERS

Rev. A, 9/84



Weight - 17 lbs (7.7 kg)
 Power - 15 watts

MODULE SIZE:

Half-Rack

AVAILABLE OPTIONS:

- Sub-octave Preselector
- Master/ Handoff Software
- FSK Demodulator
- (see detailed option list for further options)

MODULE I/O :

- (A2J1) RF Input
 - (J3) SM Output
 - (J5) Selected Video Output
 - (J4) IF Output
 - (J2) 50 MHz Reference Input
 - (J6) Auxiliary I/O (9 Pin SRE Female Connector)
- } SMA Female Connector
- Pin Assignments:
- A — Ground
 - B — FM Audio Output
 - C — AM Audio Output
 - D — Signal Strength Output (analog - 0 to +10 Vdc)
 - E — Carrier Operated Relay Control (open collector, 30 mA sink to ground for switching up to +24 Vdc)
 - F — Carrier Operated Squelch (0 or 5 Vdc)
 - H — CW/SSB Audio Output (FSK Output — optional)
 - J — Squelched Audio Output
 - K — AFC Output
- (J1) WJ-9040 System Connector (25 Pin, Type "D")
 (see page four for pinouts)

REQUIRED ADDITIONAL EQUIPMENT:

- EFR100 Series Equipment Frame
- EPS100 Series Power Supply
- FRM/SRM-1XX Series Site or Frequency Reference Module

FEATURES

- Half-Rack General Purpose HF Receiver/ Receiver Controller
- Full Local or Remote Control
- Indicating Microprocessor Front Panel with 48-Character Alphanumeric Display
- Up to Five Selectable IF Bandwidths
- AM, FM, CW, USB and LSB Detection Modes
- Extensive Uncommitted ROM and RAM Space for Maximum User-Defined Applications
- Master Handoff/ Monitor/ Control Functions with up to 34 WJ-9040 HF/VHF/UHF Handoff Receivers
- Channel or Sector Scan Capability
- Consistent with WJ-9040 Low Power Consumption, Modular Construction and High Performance Standards
- Tuning Resolution of 10 Hz Using Low Phase Noise, High Speed Synthesizers

COMPATIBLE ACCESSORY EQUIPMENT:

- IOM108 I/O Module
- DIO232, DIO488 Interface
- SSU1XX Series Signal Select Units
- SMF455 FFT Signal Monitor
- SPN108 Speaker Panel
- WJ-8626A-1 HF Handoff Receiver
- WJ-8627-X Series VHF/UHF Handoff Receiver

DESCRIPTION

The WJ-8626A-4 Receiver is a fully synthesized, microprocessor-controlled receiver capable of local or remote control for surveillance applications in the 5 kHz to 30 MHz frequency range. Two half-rack units, when mounted side by side in a fully equipped 19-inch WJ-9040 System Equipment Frame, occupy only 5.25 inches of vertical rack space. Each receiver is a complete, synthesized, high dynamic range HF receiver with up to five selectable IF bandwidths and AM, FM, CW, USB, and LSB detection modes.

SSB detection is achieved with either USB and LSB filters (leaving three remaining bandwidths) or with a special 2.85 kHz filter used in conjunction with offset local oscillators (leaving four remaining bandwidths in addition to 2.85 kHz).

The receiver's microprocessor-controlled, general purpose keypad and liquid crystal display provide for 48-character alphanumeric indication of operating status. The modular LCD features an adjustable viewing angle and backlighting circuit.

Variable tuning resolution to a minimum of 10 Hz is provided. Either the general purpose keypad or a tuning knob allows for direct frequency selection or sweep tuning, respectively. Operating versatility is enhanced with additional front panel control of detection mode, IF bandwidth, gain mode, BFO offset, COS level, RF gain and audio gain.

WJ-8626A-4
5KHz - 30 MHz
HF MASTER RECEIVER

RECEIVERS

Rev. A, 9/84

CAPABILITIES AND APPLICATIONS

The WJ-8626A-4 HF Receiver installed in an appropriately equipped WJ-9040 Equipment Frame offers a high degree of flexibility, achieved through the NSC800 Microprocessor. The WJ-8626A-4's memory provides up to 56 kbytes of ROM and 12 kbytes of RAM to allow for future software expansion. Special software may provide unique performance in conjunction with other WJ-9040 Receivers and ancillary devices.

The WJ-8626A-4 is capable of talk/listen communication within its own WJ-9040 Equipment Frame. An external controller may send command/control information to the unit via the IOM108, either to interrogate its status or change its tuning parameters when in a remote mode. IEEE-488 or RS-232 interface options in the IOM108 provide easy configuration with other equipment for system applications.

When used as a Master Receiver Controller, the WJ-8626A-4 generates a high speed WJ-9040 I/O data stream from a BNC connector on the rear panel. This 50 ohm link may be connected to any IOM108 for control of all receivers in that frame.

The Master Controller's capabilities would then include handoff of tuning parameters to any configured "slave" receiver. After downloading of data, that receiver can be monitored, with signal strength, COS status and center tuning continuously updated and displayed on the WJ-8626A-4 front panel. Since the WJ-8626A-4 is a true "Controller", all parameters and status of a "slave" receiver may be controlled without affecting the status of the Master's receiver section.

For larger subsystems, a ZIU (Zone Interface Unit) allows control of up to eight WJ-9040 Equipment Frames. Using quarter-rack units, the WJ-8626A-4 can effectively control up to 34 WJ-9040 series HF, VHF, or UHF Handoff Receivers.

SPECIFICATIONS

Tuned Frequency	5.0 kHz to 30.00000 MHz
Tuning Resolution	10 Hz
Synthesizer Tuning Speed	15 ms, typical
Antenna Conducted Local Oscillator Radiation	-87 dBm, maximum
Antenna Input Protection	The antenna input will withstand the effects of RF power to +27 dBm and static build-up. The protection circuit automatically resets.
Input Impedance	50 ohms, unbalanced, nominal
IF Bandwidths (3 dB)	Standard: 2.85 kHz Optional: Any four of the following: 0.2, 0.5, 1, 2, 3, 4, 6, 8, 12 or 16 kHz; USB, LSB
Detection Modes	Standard: FM, AM, CW, LSB and USB

Gain Control Modes	Manual, AGC
AGC and Manual Range	90 dB, minimum
AGC Threshold	3.0 microvolt, typical
AGC Attack Time	15 ms, maximum
AGC Release Time	AM, FM = 100 ms, maximum CW, SSB = 2-4 Sec., nominal
Synthesized BFO	±8.0 kHz in 100 Hz steps
IF Rejection	Greater than 90 dB
Image Rejection	Greater than 90 dB
Sensitivity	See IF Options and Sensitivity Table
IF Output	455 kHz, 20 mV into 50Ω, minimum, at 3 microvolt input level, IF BW limited
Signal Monitor Output	455 kHz, center frequency, 17 kHz bandwidth, 50Ω, output impedance
Third Order Input	+20 dBm, minimum for signals separated by 30 kHz minimum.
Video Amplifier Response	Within 3 dB from 20 Hz to 1/2 IF Bandwidth
Video Output Level	350 mV rms into 75 ohms
Video Distortion	Less than 5% total Harmonic Distortion in AGC or Manual Gain Modes
Phones Output	10 mW minimum into 600 Ω phones
Signal Strength Output	Shaped DC AM Detector output, 0 to 10 Vdc
Squelch/COR	Adjustable threshold from noise level to 80 dB above noise. COR holds a nominal 4 seconds after carrier disappears.
Digital Control	72 Bit Serial Word (WJ-9040 System compatible)
Environmental Conditions:	
Temperature, Operating	0° to 50°C
Temperature, Non-operating	-40°C to +70°C
Power Consumption	Approximately 15 W
Weight	Approximately 17 lbs (7.7 kg)
Size	5.2 inches (132 mm) high, 8.0 inches (203 mm) wide and 14.38 inches (365 mm) deep

WJ-8626A-4
5KHz - 30 MHz
HF MASTER RECEIVER

RECEIVERS

Rev. A, 9/84

IF OPTIONS AND SENSITIVITY LEVELS

	3 DB IF Band- width	IF Shape Factor (Typical) 50dB:3dB	RF Input Level	
			Micro- volts	dBm
WJ-9926/200	200 Hz	10:1	0.50	-113
WJ-9926/500	500 Hz	7:1	0.64	-111
WJ-9926/1K	1 kHz	5:1	0.80	-109
WJ-9926/2K	2 kHz	3:1	1.0	-107
WJ-9926/3K	3 kHz	3:1	1.4	-104
WJ-9926/4K	4 kHz	3:1	1.6	-103
WJ-9926/6K	6 kHz	3:1	2.0	-101
WJ-9926/8K	8 kHz	3:1	2.2	-100
WJ-9926/12K	12 kHz	3:1	2.9	-98
WJ-9926/16K	16 kHz	2:1	3.2	-97
WJ-9926/USB	2.85 kHz	1.8:1	0.7	-110
WJ-9926/LSB	2.85 kHz	1.8:1	0.7	-110
WJ-9926/SSB	2.85 kHz	1.8:1	0.7	-110

(uses offset L.O.)

SENSITIVITY

Over the frequency range of 0.2 to 30 MHz, the RF input levels and IF Bandwidths specified above will:

1. Produce a minimum AM (SN)/N ratio of 10 dB at the audio for 50% AM modulation at a 400% Hz rate, (kHz and wider IF Bandwidths).
2. Produce a minimum CW (SN)/N ratio of 16 dB at the audio output.
3. Produce a minimum FM (SN)/N ratio of 17 dB at the audio output (10 kHz and wider IF Bandwidth).
4. Produce a minimum USB/LSB (SN)/N ratio of 10 dB at the audio output (SSB Filters only).

Over the frequency range of 5 kHz to 200 kHz, the following applies:

CW Sensitivity (1 kHz
IF Bandwidth)

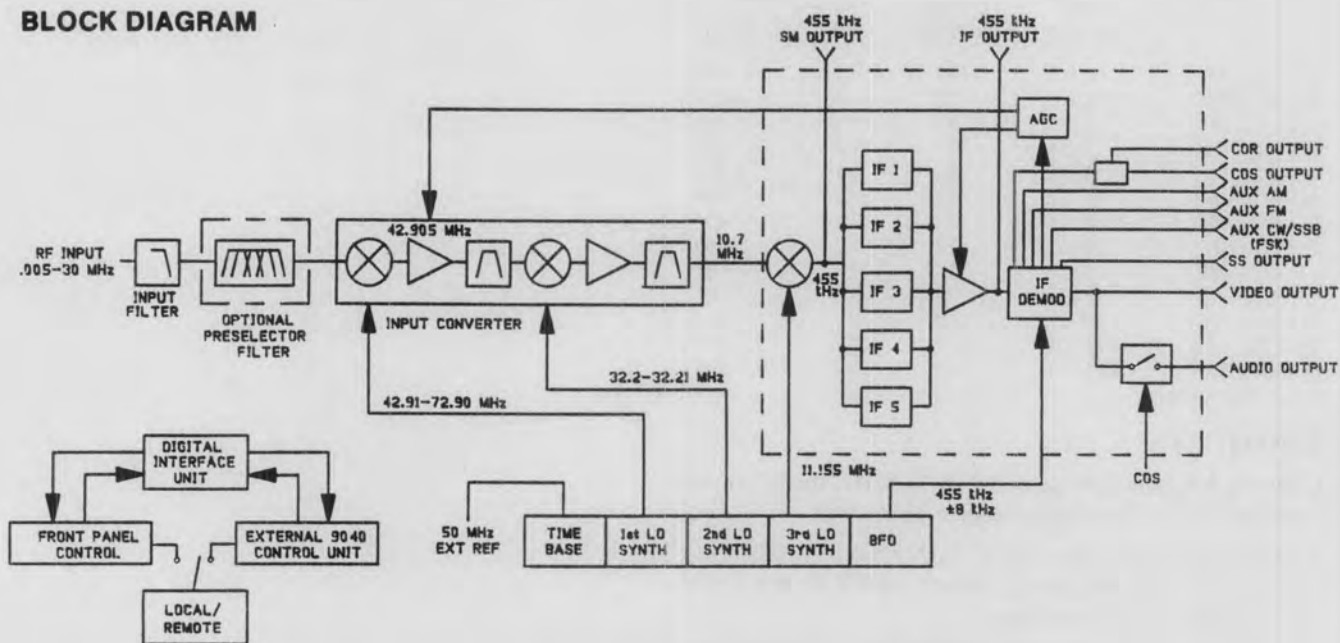
200 kHz - 30 MHz	A 0.8 microvolt signal will produce at least a 16 dB (S+N)/N ratio at the audio output.
50 kHz - 200 kHz	A 1.8 microvolt signal will produce at least a 16 dB (S+N)/N ratio at the audio output.
15 kHz - 50 kHz	A 7.1 microvolt signal will produce at least a 16 dB (S+N)/N ratio at the audio output.
5 kHz - 15 kHz	A 128 microvolt signal will produce at least a 16 dB (S+N)/N ratio at the audio output.

WJ-8626A-4
5KHz - 30 MHz
HF MASTER RECEIVER

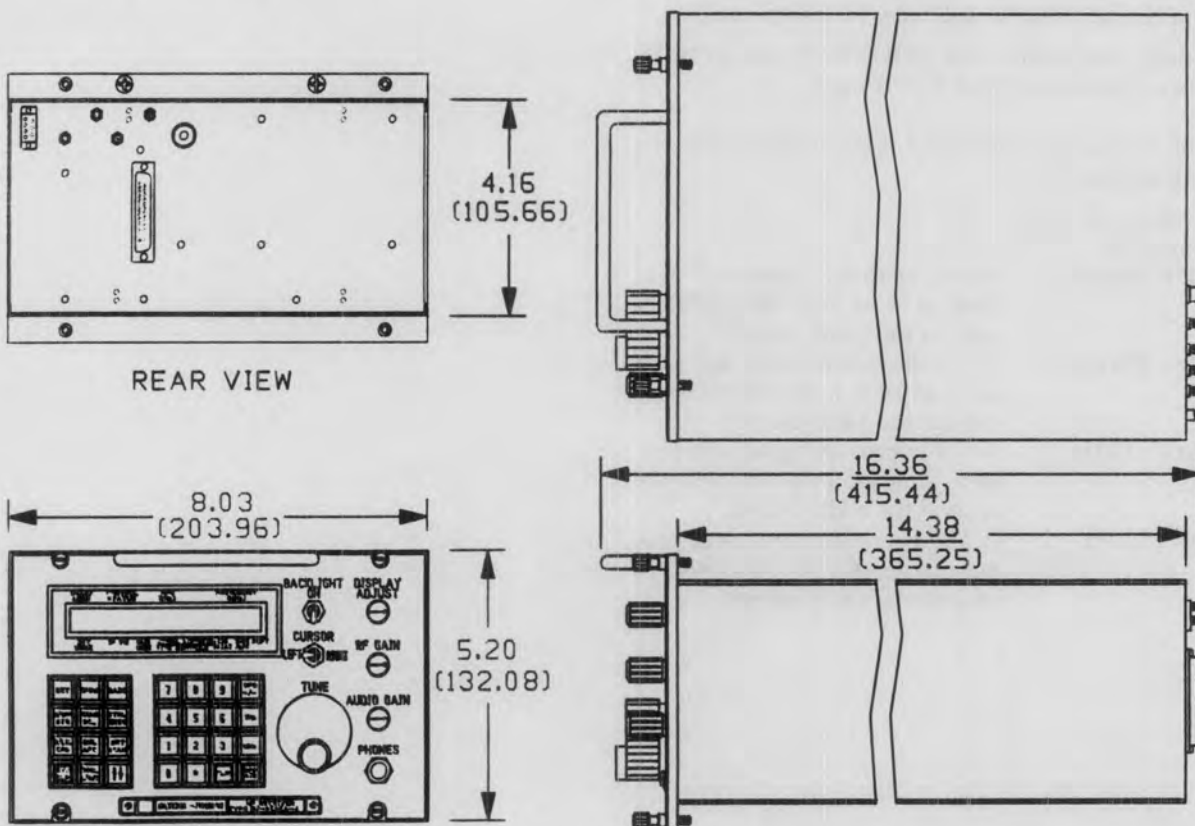
RECEIVERS

Rev. A, 9/84

BLOCK DIAGRAM



OUTLINE DRAWING



XX INCHES
 (XXX) MM

WJ-8626A-4
5KHz - 30 MHz
HF MASTER RECEIVER

RECEIVERS

Rev. A, 9/84

IEEE-488/RS-232 COMMANDS

COMMAND	DESCRIPTION	COMMAND	DESCRIPTION
AFC	Turns on AFC	*F1 n,f	Asks for start frequency of sector
AFC/	Turns off AFC	\$F2 n,f	Sets stop frequency of sector
AGC?	Asks for AFC state	\$F2 n?	Asks for stop frequency of sector
AGC	Turns on AGC	FM	Selects FM detection mode
AGC/	Turns off AGC	FRQ f	Sets tuned frequency
AGC?	Asks for AGC state	FRQ?	Asks for tuned frequency
AM	Selects AM detection mode	INL n,m-p	Includes channels for channel scan
BFO (+/-)f	Sets BFO frequency	LCK n,m-p	Locks channels out of channel scan
BFO?	Asks for BFO frequency	LSB	Selects LSB detection mode
BW n	Sets receiver bandwidth	MAN n	Stops specified a scan
BW?	Asks for bandwidth #	RMT	Sets receiver into remote mode
BWC?	Asks for bandwidth in kHz	RMT?	Asks for remote/local mode
CLR	Resets receiver	RCL n	Recalls a memory channel
COS n	Sets COS threshold level	RFG n	Sets RF gain level
COS?	Asks for COS threshold level	RFG?	Asks for RF gain level
CST?	Asks for COS state	SCN	Starts channel scan
CW	Selects CW detection mode	SLOT n	Addresses a specified slot
DET?	Asks for detection mode	SS?	Asks for signal strength
DWL n,m	Sets sector & channel dwell time	STO n	Allocates a memory channel
DWL?	Asks for dwell times	*STP n	Starts a sector scan
EXAM n	Asks for slot status	USB	Selects USB detection mode
*F1 n,f	Sets start frequency of sector		

*Optional Commands

COMMAND/CONTROL SERIAL BIT STREAM

BYTE	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
0				Change Complete Status Command				
1		10 Hz BFO			BFO sign			unassigned
2		1 kHz BFO			100 Hz BRO			
3		100 Hz Frequency			10 Hz Frequency			
4		10 kHz Frequency			1kHz Frequency			
5		1 MHz Frequency			100 kHz Frequency			
6		unassigned			10 MHz Frequency			
7	AGC select				COS Threshold Level			
8	AGC select				Manual Gain Control Level			
9		IF BW select		unassigned			Detection mode	

Effective Bit Rate = 17.1 Kbit/sec. For detailed data transfer timing, please refer to the IOM108 I/O Module Data Sheet.

25 PIN EQUIPMENT FRAME CONNECTOR

1.	Addressed Enable B IN	15.	Report Data Out
2.	Strobe In	16.	Logic Ground
3.	Clock In	18.	Power Ground
5.	Power Ground 1	19.	-18.3 VDC
6.	29 VDC	20.	8.2 VDC
7.	18.3 VDC	21.	Signal Ground
9.	Addressed Enable A in	22.	Signal Strength
12.	AFC Tuning Out	23.	Read Request
13.	COS Status Out	24.	Squelched Audio
14.	Command/Control Data In	25.	Not Assigned

WJ-8627-X
20 MHz - 440 MHz
VHF/UHF RECEIVERS

WJ-9040

RECEIVERS

Rev. A, 6/84



Weight - 12 lbs (5.4 kg)
 Power - 14 watts

MODULE SIZE:

Quarter-Rack

AVAILABLE OPTIONS:

Dual Bandwidth IF
 Wideband (200 kHz - 2 MHz) IF

MODULE I/Os:

- (A1J1) RF Input
 - (A1J2) SM Output
 - (A2J1) Selected Video Output
 - (A2J2) IF Output
 - (A3J2) 50 MHz Reference Input
 - (A3J3) Auxiliary I/O (9 Pin SRE Female Connector)
- Pin Assignments:
- A - Ground
 - B - FM Audio Output
 - C - AM Audio Output
 - D - Signal Strength Output (Analog 0 to +10V)
 - E - Carrier Operated Relay Control (open collector, 30 mA sink to ground for switching +24 V maximum external voltage)
 - F - Carrier Operated Squelch
- (A3J1) WJ-9040 System Connector (25 Pin, Type "D")
 (see page four for pinouts)

SMA Female Connector

FEATURES

- Four receivers covering 20-440 MHz frequency range
- Low power consumption
- One-quarter rack, modularized construction
- Low phase noise, high speed synthesizers
- 100 Hz tuning resolution
- Remotely controllable
- Tunable preselection
- Wide dynamic range
- 10 kHz - 2 MHz Field Changeable Bandwidths

DESCRIPTION

The WJ-8627 Series of VHF/UHF Handoff Receivers function as intercept, Handoff, and monitor receivers in the WJ-9040 System. Frequency coverage from 20 to 440 MHz is accomplished in four bands: 20 to 100 MHz, 100 to 180 MHz, 180 to 300 MHz and 220 and 440 MHz, all in 100 Hz steps. To achieve the wide dynamic range of the receiver, the front end low noise amplifier stage is preceded by a voltage tuned preselector with a nominal bandwidth equal to or less than 10% of tuned frequency. This preselector is continuously tunable, insures high image and IF rejection, minimal local oscillator radiation, and improved intermodulation and spurious response in dense signal environments. All tuning is performed via frequency synthesized local oscillators exhibiting very low phase noise (-95 dBc/ Hz at 10 kHz offset) and resulting in an ultimate receiver signal-to-noise ratio of 45 dB.

Detection modes for this series of receivers are AM and FM through a single IF Bandwidth filter (Dual IF Bandwidth Module optional). This filter's bandwidth is optional, easily changed by the user, and is selected from the WJ-9927-XX Series of IF Filter sets, varying in bandwidth from 10 to 200 kHz (200 kHz - 2 MHz optional). Tuning, detection mode selection, gain control, audio output, signal strength, AFC, and COR functions are operating parameters remotely accessed through a serial data stream provided by the Equipment Frame IOM108, I/O Module.

Reliability and ease of maintenance are inherent to the construction of the receivers. These quarter-rack VHF Receivers feature a hinged chassis design resulting in easy access and superior EMI/RFI isolation and shielding between receiver functions.

CAPABILITIES AND APPLICATIONS

The WJ-8627-X Series of VHF/UHF Receivers may be used as either scanning, remotely controllable units or as handoff or monitor receivers in larger systems.

The receivers operate in conjunction with the IOM-108 I/O Module which stores up to 99 channels or 16 sectors

REQUIRED ADDITIONAL EQUIPMENT:

- EFR100 Series Equipment Frame
- EPS100 Series Power Supply
- FRM/SRM1XX Series Site or Frequency Reference Module
- IOM108 I/O Module

COMPATIBLE ACCESSORY EQUIPMENT:

- DIO232, DIO488 Interface
- SSU1XX Series Signal Switching Units
- SMU120 Signal Monitor Unit
- SPN108 Speaker Panel
- DDF108 Direction Finding Unit
- WJ-8628-4 VHF/UHF Scanning Receiver
- WJ-8626-4 HF Receiver and Controller

WJ-8627-X
20 MHz - 440 MHz
VHF/UHF RECEIVERS

RECEIVERS

Rev. A, 6/84

per equipment frame and will perform either channel or F1-F2 scans. Threshold and dwell are adjustable for each channel or sector. Since these receivers occupy only one quarter of a standard 19 inch frame, up to four identical receivers may be installed in a frame and the probability of intercept in the scan mode will increase dramatically. This is useful when only a certain portion of the VHF/UHF band is of interest.

The receivers may also be used in a handoff mode in conjunction with 20-500 MHz fast scanning head end receivers such as the WJ-8628-X. When used this way, numerous frequencies may be monitored with a system requiring minimum rack space, power and cost.

The receivers may also be controlled by the WJ-8626A-4 HF Receiver and Controller thus allowing HF/VHF/UHF coverage in a single equipment frame.

SPECIFICATIONS

	<u>WJ-8627-2</u>	<u>WJ-8627-4</u>
Frequency Range	20 to 100 MHz	100 to 180 MHz
Image Rejection	80 dB min.	70 dB min.
IF Rejection	80 dB min.	80 dB min.
Noise Figure	10 dB max.	9 dB max.
	<u>WJ-8627-5</u>	<u>WJ-8627-6</u>
Frequency Range	180 to 300 MHz	220 to 440 MHz
Image Rejection	80 dB min.	80 dB min.
IF Rejection	70 dB min.	70 dB min.
Noise Figure	10 dB max.	10 dB max.
Detection Modes	FM, AM	
Tuning Resolution	100 Hz	
Synthesizer Tuning Speed	25 msec	
Phase Noise	-95 dBc/Hz maximum at 10 kHz offset frequency	
Input Impedance	50Ω, unbalanced	
Input VSWR	2.5:1 maximum	
Internal Spurious	-110 dBm	
Third Order Input Intercept Point	0 dBm, minimum	
Preselection	Tunable, nominal BW = 10% Ft	
LO Radiation	-95 dBm maximum	
SM Output	21.4 MHz with 4 MHz nominal BW	
IF Bandwidth	One (1), standard selection from 10, 20, 25, 30, 40, 50, 75, 100 or 200 kHz (200 kHz - 2 MHz optional)	
IF Output	20 mV nominal into 50Ω at AGC threshold, IF BW limited	
AM Stability with AGC	Video Output changes 6 dB maximum from AGC threshold to a level 100 dB above (or maximum input of 0 dBm)	
Manual Gain Control	100 dB	
Video Output	0.35 Volts RMS minimum into 75Ω under sensitivity conditions	
Video Response	200 Hz to 1/2 IF Bandwidth (AM) 0 Hz to 1/2 IF Bandwidth (FM)	

Squelch/COR	Adjustable threshold from noise level to 80 dB above noise. COR holds a nominal 4 seconds after carrier disappears
Signal Strength Output	Shaped DC AM detector output, 0 to +10 V
Digital Control	56 bit serial word (WJ-9040 System compatible)
Operating Temperature	0°C to 50°C
Power Consumption	14 W
Weight	12 lbs (5.4 kg)
Size	5.2 in (132 mm) high, 4.0 in (102 mm) wide, and 14.38 in (365 mm) deep

IF BANDWIDTH OPTIONS AND SENSITIVITY

	<u>3 DB IF Bandwidth (kHz)</u>	<u>(-2,-5,-6) RF Level (dBm)</u>	<u>(-4) RF Input Level (dBm)</u>
WJ-9927-10K	10	-105	-106
WJ-9927-20K	20	-102	-103
WJ-9927-25K	25	-101	-102
WJ-9927-30K	30	-100	-101
WJ-9927-40K	40	-99	-100
WJ-9927-50K	50	-98	-99
WJ-9927-75K	75	-96	-97
WJ-9927-100K	100	-95	-96
WJ-9927-200K	200	-92	-93
WJ-9927-250K	250	-91	-92
WJ-9927-300K	300	-90	-91
WJ-9927-400K	400	-89	-90
WJ-9927-500K	500	-88	-89
WJ-9927-600K	600	-87	-88
WJ-9927-800K	800	-86	-87
WJ-9927-1.0M	1000	-85	-86
WJ-9927-1.2M	1200	-84	-85
WJ-9927-1.5M	1500	-83	-84
WJ-9927-2.0M	2000	-82	-83

AM - Input signal AM modulated 50% by a 1 kHz tone, will produce a minimum video output (S+N)/N ratio of 10 dB.

FM - Input signal modulated at 1 kHz rate with a peak deviation equal to 30% of selected IF BW, will produce a minimum video output (S+N)/N ratio of 17 dB. (NOTE: A 400 Hz rate is required for 10 kHz and 20 kHz IF Bandwidth).

NOTE

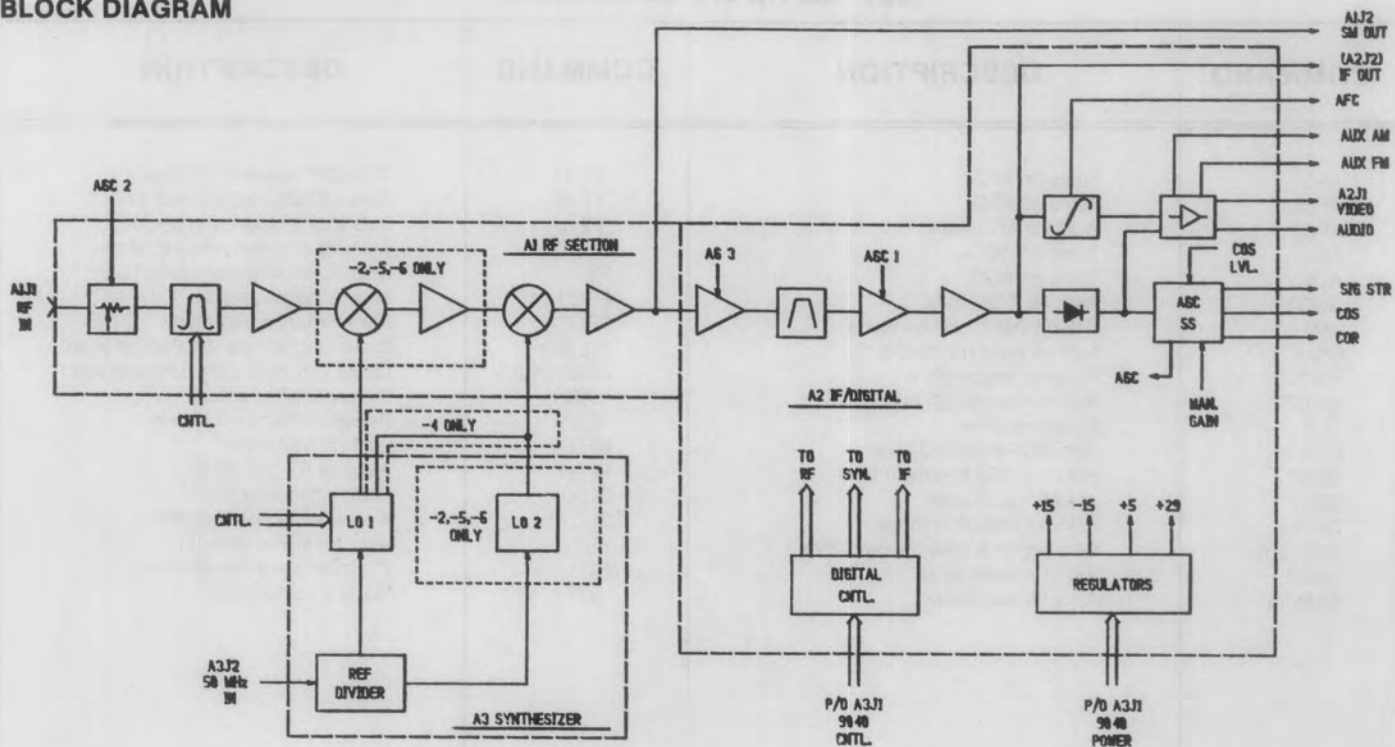
WJ-9927-10K through WJ-9927-200K IF Bandwidths are used in WJ-8627-X Receivers equipped with standard IF Section. WJ-9927-250K through WJ-9927-2M IF Bandwidths are used in WJ-8627-XI Receivers equipped with wideband IF Section.

WJ-8627-X
20 MHz - 440 MHz
VHF/UHF RECEIVERS

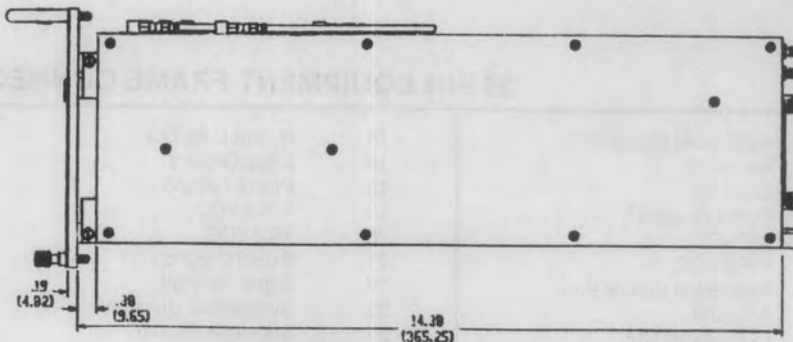
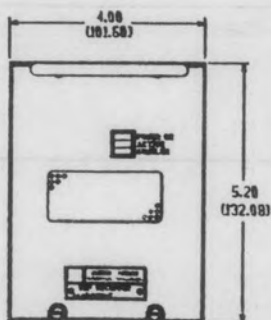
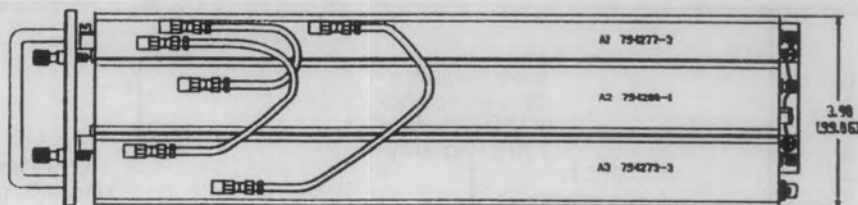
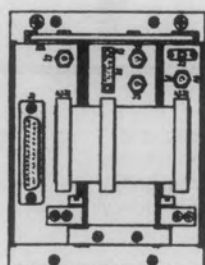
RECEIVERS

Rev. A, 9/84

BLOCK DIAGRAM



OUTLINE DRAWING



XX INCHES
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IEEE-488/RS-232 COMMANDS

COMMAND	DESCRIPTION	COMMAND	DESCRIPTION
AFC	Turns on AFC	*F1 n,f	Sets start frequency of sector
AFC/	Turns off AFC	*F1 n?	Asks for start frequency of sector
AFC?	Asks for AFC state	*F2 n,f	Sets stop frequency of sector
AGC	Turns on AGC	*F2 n?	Asks for stop frequency of sector
AGC/	Turns off AGC	FM	Selects FM detection modeTL
AGC?	Asks for AGC state	FRQ f	Sets tuned frequency
AM	Selects AM detection mode	FRQ?	Asks for tuned frequency
BW n	Sets receiver bandwidth	INL n,m-p	Includes channels for channel scan
BW?	Asks for bandwidth #	LCK n,m-p	Locks channels out of channel scan
BWC?	Asks for bandwidth in kHz	MAN n	Stops specified a scan
CLR	Resets receiver	RCL n	Recalls a memory channel
COS n	Sets COS threshold level	RFG n	Sets RF gain level
COS?	Asks for COS threshold level	RFG?	Asks for RF gain level
CST?	Asks for COS state	SCN	Starts channel scan
DET?	Asks for detection mode	SLOT n	Addresses a specified slot
DWL n,m	Sets sector & channel dwell time	SS?	Asks for signal strength
DWL?	Asks for dwell times	STO n	Allocates a memory channel
EXAM n	Asks for slot status	*STP n	Starts a sector scan

*Optional Commands

COMMAND/CONTROL SERIAL BIT STREAM (Pin 14)

BYTE	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
0		1 kHz Frequency				100 Hz Frequency		
1		100 kHz Frequency				10 kHz Frequency		
2		10 MHz Frequency				1 MHz Frequency		
3		1 GHz Frequency				100 MHz Frequency		
4		AFC				COS Threshold Level		
5		AGC mode sel				Manual Gain Control Level		
6		IF BW select			unassigned		Detection mode	

Effective Bit Rate = 17.1 Kbit/sec. For detailed data transfer timing, please refer to the IOM 108 I/O Module Data Sheet.

25 PIN EQUIPMENT FRAME CONNECTOR

1.	Addressed Enable B In	15.	Report Data Out
2.	Strobe In	16.	Logic Ground
3.	Clock In	18.	Power Ground 2
5.	Power Ground 1	19.	-18.3 VDC
6.	+29 VDC	20.	+8.2 VDC
7.	+18.3 VDC	21.	Signal Ground
9.	Addressed Enable A In	22.	Signal Strength
12.	AFC Out	23.	Synthesizer Unlocked
13.	COS Status Out	24.	Squelched Audio
14.	Command/Control Data In	25.	Not Assigned

**EFR100
EQUIPMENT FRAME**

WJ-9040

COMMON EQUIPMENT

Rev. A, 9/84



Weight - 14 lbs (6.4 kg)
Power - 0 watts

FRAME SIZE:

Standard 19 inch Rack Mountable
Frame, 5.25 inches high by 20 inches deep

AVAILABLE OPTIONS:

Slides for Rack Mounting

FRAME I/Os:

- A1 (J1-J8) WJ-9040 System Module Connector - 25 Pin, Type D, Female
- A1 J9 EFR100 Series Power Supply Connector - 15 Pin, Type D, Male
- A1 J10 IOM108/ZIU108 Control Module Connector - 37 Pin, Type D, Female
- A1 J11 Accessory Module Connector - 25 Pin, Type D, Female

REQUIRED ADDITIONAL EQUIPMENT:

EPS100 Series Power Supply

COMPATIBLE ACCESSORY EQUIPMENT:

- IOM108 I/O and Control Module
- ZIU108 Zone Interface Unit
- FRM105 Frequency Reference Module
- SRM105 Site Lockable Reference Module
- MVU104 VHF/UHF Multicoupler
- Any combination of WJ-9040 eighth, quarter or half rack modular components

DESCRIPTION

The WJ-9040 EFR100 Equipment Frame is the basic building block of the WJ-9040 System. The frame and its associated power, control and accessory modules ensure a system which accepts components that are compatible in size, power and control.

The frame consists of an enclosure in which system modules are mounted, and a backplane which provides the modules with power and control signals. At the rear of the frame are mounting spaces and connectors for a

FEATURES

- Lightweight
- 20" Maximum Depth
- Flexible pc board eliminates all discrete wiring
- Modules are easily installed or removed
- Accepts any combination of eighth, quarter or half rack WJ-9040 System Modules

Power Supply (EPS100 Series), I/O Control Module (IOM/ZIU108) and Auxiliary Module (FRM150, SRM105, MVU104, etc.). All modules can be easily installed, changed or removed as required. In addition, all wiring within the frame is accomplished by the use of a flexible printed circuit board.

The EFR100 Equipment Frame is capable of accepting up to eight eighth-rack, four quarter-rack, two half-rack or any combination of the above modules. The frame is equipped with mounting holes for slides or brackets, thus allowing for easy rack mounting. Handles are supplied at the front of the frame to improve transportability.

CAPABILITIES AND APPLICATIONS

The WJ-9040 EFR100 Equipment Frame forms the base of any WJ-9040 system. Eighth, quarter and half-rack system modules slide into the front of the frame and receive their power and control signals from it. Module outputs such as audio, signal strength and COS are routed within the frame to the IOM108 I/O Module. In addition, a 1 inch high "window" is provided across the rear of the frame to provide direct access to module I/O's such as RF input or IF output, thus eliminating the need for extra connectors and cabling within the frame. The frame also allows routing of signals from module to module via DIP switch settings. This is useful when two modules function together and require a direct connection such as an AGC line between a tuner and IF module.

Common module size, power, and control coupled with unique module identifier codes allow for the addition, removal or change of any module in any position within the frame. Plug in mounting of the power supply and I/O module yields low MTTR while the use of the auxiliary position yields high system flexibility. For larger system applications, the IOM108 I/O Module can be replaced with a ZIU108 Zone Interface Module. This unit allows for control of the frame in which it is mounted in addition to seven other frames. All frame and power supply cooling is via connection thus eliminating the need for fans or blowers.

**EFR100
EQUIPMENT FRAME**

COMMON EQUIPMENT

Rev. A, 9/84

SPECIFICATIONS

Front Mounting Positions	Up to eight eighth, four quarter, two half or any combination of WJ-9040 Modules.
Mounting Method (Front)	Slide-in and secure with thumb screws.
Rear Mounting Positions	Power supply, I/O module, auxiliary slot.
Mounting Method (Rear)	Drop-in and secure with conventional screws.
Frame Wiring Method	11 Type "D" connectors connected by flexible pc board and enclosed in aluminum shell.
Frame/Power Supply Cooling	Convection.
Slide/Bracket Mounting Capability	Panel "Ears" or Jonathon 110 QD-20-2 Slides. (Optional)
Frame Size (including connectors)	19 inches (483 mm) Wide 5.25 inches (133 mm) High 20 inches (508 mm) Deep
Frame Weight (excluding front and rear modules)	Approx. 14 lbs. (6.4 kg)
Power Consumption	0 Watts

IEEE-488/RS-232 COMMANDS

COMMAND	DESCRIPTION	COMMAND	DESCRIPTION
	See individual Module Data Sheets		

COMMAND/CONTROL SERIAL BIT STREAM

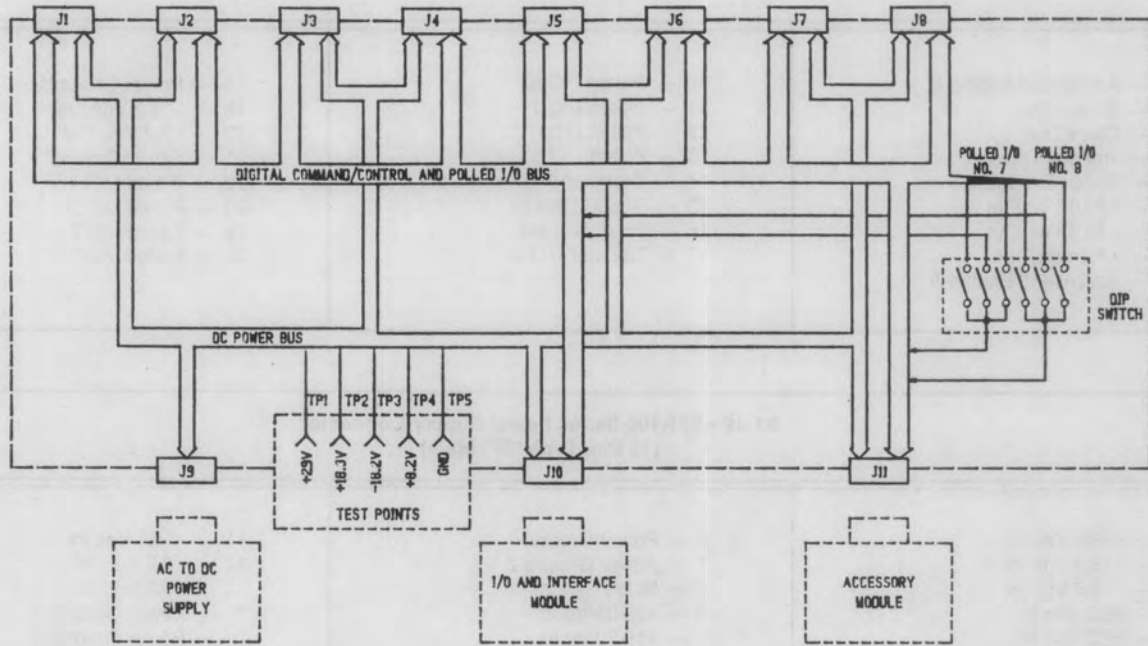
BYTE	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
	See individual Module Data Sheets							

**EFR100
EQUIPMENT FRAME**

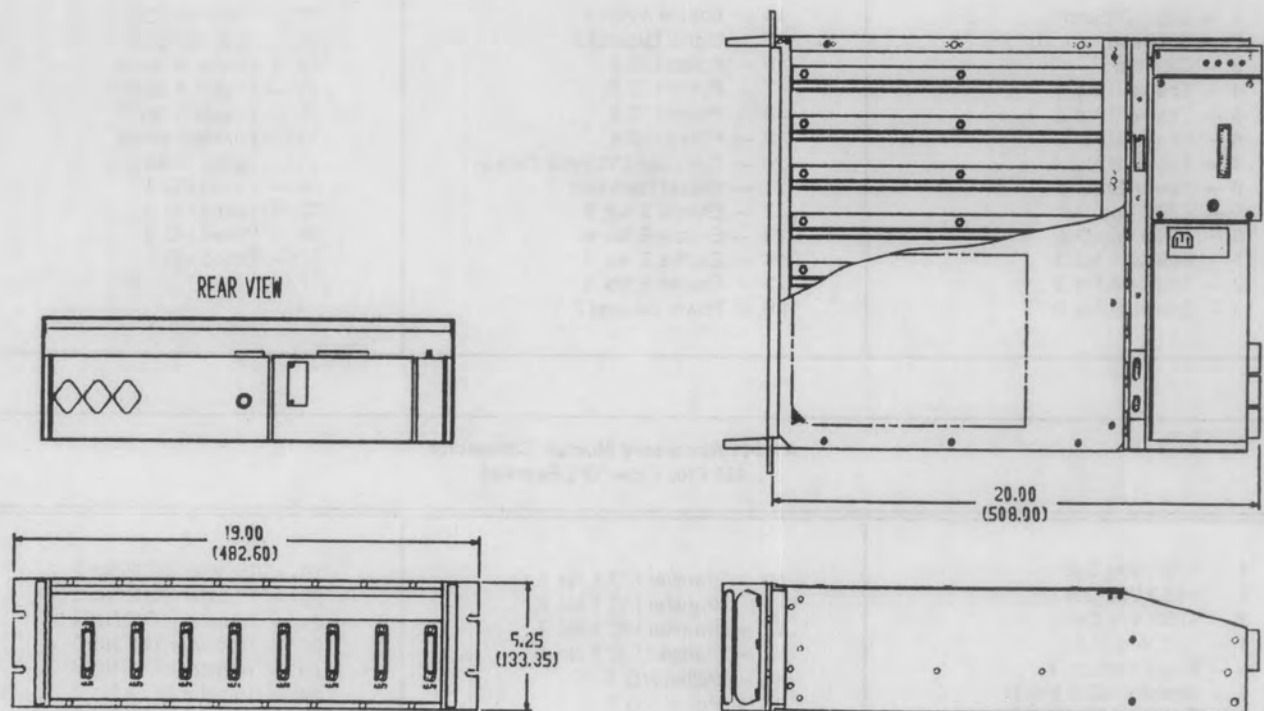
COMMON EQUIPMENT

Rev. A, 9/84

BLOCK DIAGRAM



OUTLINE DRAWING



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(SHOWN WITH ESP100 POWER SUPPLY, 10M108 CONTROL MODULE,
FRM150 FREQUENCY REFERENCE MODULE)

**EFR100
EQUIPMENT FRAME**

COMMON EQUIPMENT

Rev. A, 9/84

EQUIPMENT FRAME CONNECTOR PINOUTS

**A1 (J1-J8) WJ-9040 System Module Connector
(25 Pin, Type "D", Female)**

<ul style="list-style-type: none"> 1 — Addressed Enable B 2 — Strobe Out 3 — Clock Out 4 — Transfer I/O 1 5 — Power Ground 1 6 — +29.0 Vdc Out 7 — +18.3 Vdc Out 8 — +8.2 Vdc Out 9 — Addressed Enable A 	<ul style="list-style-type: none"> 10 — Polled I/O 8 11 — Polled I/O 7 12 — Polled I/O 6 13 — Polled I/O 5 14 — Command/Control Data Out 15 — Report Data In 16 — Logic Ground 17 — Transfer I/O 2 	<ul style="list-style-type: none"> 18 — Power Ground 2 19 — -18.3 Vdc Out 20 — +8.2 Vdc Out 21 — Signal Ground 22 — Polled I/O 4 23 — Polled I/O 3 24 — Polled I/O 2 25 — Polled I/O 1
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**A1 J9 - EFR100 Series Power Supply Connector
(15 Pin, Type "D", Male)**

<ul style="list-style-type: none"> 1 — +29.0 Vdc In 2 — +18.3 Vdc In 3 — -18.3 Vdc In 4 — +8.2 Vdc In 5 — +8.2 Vdc In 	<ul style="list-style-type: none"> 6 — Power Ground 1 7 — Power Ground 2 8 — Spare 9 — +29.0 Vdc In 10 — +18.3 Vdc In 	<ul style="list-style-type: none"> 11 — -18.3 Vdc In 12 — +8.2 Vdc In 13 — +8.2 Vdc In 14 — Power Ground 1 15 — Power Ground 2
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**A1 J10 - 10M108/ZIU108 Control Module Connector
(37 Pin, Type "D", Female)**

<ul style="list-style-type: none"> 1 — Logic Ground 2 — Strobe In 3 — Clock In 4 — Enable B No. 1 5 — Enable B No. 2 6 — Enable B No. 3 7 — Enable B No. 4 8 — Power Ground 1 9 — +29.0 Vdc Out 10 — +18.3 Vdc Out 11 — Enable A No. 1 12 — Enable A No. 2 13 — Enable A No. 3 	<ul style="list-style-type: none"> 14 — Enable A No. 4 15 — Signal Ground 2 16 — Polled I/O 8 17 — Polled I/O 7 18 — Polled I/O 6 19 — Polled I/O 5 20 — Command/Control Data In 21 — Report Data Out 22 — Enable B No. 5 23 — Enable B No. 6 24 — Enable B No. 7 25 — Enable B No. 8 26 — Power Ground 2 	<ul style="list-style-type: none"> 27 — -18.3 Vdc Out 28 — +8.2 Vdc Out 29 — Enable A No. 5 30 — Enable A No. 6 31 — Enable A No. 7 32 — Enable A No. 8 33 — Signal Ground 1 34 — Polled I/O 4 35 — Polled I/O 3 36 — Polled I/O 2 37 — Polled I/O 1
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**A1 J11 Accessory Module Connector
(25 Pin, Type "D", Female)**

<ul style="list-style-type: none"> 1 — +29.0 Vdc Out 2 — +18.3 Vdc Out 3 — -18.3 Vdc Out 4 — +8.2 Vdc Out 5 — Power Ground 1 6 — Transfer I/O 1 No. 1 7 — Transfer I/O 1 No. 2 8 — Transfer I/O 1 No. 3 9 — Transfer I/O 1 No. 4 	<ul style="list-style-type: none"> 10 — Transfer I/O 1 No. 5 11 — Transfer I/O 1 No. 6 12 — Transfer I/O 1 No. 7 13 — Transfer I/O 1 No. 8 14 — Polled I/O 7 15 — Polled I/O 8 16 — Spare 17 — Logic Ground 18 — Transfer I/O 2 No. 1 	<ul style="list-style-type: none"> 19 — Transfer I/O 2 No. 2 20 — Transfer I/O 2 No. 3 21 — Transfer I/O 2 No. 4 22 — Transfer I/O 2 No. 5 23 — Transfer I/O 2 No. 6 24 — Transfer I/O 2 No. 7 25 — Transfer I/O 2 No. 8
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**WJ-9040 EPS100
AC POWER SUPPLY**

WJ-9040

COMMON EQUIPMENT

Rev. A, 9/84



Weight - 5 lbs. (2.25 kg)
Power - 70% efficient

MODULE SIZE:

9.0 inches wide by 4.7 inches deep by 3.5 inches high
(fits in rear of EFR100 frame)

AVAILABLE OPTIONS:

None at this time

MODULE I/Os:

(J1) AC Input - Universal 3-Prong Male Connector
(P1) DC Power Output - 15 Pin, Type D, Female

REQUIRED ADDITIONAL EQUIPMENT:

EFR100 Series Equipment Frame

COMPATIBLE ACCESSORY EQUIPMENT:

Any WJ-9040 System Module

FEATURES

- Supplies required voltages to all WJ-9040 modules
- High efficiency switching type design
- 115/230 Vac, 47 to 450 Hz operation
- Convection cooling eliminates the use of fans or blowers
- Modular, easily replaceable unit

DESCRIPTION

The WJ-9040 EPS100 AC Power Supply supplies +8.2 Vdc, ± 18.3 Vdc and +29 Vdc to all WJ-9040 System Modules through the EFR100 Equipment Frame. The unit utilizes switching supply technology is 70% efficient and is convection cooled. Single phase supply voltages from 90 to 130 Vac and 180 to 260 Vac at 47 to 450 Hz may be used to operate the unit. Input voltage selection is achieved by use of a reversible PC card mounted in the units ac input receptacle.

The EPS100 mounts in the rear of a WJ-9040 EFR100 Equipment Frame and employs a power line filter and short circuit protection. A pushbutton power switch/indicator is located at the rear of the unit and a replaceable fuse is located in the units ac input receptacle.

CAPABILITIES AND APPLICATIONS

The WJ-9040 EPS100 AC Power Supply provides ± 18.3 Vdc, +8.2 Vdc and +29.0 Vdc to all WJ-9040 Modules. These modules then re-regulate the voltages thus providing isolation and extremely low supply ripple.

The WJ-9040 System definition includes constraints on total module power and total current drawn from each voltage output. For example, a quarter-rack unit's maximum allowable power consumption is 17 watts. These constraints, and a power supply mounting location which allows for convection cooling, eliminate the need for fans and blowers.

**WJ-9040 EPS100
AC POWER SUPPLY****SPECIFICATIONS**

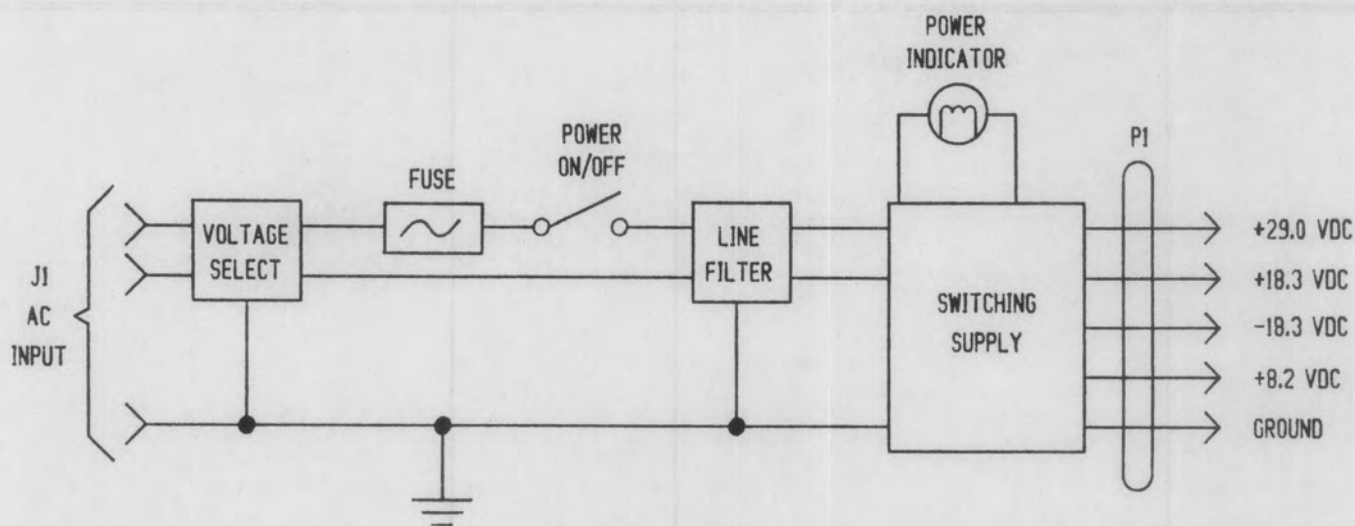
Switching Frequency	21 to 29 kHz
Efficiency	70%, minimum
AC Input Voltages	90 to 130 Vac or 180 to 260 Vac
AC Input Frequency	47 to 450 Hz
Output Voltages	+29.0, +8.2, \pm 18.3 Vdc
Output Ripple	100 mV peak-to-peak, maximum
Maximum +29.0 Vdc Output Current	0.7 A
Maximum +8.2 Vdc Output Current	6.5 A
Maximum +18.3 Vdc Output Current	1.9 A
Maximum -18.3 Vdc Output Current	1.3 A
+29.0 Vdc Output Voltage Tolerance	\pm 1.0 Vdc, maximum
+8.2 Vdc Output Voltage Tolerance	+0.9, -0.0 Vdc, maximum
+18.3 Vdc Output Voltage Tolerance	+1.65, -0.0 Vdc, maximum
-18.3 Vdc Output Voltage Tolerance	+1.65, -0.0 Vdc, maximum
Load Regulation	Output voltage will stay within specified tolerances for loads of 10% to 100%
Line Regulation	Output voltages will not change more than \pm 2% over specified ac input voltage range
Cooling	Convection
Operating Temperature Range	0°C to 50°C
Weight	5 lbs. (2.25 kg)
Size	9.0 inches (229 mm) wide by 4.7 inches (120 mm) deep by 3.5 inches (89 mm) high
Power Consumption (Dissipation Only)	Power dissipated is equal to sum of all module power multiplied by 0.43. (Module Power = 0.7 total power; Total Power = module power plus power dissipated)
Maximum Possible Total Power Consumption	105 watts (Assuming 70% efficiency and fully loaded, maximum power consuming frame)

**WJ-9040 EPS100
AC POWER SUPPLY**

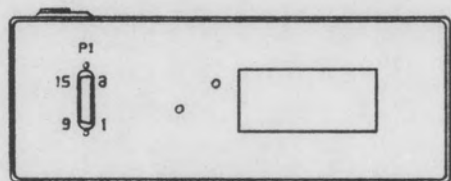
COMMON EQUIPMENT

Rev. A, 9/84

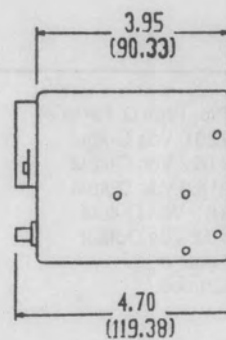
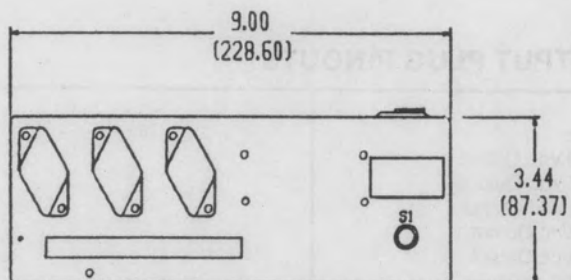
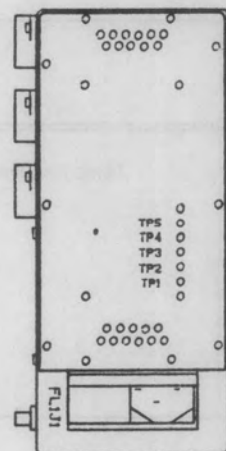
BLOCK DIAGRAM



OUTLINE DRAWING



REAR VIEW



IEEE-488/RS-232 COMMANDS

COMMAND	DESCRIPTION	COMMAND	DESCRIPTION
	None Required		

COMMAND/CONTROL SERIAL BIT STREAM

	None Required

P1 - DC POWER OUTPUT PLUG PINOUTS

(15 Pin, Type D, Female) 1. +29.0 Vdc Output 2. +18.3 Vdc Output 3. -18.3 Vdc Output 4. +8.2 Vdc Output 5. +8.2 Vdc Output 6. Ground 7. Ground	8. Spare 9. +29.0 Vdc Output 10. +18.3 Vdc Output 11. -18.3 Vdc Output 12. +8.2 Vdc Output 13. +8.2 Vdc Output 14. Ground 15. Ground
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**FRM150 [SRM105]
FREQUENCY [SITE
LOCKABLE]
REFERENCE MODULE**

WJ-9040 COMMON EQUIPMENT

Rev. A, 9/84



Weight - 1 lb. (0.45 kg)
Power - 1.5 watts [SRM105-2 watts]

MODULE SIZE:

3.5 inches high by 4.5 inches wide by 1 inch deep
(Fits in auxillary slot at rear of EFR100 frame)

AVAILABLE OPTIONS:

10 MHz input [SRM105 only]

MODULE I/Os:

(A1J1) WJ-9040 System Connector -25 pin, Type "D"
(see page four for pinouts)
(J1-J4) 50 MHz Reference Output - SMA Female
(J5) [SRM105 only] - Site Reference Input - SMA Female

REQUIRED ADDITIONAL EQUIPMENT:

EFR100 Series Equipment Frame
EPS100 Series Power Supply

COMPATIBLE ACCESSORY EQUIPMENT:

Any WJ-9040 Module requiring a frequency reference
Any 1 or 5 MHz site reference [SRM105 only]
WJ-9311 HF Multicouplers [SRM105 only]

DESCRIPTION

The WJ-9040 FRM150 Frequency Reference and SRM105 Site Lockable Reference Modules are designed to mount in the auxillary slot of the EFR100 Equipment Frame. The units provide four highly stable, 50 MHz signals to any WJ-9040 Module requiring a frequency reference for proper operation. In addition, the SRM105 is capable of locking to a 1 or 5 MHz (10 MHz optional) site reference such as a cesium beam, rubidium cell or quartz crystal frequency standard. The unit also operates in a "free run" mode during which its internal 50 MHz TCVCXO is not phase locked to an external signal (identical to FRM150). Dip switches are used to select 1 MHz input, 5 MHz input, or "free run".

FEATURES

- Provides up to four 50 MHz outputs to WJ-9040 modules
- Low power, compact unit
- Mountable in rear of WJ-9040 EFR100 Equipment Frame
- Employs a highly stable TCVCXO
- Lockable to a 1 or 5 MHz site reference [SRM105 only]

Both the SRM105 and FRM150 receive power from the EPS100 Power Supply, and utilize output splitter and buffer amplifier circuitry for high isolation. A highly stable, temperature compensated crystal oscillator is used to provide the four 50 MHz outputs. The units require no remote or local control and are switched on automatically when the EPS100 Power Supply is activated.

CAPABILITIES AND APPLICATIONS

Any WJ-9040 Module requiring a frequency reference will accept the "System standard" 50 MHz signal from the FRM150 or SRM105. Modules require a frequency reference when they employ phase locked loop circuitry such as that used in receiver synthesized local oscillators. Each of the two units supplies four outputs. Typically, this number is adequate for a standard configuration of modules mounted within one EFR100 Equipment Frame.

For systems requiring accuracy beyond that provided by the FRM150, or for systems requiring a common reference, the SRM105 Site Lockable Reference may be utilized. In larger systems, a WJ-9311 HF Multicoupler may be used to distribute 1 or 5 MHz to each of 12 SRM105 units thus allowing up to 12 equipment frames to be locked to a common site reference. Where a SRM105 is installed and a site reference is either not available or inoperable, the unit may be switched to its "free run" mode and will continue to provide a highly stable reference frequency to the system.

**FRM150 [SRM105]
FREQUENCY [SITE LOCKABLE]
REFERENCE MODULE**

COMMON EQUIPMENT

Rev. A, 9/84

SPECIFICATIONS

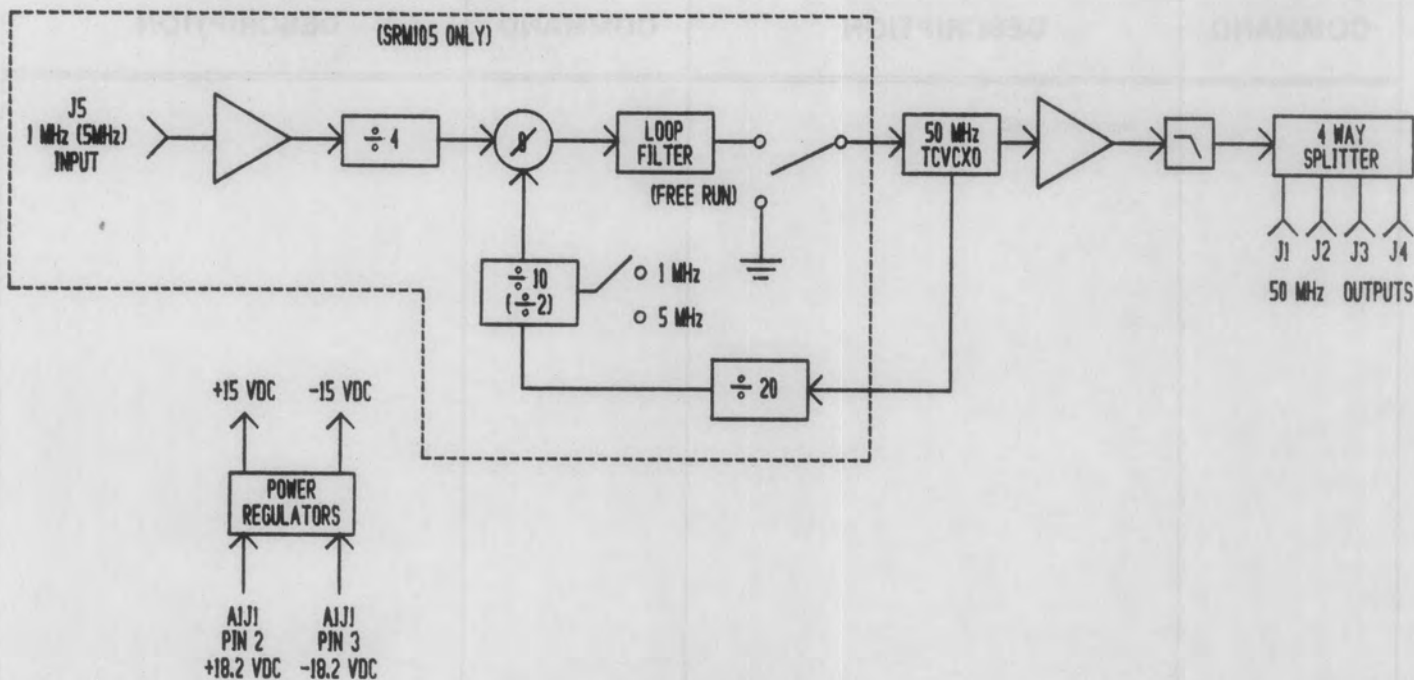
Number of Outputs	Four, SMA Female Connector
Output Frequency	50 MHz Sinewave
Output Level	0 dBm, min.; +5 dBm, max.
Output Impedance	50 ohms, nominal
Output VSWR	2.0:1, max.
Output Port-to-Port Isolation	25 dB, min.
Output Phase Noise	-140 dBc/Hz at 10 kHz carrier offset
Output Frequency Stability (FRM150 or SRM105 in "free run" Mode)	± 1 ppm from 0°C to 50°C ± 3 ppm per year
Output Second Harmonic Level	30 dB3 ppm perc, min.
Reference Input Frequency [SRM105 Only]	1 or 5 MHz through a single SMA Female connector
Input Impedance [SRM105 Only]	50 ohms, nominal
Reference Input Level [SRM105 Only]	TTL (0 to 5 Vdc) CMOS (0 to 5 Vdc) Sinewave (-10 dBm to +10 dBm)
Output Frequency Stability [SRM105 Only]	Dependent on site reference stability
External Site Reference Accuracy Required [SRM105 Only]	± 5 ppm
Operating Temperature Range	0°C to 50°C
Size	3.5 inches (89 mm) high by 4.5 inches (114 mm) wide by 1.0 inches (25 mm) deep
Power Consumption	1.5 watts [SRM105 - 2 watts]
Weight	1 lb. (0.45 kg)

**FRM150 [SRM105]
FREQUENCY [SITE LOCKABLE]
REFERENCE MODULE**

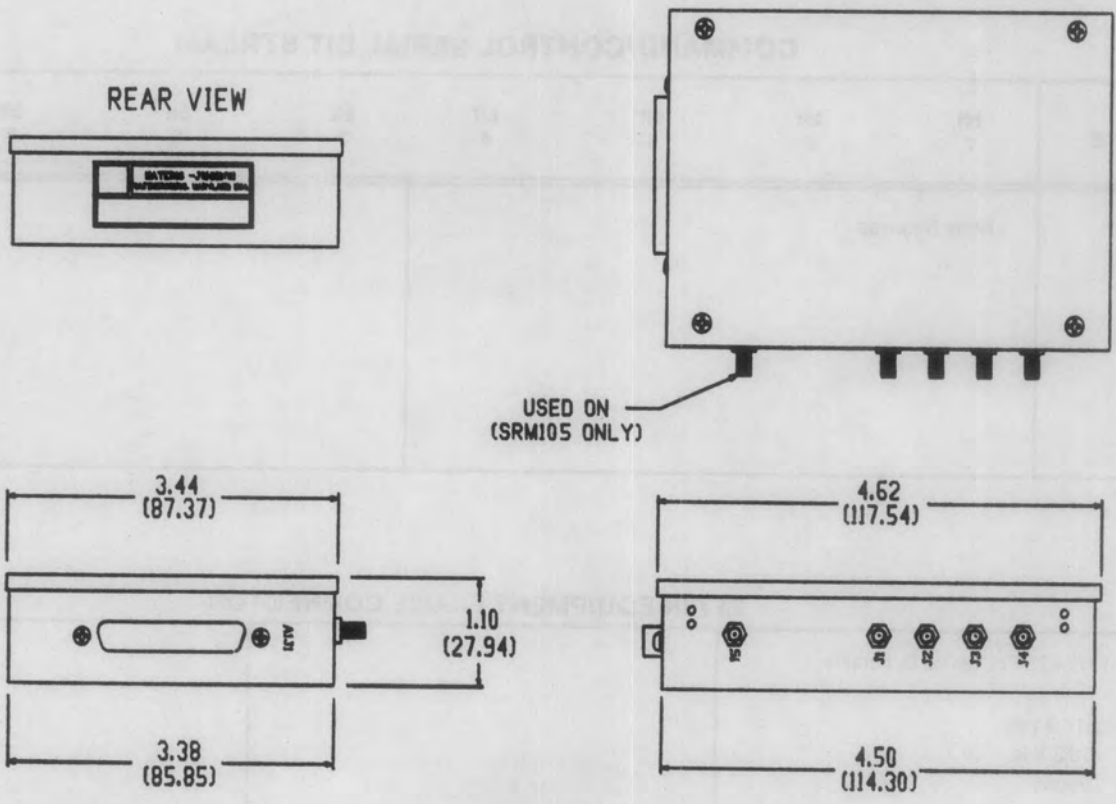
COMMON EQUIPMENT

Rev. A, 9/84

BLOCK DIAGRAM



OUTLINE DRAWING



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**FRM150 [SRM105]
FREQUENCY [SITE LOCKABLE]
REFERENCE MODULE**

COMMON EQUIPMENT

Rev. A, 9/84

IEEE-488/RS-232 COMMANDS

COMMAND	DESCRIPTION	COMMAND	DESCRIPTION
	None Required		

COMMAND/CONTROL SERIAL BIT STREAM

BYTE	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
	None Required							

25 PIN EQUIPMENT FRAME CONNECTOR

<p>(A1J1) - 25 Pin, Series D, Female</p> <p>2. ± 18.3 Vdc 3. -18.3 Vdc 5. Ground</p>		
--	--	--



Weight - 3 lbs (1.35 kg)
Power - 10 watts

MODULE SIZE:

5.75 inches wide, 3.38 inches high and 5.5 inches deep.
(Plugs into back of WJ-9040 EFR100 Equipment Frame)

AVAILABLE OPTIONS:

WJ-9040 DIO232 RS-232C Digital I/O PCB
WJ-9040 DIO488 IEEE-488 Digital I/O PCB

MODULE I/Os:

Standard Control Input/Output (A1A3J1) -
Bidirectional Serial Asynchronous at 156.3 kilobaud
using a Female BNC Connector.

Standard Polled Input/Output (A1A2J1) -
Polled outputs of modules using a 25 Pin, "D" Series,
Female Connector.

Equipment Frame Interface (A1J1) -
Data communication lines, power and polled inputs
from all eight slots of the WJ-9040 EFR100 Equip-
ment Frame using a 37 Pin, "D" Series, Male
Connector.

Optional Input/Output (A1A1J1) -
RS-232C or IEEE-488 using appropriate connectors.

REQUIRED ADDITIONAL EQUIPMENT:

EFR100 Series Equipment Frame
EPS100 Series Power Supply

COMPATIBLE ACCESSORY EQUIPMENT:

Any WJ-9040 Module requiring system or remote
control.
ZIU108 Zone Interface Module

DESCRIPTION

The WJ-9040 I/O Module (IOM) is used to interface WJ-9040 Series modules (i.e., receivers and tuners) to a control device. Standard WJ-9040 Controller I/O is bidirectional serial asynchronous at 156.3 kilobaud.

FEATURES

- Provides a standard WJ-9040 System Interface for total configuration flexibility
- Implements a 5 MHz, NSC800 CMOS microprocessor (Z80 software compatible)
- Contains 56 kbytes EPROM, 2 kbytes battery backed up RAM, 2 kbytes volatile RAM and 256 bytes non-volatile RAM (NOVRAM)
- Employs CMOS circuitry for low power consumption
- Provides communications link for external computers and terminals via the RS-232C or IEEE-488 Digital I/O Options

Remote control using IEEE-488 or RS-232C formats is accomplished with the WJ-9040 DIO232 or DIO488 plug-in printed circuit boards.

The IOM connects to the rear backplane of a WJ-9040 EFR100 Equipment Frame through a 37 pin D-type connector on the IOM motherboard. The motherboard also allows the IOM to accept the five plug-in printed circuit boards shown in the block diagram.

The CPU board contains a powerful NSC800 micro-processor which is programmed for the data handling and communications necessary for the modules residing in its frame. Controller I/O is interrupt driven for immediate processor attention. The CPU is complete with 8 kbytes EPROM, 2 kbytes RAM, and 256 bytes of non-volatile RAM (NOVRAM) for memory retention during an AC power-down situation.

The Extended Memory board currently provides the processor with an additional 48 kbytes of EPROM and 2 kbytes of battery backed-up RAM. An additional 8 kbytes of RAM may be substituted for 8 kbytes of EPROM via jumper wires. The RAM is partitioned to allow for simple downloading of data from controllers.

The Bidirectional Polled I/O board allows for selection of a module's polled outputs for monitoring and distribution externally to the equipment frame. The polled outputs are, in general, unique to each module and used by the IOM to provide optimal control.

The Equipment Frame I/O board is the interface between the IOM's processor and each module present in the equipment frame. Data transfer timing and protocol are described on the following page. This board also contains the serial interface for the WJ-9040 Controller I/O. A Universal Asynchronous Receiver/Transmitter is employed to receive commands and transmit responses through a 50 ohm coaxial cable.

The external I/O board is an option that provides either an IEEE-488 or RS-232C interface. This option allows for a user selectable controller for the modules residing in the equipment frame.

**IOM108
I/O CONTROL MODULE****CAPABILITIES AND APPLICATIONS**

The WJ-9040 IOM108 I/O Control Module is the central point of interface within any Equipment Frame. The unit serves as an input/output port for both control signals and module output signals. In addition, the IOM108 performs all "housekeeping" functions within the frame. The large amount of memory provided allows for storage of up to 99 channels or 8 sectors to be used in any combination for receiver scanning. This capability is in addition to that provided in certain master receivers (such as the WJ-8626A-4 or WJ-8628A-4).

All programs required for interface to any WJ-9040 Module are stored within the IOM108. Extra RAM and ROM is provided for special, user defined applications. Since an IOM108 is located in each WJ-9040 Equipment Frame, intelligence is distributed throughout the system.

The IOM108 can be controlled via a serial 156 kbaud port or through optional IEEE-488 or RS-232 ports. For larger systems, a ZIU108 may be employed. This unit utilizes a single input control port as outlined above and outputs up to seven serial I/O lines to control IOM108 units. In addition, an eighth IOM108 is resident within the ZIU108.

IOM Data Transfer Protocol

Communication between the IOM and WJ-9040 System modules is accomplished through program controlled I/O. The IOM performs all data transfers by utilizing five signal lines. Data is transferred serially via the Data In and Data Out lines. Addressed Enable B, Clock, and Strobe are the handshaking signals used to guarantee a valid transfer. Addressed Enable B is used to enable one of 8 slots of the equipment frame for communication. After a module is enabled, data is serially shifted into it by the IOM software driven Clock line. The Strobe line is toggled by the IOM to latch the data into the modules' internal registers. Two typical data transfers are explained below.

Each WJ-9040 System module is assigned a unique sixteen bit "configurator" which is read by the IOM for communication purposes. Figure 1 shows the speed in which the configurator is read.

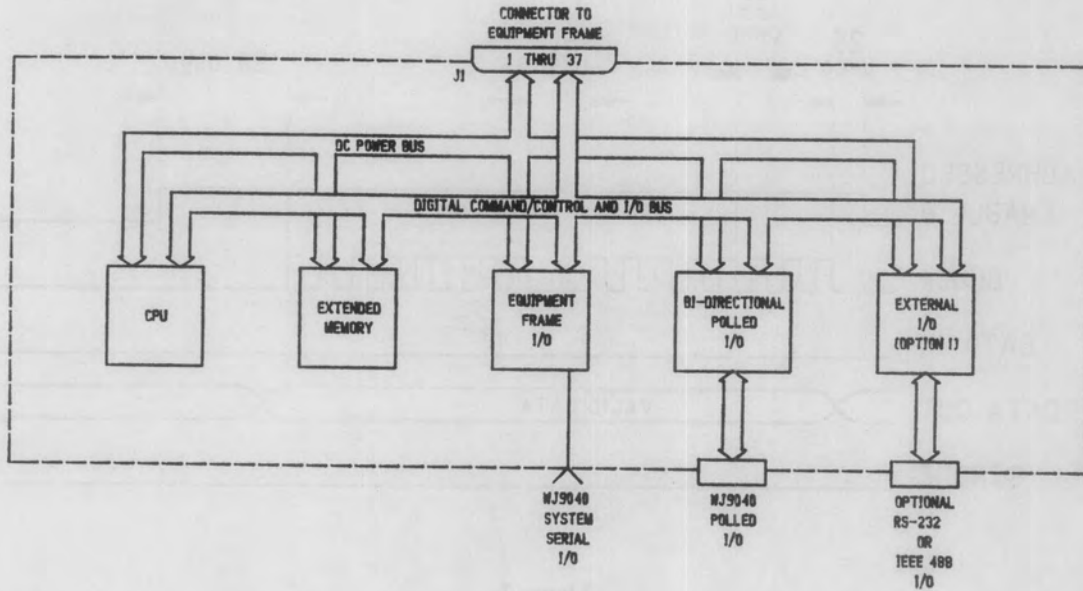
Figure 2 shows the timing diagram of an IOM command that reads the parameters from a master (front panel) receiver. After enabling the receiver with Addressed Enable B, a command byte is serially shifted into it at 21 kHz. The Strobe line is then toggled to latch the command into the receiver. The IOM waits for the command to be decoded and executed. Parameter data is then clocked out of the receiver at 40 kHz. The IOM completes the communication transfer by bringing Addressed Enable B low.

**IOM108
I/O CONTROL MODULE**

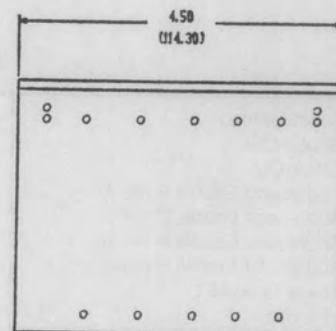
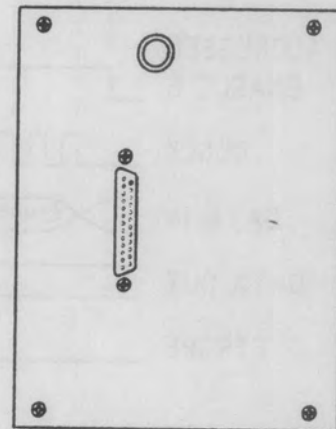
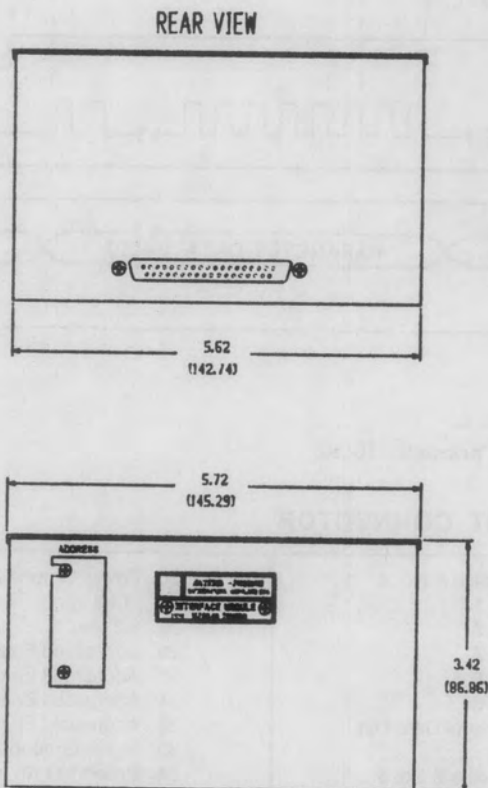
COMMON EQUIPMENT

Rev. A, 9/84

BLOCK DIAGRAM



OUTLINE DRAWING



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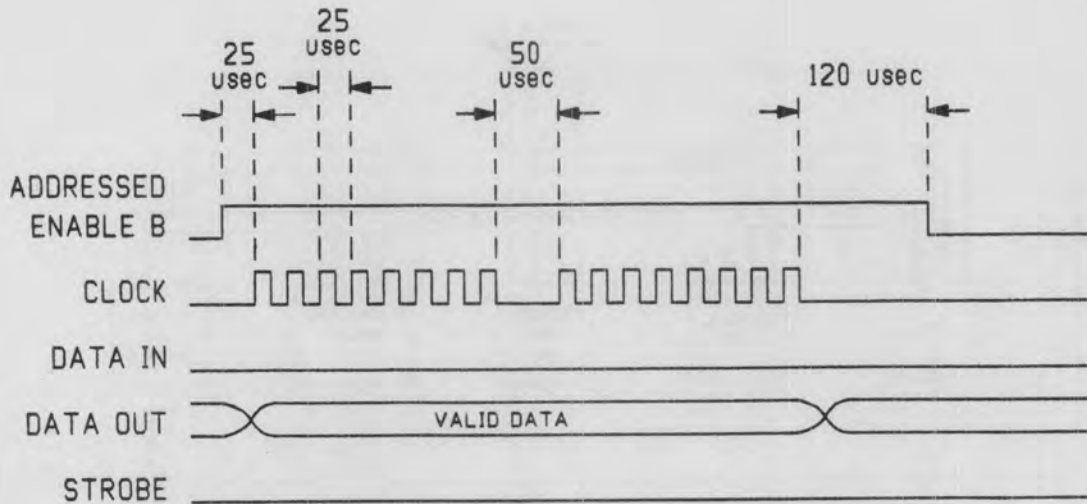


Figure 1.
Configurator Read

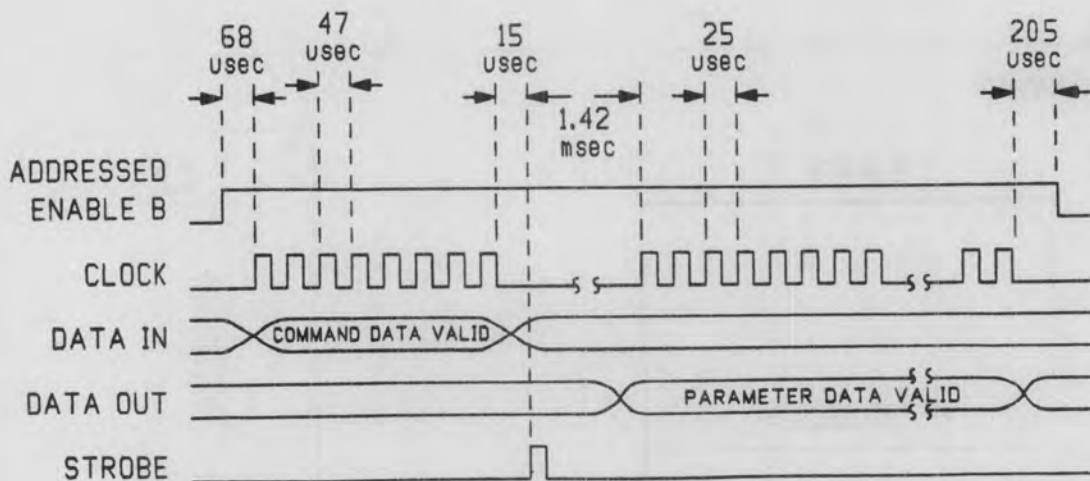


Figure 2.
Master Receiver Parameter Read

37 PIN EQUIPMENT CONNECTOR

1. Logic Ground	14. Addressed Enable A No. 4	26. Power Ground 2
2. Strobe Out	15. Signal Ground 1	27. -18.3 Vdc
3. Clock Out	16. Polled I/O No. 8	28. 8.2 Vdc
4. Addressed Enable B No. 1	17. Polled I/O No. 7	29. Addressed Enable A No. 5
5. Addressed Enable B No. 2	18. Polled I/O No. 6	30. Addressed Enable A No. 6
6. Addressed Enable B No. 3	19. Polled I/O No. 5	31. Addressed Enable A No. 7
7. Addressed Enable B No. 4	20. Command/Control Data Out	32. Addressed Enable A No. 8
8. Power Ground 1	21. Report Data In	33. Signal Ground 2
9. +29 Vdc	22. Addressed Enable B No. 5	34. Polled I/O No. 4
10. +18.3 Vdc	23. Addressed Enable B No. 6	35. Polled I/O No. 3
11. Addressed Enable A No. 1	24. Addressed Enable B No. 7	36. Polled I/O No. 2
12. Addressed Enable A No. 2	25. Addressed Enable B No. 8	37. Polled I/O No. 1
13. Addressed Enable A No. 3		

SMU120
21.4 MHz SIGNAL MONITOR

WJ-9040

SIGNAL MONITORS

Rev. A, 9/84



Weight - 6 lbs (2.3 kg)
Power - 3 watts

FEATURES

- Compact, Low-power, eighth-rack WJ-9040 compatible module
- Standard 21.4 MHz input
- Sweep widths up to 4 MHz
- Resolution down to 2 kHz
- Logarithmic or linear operation
- 60 dB Dynamic range
- Internal marker
- Utilizes crystal filters for high performance

MODULE SIZE:

Eighth-Rack

AVAILABLE OPTIONS:

None available at this time

MODULE I/Os:

- | | | |
|--|------------|------------------------|
| (J2) 21.4 MHz Input | | } SMA Female Connector |
| (J3) Horizontal | (X) Output | |
| (J4) Vertical | (Y) Output | |
| (J5) Blanking | (Z) Output | |
| (J1) WJ-9040 System -25 Pin, Type "D"
(see page four for pinouts) | | |

REQUIRED ADDITIONAL EQUIPMENT:

- EFR100 Series Equipment Frame
- EPS100 Series Power Supply
- DXY100 X, Y, Z Display

COMPATIBLE ACCESSORY EQUIPMENT:

- WJ-8627-X Series VHF/UHF Handoff Receivers
- WJ-8628-X Series VHF/UHF Scanning Receivers
- SSUXXX Series Signal Switching Unit

DESCRIPTION

The WJ-9040 SMU120 is an eighth-rack, 21.4 MHz signal monitor which fits into, and is powered by, an EFR100 equipment frame. The unit accepts signals at 21.4 MHz up to 4 MHz wide and outputs X, Y and Z DC voltages which are capable of driving a CRT such as the WJ-9040 DXY100.

The unit is controllable via its front panel and offers both linear and logarithmic response with a dynamic range of up to 60 dB. Resolution as low as 2 kHz is achievable by the use of crystal filters which provide 90 dB of ultimate rejection. Four possible sweep widths are selectable (50 kHz, 200 kHz, 1 MHz or 4 MHz) and the sweep rate is continuously variable from 5 to 30 Hz. The unit is also capable of producing a marker at 21.4 MHz and provides center frequency and overall gain adjustments on its front panel.

CAPABILITIES AND APPLICATIONS

The WJ-9040 SMU120 will act as both a tuning aid and a signal identifier for any receiver with a 21.4 MHz signal monitor output. This type of receiver includes both the WJ-8627-X Series of VHF/UHF Handoff Receivers and the WJ-8628-X Series of VHF/UHF Scanning Receivers.

The unit is capable of driving any X, Y, Z type display and is specifically designed to operate with the WJ-9040 DXY100 CRT type display.

When used with the SSUXXX series of signal switching units, signal monitoring of any one of multiple receivers is possible through manual or automatic switching control. As a result of the unit's small size, a SMU120, SSUXXX and DXY100 will provide full signal monitoring, switching and display while occupying only one-half of a standard 19" frame.

SMU120
21.4 MHz SIGNAL MONITOR
SIGNAL MONITORS

Rev. A, 9/84

SPECIFICATIONS

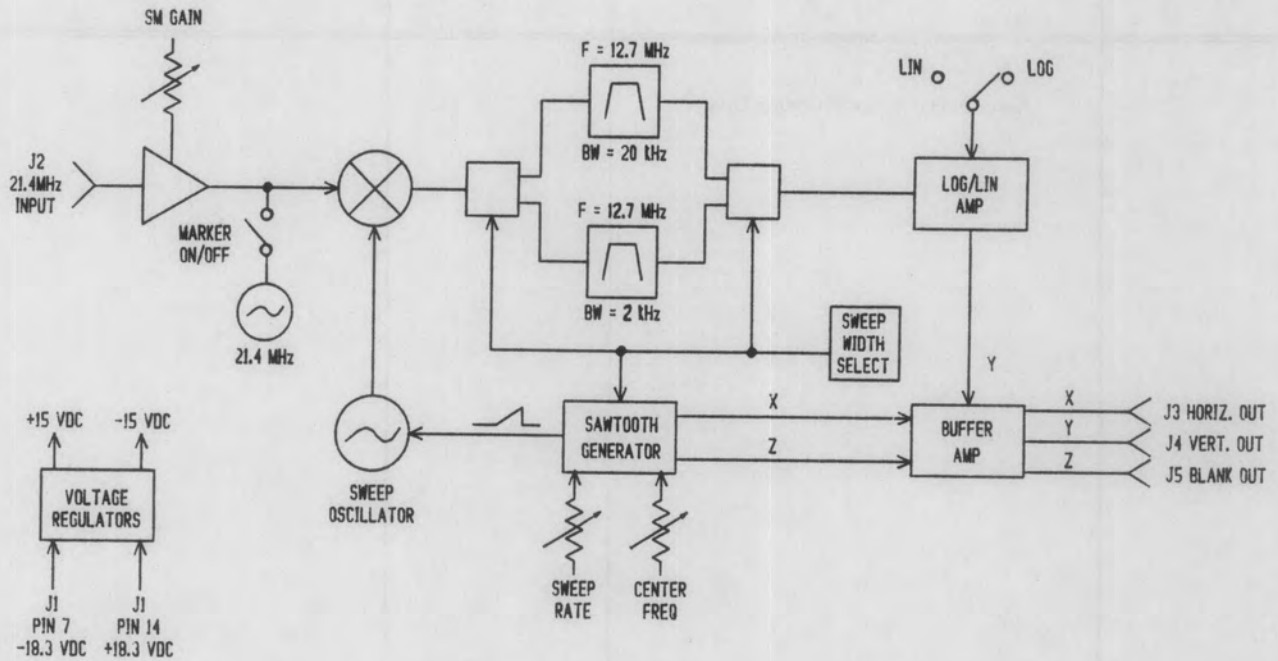
Input Frequency	21.4 MHz
Input Impedance	50 ohms, nominal
Input Sensitivity	A 10 μ V input signal (-87 dBm) will produce a 140 mV dc level at the Y output in the LOG mode. (5/16 inch deflection on WJ-9040 DXY100) A 10 μ V input signal will produce a 500 mV dc level at the Y output in the linear mode. (1 inch deflection on WJ-9040 DXY100)
Dynamic Range	60 dB in LOG mode. A 10 mV input signal (-27 dBm) will produce a 1 V dc level at the Y output. (Full deflection on WJ-9040 DXY100). 30 dB in linear mode.
Response Modes	Log or Linear
Center Frequency	150 kHz
Adjustment Range	
Horizontal (X) Output Levels	-1/2 Vdc to +1/2 Vdc for full sweep
Blanking (Z) Output Level	0 Vdc - full intensity 2.5 Vdc blanked
Sweep Widths	50 kHz, 200 kHz, 1 MHz, 4 MHz
Resolution:	
50 kHz and 200 kHz Sweep	2.0 kHz
1 MHz and 4 MHz Sweep	20.0 kHz
Sweep Rate	5 Hz to 30 Hz
Sweep Linearity	Linear to 5% of total sweep width
Response Flatness	± 1.5 dB
Internal Marker Frequency	21.4 MHz
Internal Marker Accuracy	$\pm 0.005\%$
Gain Control Range	50 dB
Front Panel Controls	Sweep Rate Adjust Center Frequency Adjust Gain Adjust Sweep Width Select Marker ON/OFF Mode LOG/LIN
Power Requirements	± 18.3 Vdc supplied by WJ-9040 Equipment Frame
Power Consumption	Approx. 3 watts
Size	5.2 inches (132 mm) high 2.0 inches (50 mm) wide 14.38 inches (365 mm) deep
Weight	Approx. 6 lbs. (2.3 kg)
Operating Temperature Range	0°C to 50°C

**SMU120
21.4 MHz SIGNAL MONITOR**

SIGNAL MONITORS

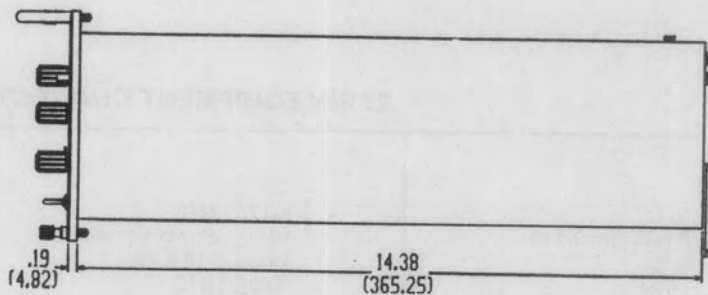
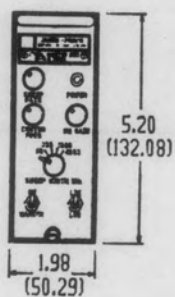
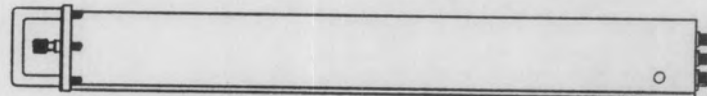
Rev. A, 9/84

BLOCK DIAGRAM



OUTLINE DRAWING

REAR VIEW



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IEEE-488/RS-232 COMMANDS

COMMAND	DESCRIPTION	COMMAND	DESCRIPTION
	None available, Local Control Only.		

COMMAND/CONTROL SERIAL BIT STREAM

	None available, Local Control Only.

25 PIN EQUIPMENT CONNECTOR

1-4. N/C 5. Power Ground #1 6. N/C 7. 18.3 Vdc	8-17. N/C 18. Power Ground #2 19. -18.3 Vdc 20-25. N/C
---	---



Weight - 12 lbs (5.5 kg)
Power - 16 watts

MODULE SIZE:

Quarter-Rack

AVAILABLE OPTIONS:

None at this time

MODULE I/Os:

- | | |
|---|---------------------------|
| (A2J1) RF Input | } SMA Female
Connector |
| (A2J2) 160 MHz IF Output | |
| (A2J6) 21.4 MHz IF Output | |
| (A1J4) 50 MHz Reference Input | |
| (A2J5) RF AGC Input | |
| (A1J2) Auxiliary I/O (9 Pin SRE Female) | |
| Pin Assignments | |
| 1 through 6 — Microwave Down Converter
Identification Code | |
| 7 through 9 — not assigned | |
| (A1J1) WJ-9040 System Connector (25 Pin, Type
"D") (see page four for pinouts) | |

REQUIRED ADDITIONAL EQUIPMENT:

- EFR100 Series Equipment Frame
- EPS100 Series Power Supply
- IOM108 I/O Module
- FRM150 Frequency Reference Module

COMPATIBLE ACCESSORY EQUIPMENT:

- IFD160 IF Demodulator
- MDCXXX Series Microwave Down Converters
- DIO232, DIO488 Interface
- SSUXX Series Signal Switching Units
- SPN108 Speaker Panel
- SMU120 Signal Monitor

FEATURES

- Tuning Range of 500 to 1000 MHz
- Low Phase Noise
- 50 MHz Bandwidth
- 160 MHz and 21.4 MHz IF Outputs
- 5 dBm 3rd Order Input Intercept Point
- Synthesized Local Oscillator
- 10 kHz Frequency Resolution

DESCRIPTION

The WJ-9040 IFT100 IF Tuner provides voltage tuned preselection from 500 to 1000 MHz and provides IF Outputs of 160 MHz and 21.4 MHz. The synthesized local oscillators provide excellent phase noise and allow tuning in 10 kHz frequency steps. The group delay of the tunable preselectors is relatively flat for minimum contribution to system Noise Power Ratio.

CAPABILITIES AND APPLICATIONS

The IFT100 IF Tuner is intended to be used with the MDCXXX Series Microwave Down Converters which provides a 0.5 GHz down converted section of the microwave spectrum centered at 750 MHz. The IFT100 tunes across this 500-1000 MHz spectrum in 10 kHz frequency steps and provides a 160 MHz and a 21.4 MHz IF Output for demodulation with auxiliary equipment (i.e., IFD160). The unit is controlled through the IOM108 with a serial 72 bit data word. Microwave down converter identification is provided by a rear panel SRE connector which connects to the down converter.

The IFT100 when used with the MDCXXX Microwave Down Converters and the IFD160 IF Demodulator provides a cost-effective approach to microwave surveillance requirements.

IFT100
IF TUNER**TUNERS**

Rev. A, 9/84

SPECIFICATIONS

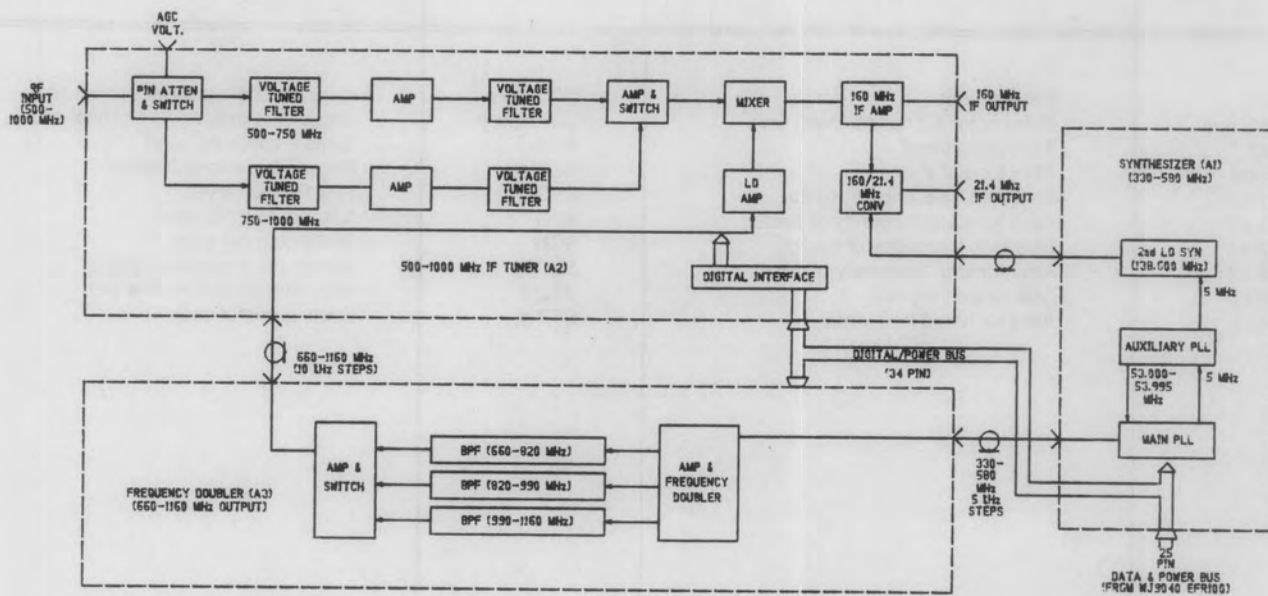
Input Frequency Range	500 MHz to 1000 MHz
Frequency Resolution	10 kHz
Noise Figure	14.5 dB maximum
Gain	nominal 6 dB at 160 MHz output nominal 5 dB at 21.4 MHz output
3rd Order Input Intercept Point	+5 dBm minimum
Input VSWR	2.5:1 maximum
Image Rejection	70 dB
IF Rejection	70 dB
Phase Noise	-90 dBc/Hz at 10 kHz
Conducted LO to RF Input	-80 dBm maximum
RF Bandwidth	50 MHz minimum to 160 MHz Output 6 MHz minimum to 21.4 MHz Output
AGC/Gain Control	0 to -10 volts for 40 dB
Temperature:	
Operating	0°C to 50°C
Storage	-40°C to 70°C
Power Consumption	15 watts
Weight	12 lbs. (5.5 Kg)
Size	5.2 inches high (132 mm) 4.0 inches wide (102 mm) 14.38 inches deep (365 mm) (One-quarter rack WJ-9040)

**IFT100
IF TUNER**

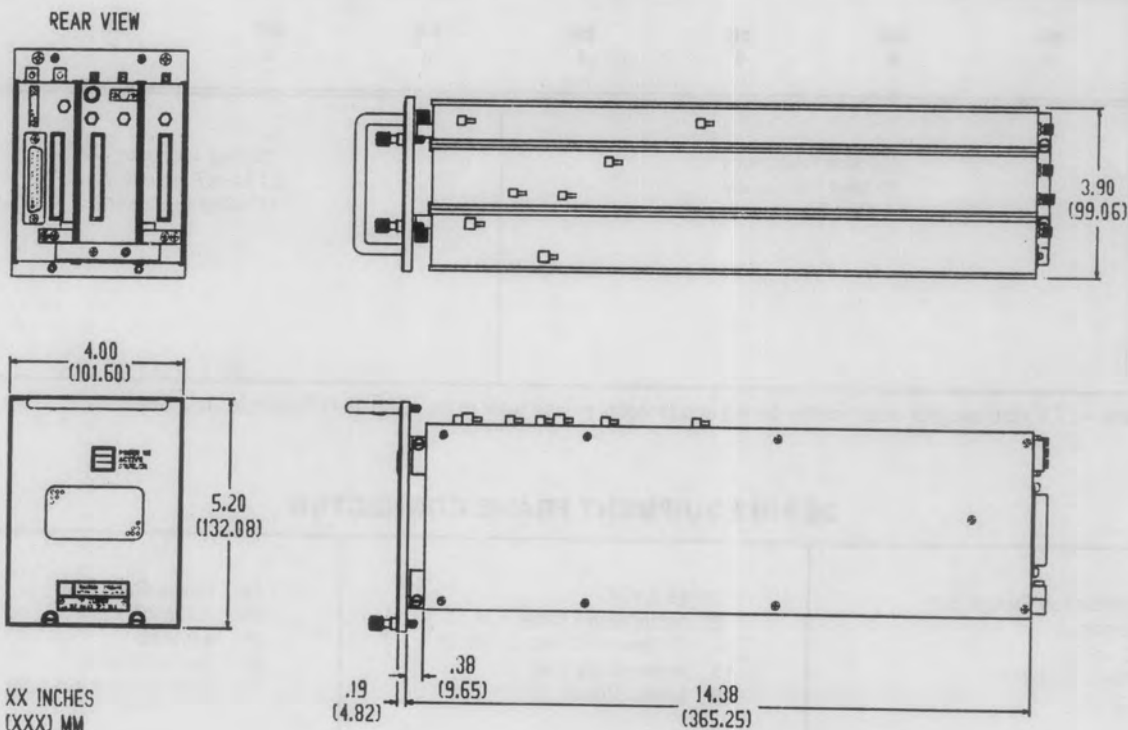
TUNERS

Rev. A, 9/84

BLOCK DIAGRAM



OUTLINE DRAWING



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**IFT100
IF TUNER**

TUNERS

Rev. A, 9/84

IEEE-488/RS-232 COMMANDS

COMMAND	DESCRIPTION	COMMAND	DESCRIPTION
CLR DWL n,m DWL? EXAM *F1 n,f *F1 n? *F2 n,f *F2 n? FRQ f FRQ?	Resets tuner Sets sector & channel dwell time Asks dwell times Asks for slot status Sets start frequency of sector Asks for start frequency of sector Sets stop frequency of sector Asks for stop frequency of sector Sets tuned frequency Asks for tuned frequency	INL n,m-p LCK n,m-p MAN n RCL n RFG n RFG? SCN SLOT n STO n STP n	Includes channels for channel scan Locks channels out of channel scan Stops a specified scan Recalls a memory channel Sets RF gain level Asks for RF gain level Starts channel scan Addresses a specified slot Allocates a memory channel Starts a sector scan

*Optional Commands

COMMAND/CONTROL SERIAL BIT STREAM

BYTE	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
0	100 kHz Frequency				10 kHz Frequency			
1	10 MHz Frequency				1 MHz Frequency			
2	1 GHz Frequency				100 MHz Frequency			

Effective Bit Rate = 17.1 Kbit/sec. For data transfer timing and protocol please refer to the IOM108 I/O Module Data Sheet.

25 PIN EQUIPMENT FRAME CONNECTOR

1. Addressed Enable B In 2. Strobe In 3. Clock In 5. Power Ground 1 6. 29 VDC	7. 18.3 VDC 9. Addressed Enable A In 14. Command/Control Data In 15. Report Data Out 16. Logic Ground	18. Power Ground 2 19. -18.3 VDC 20. 8.2 VDC 21. Signal Ground 23. Module Fault Indicator
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Watkins-Johnson Company
May 1985
Rev. A

WJ-9040 DCV167

160 MHz to 70 MHz Converter

The WJ-9040 DCV167 Downconverter converts 160 MHz to 70 MHz at bandwidths of up to 36 MHz. The unit is eighth rack in size and is part of the WJ-9040 system. The unit employs an oscillator used for **down conversion** which is phase locked to the WJ-9040 system reference to insure frequency accuracy.

The DCV167 uses high side mixing to insure low spurious responses, and has a fixed gain of approximately 20 dB. The front panel employs an adjustment for manual gain reduction.

Specifications

Input Frequency:	160 MHz, nom.
Input Bandwidth:	36 MHz, max.
Input/Output Impedance:	50 Ohms, nom.
Gain:	20 dB, min.
Nominal Input Level:	-20 dBm
Output 1 dB Compression Level:	+10 dBm, nom.
Manual Gain Reduction Range:	25 dB
IF Rejection:	65 dB
Image Rejection:	65 dB
External Reference Required:	50 MHz
Input Third Order Intercept Point:	0 dBm, min.

237.00

WJ-9040 EQUIPMENT FRAME AND COMMON EQUIPMENT



FEATURES

- Lightweight, Maximum 20-Inch Depth Per Frame
- Frame Accepts Any Combination of Eighth-, Quarter- or Half-Rack WJ-9040 System Components
- Mounts WJ-9040 System Common Modules:
 - Power Supply (EPS100A)
 - Input/Output (I/O) Interface (IOM108)
 - Frequency Reference (SRM105A)
 - Multicouplers (MVU104)
- High Efficiency Switching Power Supply: 120/220 VAC Input Provides Required Voltages to All WJ-9040 Modules
- Modular, Common Modules Easily Replaceable for Low MTTR
- I/O Module Options:
 - 5 MHz, NSC800 CMOS Microprocessor (Z80 Software Compatible) Per Frame
 - 56 kbytes EPROM, 2 kbytes Battery Backed Up RAM, 2 kbytes Volatile RAM and 256 Bytes Non-Volatile RAM Per I/O
 - RS-232C or IEEE-488 Interface
- Frequency Reference (SRM105A)
 - Provides Four Highly Stable TCVCXO 50 MHz Outputs
 - Locks to 1, 5, or 10 MHz External Reference
- Multicouplers
 - MVU104

INTRODUCTION

The WJ-9040 Modular Receiving System was developed under a design philosophy to provide high performance, small size versus capability, lower power consumption and a flexible, yet simple, system concept. The resulting design offers a unique system approach for special VLF/HF/VHF/UHF/Microwave signal acquisition, monitoring and analysis requirements.

The system concept provides a compatible family of functional modules which may be configured into a variety of specific system designs. All modules are compatible in size, power and control, thus resulting in a totally interchangeable and expandable system. This approach permits a system-level controller to control and monitor throughout the system down to the module level. Bidirectional transfer of data is possible as a result of embedded microprocessors in each equipment frame which contains remotely controllable devices. The microprocessors facilitate the down-loading of control data to an equipment frame position. Consequently, a user may configure single equipment frame/module complements for limited tasks or large, multiframe systems to satisfy complex requirements. In each case, remote control may be achieved via an RS-232C, IEEE-488 or proprietary WJ-9040 serial I/O bus. Other remote control protocols can be implemented.

**EFR100
EQUIPMENT FRAME**



DESCRIPTION

The WJ-9040 EFR100 Equipment Frame is the basic building block of the WJ-9040 System. The frame and its associated power, control and accessory modules ensure a system which accepts components that are compatible in size, power and control.

The frame consists of an enclosure in which system modules are mounted and a backplane which provides the modules with power and control signals. At the rear of the frame are mounting spaces and connectors for a Power Supply (EPS100 Series), I/O Control Module (IOM108) and Auxiliary Module (SRM105A, MVU104, etc.). All modules can be easily installed, changed or removed as required. In addition, all wiring within the frame is accomplished by the use of a flexible printed circuit board.

The EFR100 Equipment Frame is capable of accepting up to eight eighth-rack, four quarter-rack, two half-rack or any combination of the above modules. The frame is equipped with mounting holes for slides or brackets, thus allowing for easy rack mounting. Handles are supplied at the front of the frame to improve transportability.

SPECIFICATIONS

Front Mounting Positions	
Mounting Method	
Front	
Rear	
Rear Mounting Positions	
Frame Wiring Method	
Frame/Power Supply Cooling	
Slide/Bracket Mounting Capability	
Frame Size (Including Connectors)	
Frame Weight (Including Rear Mounted Modules)	
Power Consumption	

CAPABILITIES AND APPLICATIONS

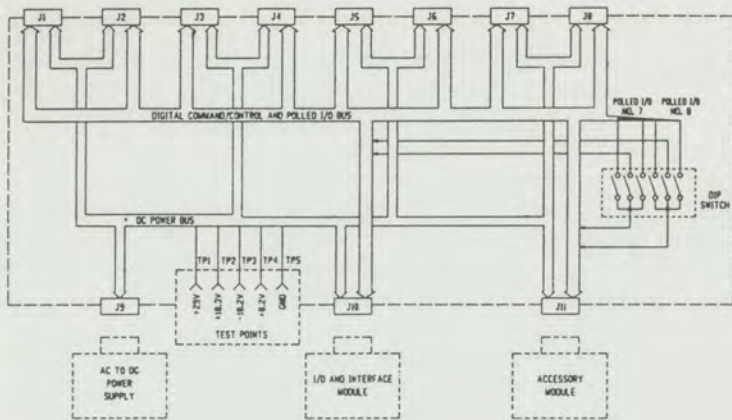
The WJ-9040 EFR100 Equipment Frame forms the basis of any WJ-9040 System. Eighth, quarter and half-rack system modules slide into the front of the frame and receive their power and control signals from it. Module outputs such as audio, signal strength and COS are routed within the frame to the IOM108 I/O Module. In addition, a 1-inch high "window" is provided across the rear of the frame to provide direct access to module I/O's such as RF input or IF output, thus eliminating the need for extra connectors and cabling within the frame. The frame also allows routing of signals from module to module via DIP switch settings. This is useful when two modules function together and require a direct connection such as an AGC line between a tuner and IF module.

Common module size, power, and control coupled with unique module identifier codes allow for the addition, removal or change of any module in any position within the frame. Plug-in mounting of the power supply and I/O module results in low MTTR, while the use of the auxiliary position results in high system flexibility.

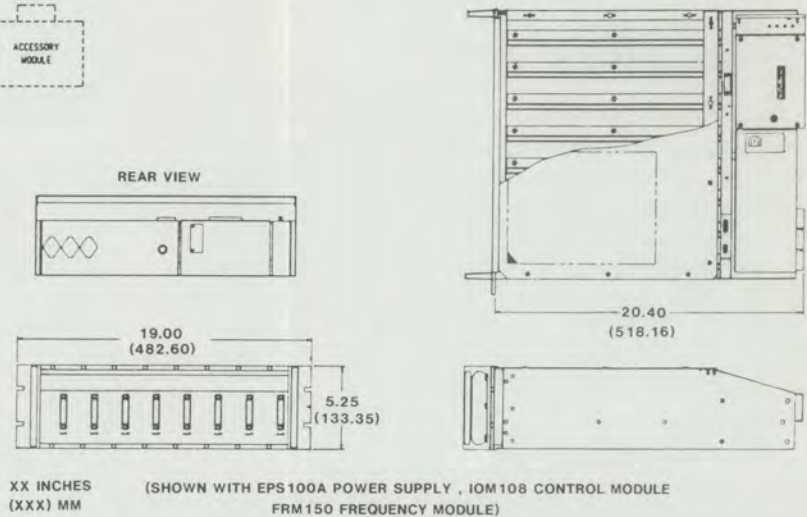
Up to eight eighth-rack, four quarter-rack, two half-rack or any combination of WJ-9040 Modules

Slide-in and secure with thumb screws
 Drop-in and secure with conventional screws
 Power supply, I/O module, auxiliary slot
 11 Type "D" connectors connected by flexible PC board and enclosed in aluminum shell
 Convection
 Panel "Ears" or Jonathan 110 QD-20-2 Slides (Optional)
 19 inches (483 mm) wide by 5.25 inches (133 mm) high by 20.4 inches (518.16 mm) deep
 Approximately 16 lbs. (7.36 kg)
 0 watts

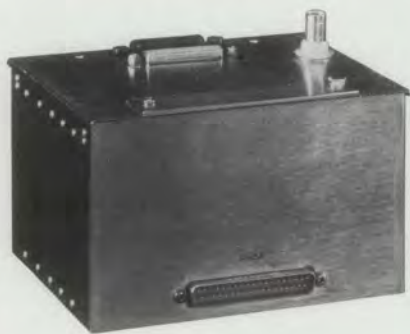
BLOCK DIAGRAM EFR100



OUTLINE DRAWING EFR100



IOM108 I/O CONTROL MODULE



DESCRIPTION

The WJ-9040 IOM108 I/O Control Module is used to interface WJ-9040 Series modules (i.e., receivers and tuners) to a control device. Standard WJ-9040 Controller I/O is bidirectional serial asynchronous at 156.3 kilobaud. Remote control using IEEE-488 or RS-232C formats is accomplished with the WJ-9040 DIO232 or DIO488 plug-in printed circuit boards.

The IOM connects to the rear backplane of a WJ-9040 EFR100 Equipment Frame through a 37-pin D-type connector on the IOM motherboard. The motherboard also allows the IOM to accept the five plug-in printed circuit boards shown in the block diagram.

The CPU board contains a powerful NSC800 micro-processor which is programmed for the data handling and

communications necessary for the modules residing in the EFR100. Controller I/O is interrupt driven for immediate processor attention.

The CPU is complete with 64 kbytes EPROM, 4 kbytes RAM, and 4 kbytes Battery Backed Up RAM for memory retention during AC power-down situations.

The RAM is partitioned to allow for simple downloading of data from controllers.

The Bidirectional Polled I/O board allows for selection of a module's polled outputs for monitoring and distribution externally to the equipment frame. The polled outputs are, in general, unique to each module and used by the IOM to provide optimal control.

The Equipment Frame I/O board is the interface between the IOM's processor and each module present in the equipment frame. This board also contains the serial interface for the WJ-9040 Controller I/O. A Universal Asynchronous Receiver/Transmitter is employed to receive commands and transmit responses through a 50 ohm coaxial cable. The Equipment Frame I/O Board also gives the frame the ability to have a Slave Frame Address from 1 to 8. This provides the WJ-9040 Controller with up to eight additional frames that can be controlled via serial interface.

The External I/O board is an option that provides either an IEEE-488 or RS-232C interface. This option allows for a user selectable controller for the modules residing in the equipment frame.

CAPABILITIES AND APPLICATIONS

The WJ-9040 IOM108 I/O Control Module is the central point of interface within any Equipment Frame.

The unit serves as an input/output port for both control signals and module output signals. In addition, the IOM108 performs all "housekeeping" functions within the frame. The large amount of memory provided allows for storage of up to 99 channels to be used in any combination for receiver scanning. This capability is in addition to that provided in certain master receivers (such as the WJ-8626A-4, WJ-8628-1 or WJ-8628-4).

All programs required for interface to any WJ-9040 Module are stored within the IOM108. Since an IOM108 is located in each WJ-9040 Equipment Frame, intelligence is distributed throughout the system.

The IOM108 can be controlled via a serial 156 kbaud port or through optional IEEE-488 or RS-232C ports.

IOM DATA TRANSFER PROTOCOL

Communications between the IOM and WJ-9040 System modules is accomplished through program controlled I/O. The IOM performs all data transfers by utilizing five signal lines. Data is transferred serially via the Data In and Data Out lines. Addressed Enable B, Clock, and Strobe are the handshaking signals used to guarantee a valid transfer. Addressed Enable B is used to enable one of eight

slots of the equipment frame for communication. After a module is enabled, data is serially shifted into it by the IOM software driven Clock line. The Strobe line is toggled by the IOM to latch the data into the modules' internal registers. Two typical data transfers are explained below.

Each WJ-9040 System module is assigned a unique sixteen bit "configurator" which is read by the IOM for communication purposes. Figure 1 shows the speed in which the configurator is read.

Figure 2 shows the timing diagram of an IOM command that reads the parameters from a master (front panel) receiver. After enabling the receiver with Addressed Enable B, a command byte is serially shifted into it at 21 kHz. The Strobe line is then toggled to latch the command into the receiver. The IOM waits for the command to be decoded and executed. Parameter data is then clocked out of the receiver at 40 kHz. The IOM completes the communications transfer by bringing Addressed Enable B low.

AVAILABLE OPTIONS:

- WJ-9040 DIO232 RS-232C Digital I/O PCB
- WJ-9040 DIO488 IEEE-488 Digital I/O PCB

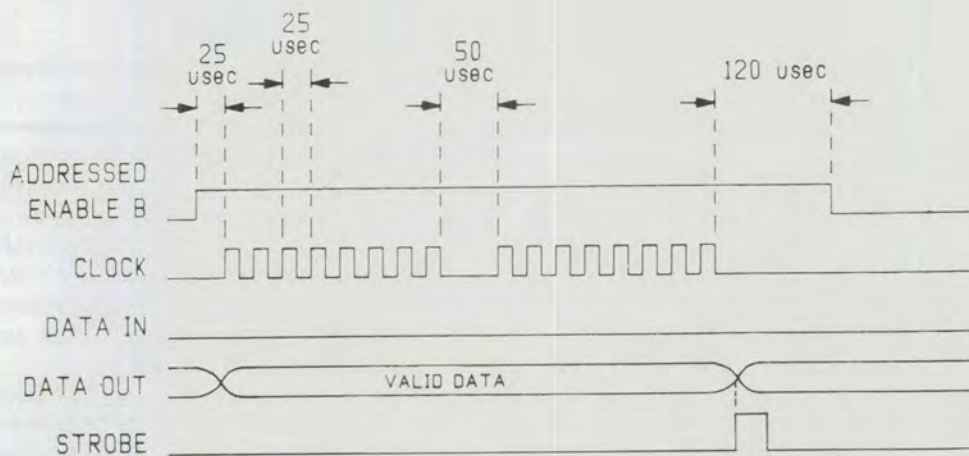


Figure 1.
Example of
Configurator Read

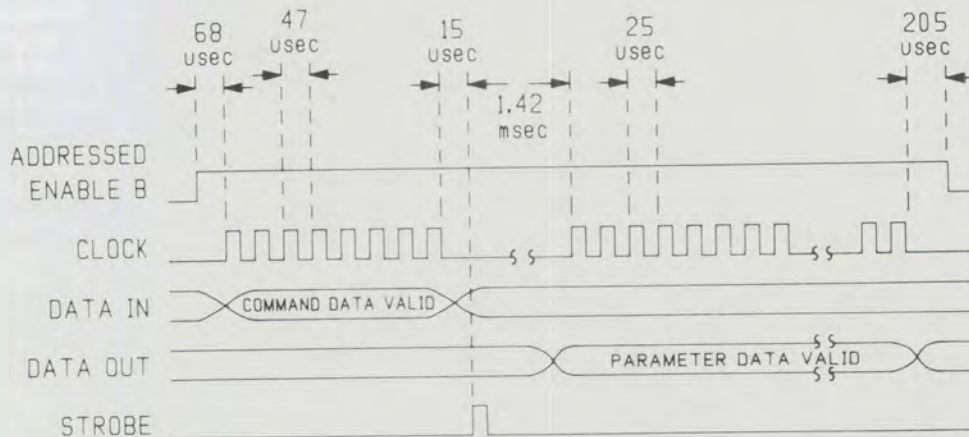
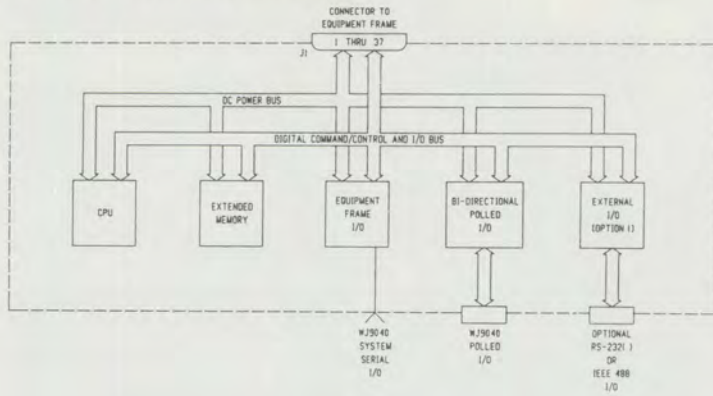
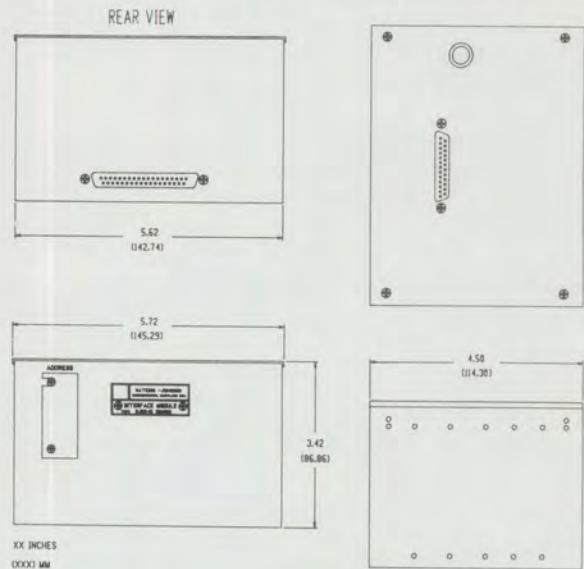


Figure 2.
Example of Master Receiver
Parameter Read

BLOCK DIAGRAM IOM108



OUTLINE DRAWING IOM108



SRM105A SITE LOCKABLE REFERENCE MODULE



DESCRIPTION

The WJ-9040 SRM105A Site Lockable Reference Module is designed to mount in the auxiliary slot of the EFR100 Equipment Frame. The unit provides four highly stable, 50 MHz signals to any WJ-9040 Module requiring a frequency reference for proper operation. The SRM105A is capable of locking to a 1, 5 or 10 MHz site reference such as a cesium beam, rubidium cell or quartz crystal frequency standard. The unit also operates in a "free run" mode during which its internal 50 MHz TCVCXO is not

phase locked to an external signal. Dip switches are used to select 1 MHz input, 5 MHz input, 10 MHz input, or "free run."

The SRM105A receives power from the EPS100A Power Supply, and utilizes output splitter and buffer amplifier circuitry for high isolation. A highly stable, temperature compensated crystal oscillator is used to provide the four 50 MHz outputs. The unit requires no remote or local control and is switched on automatically when the EPS100A Power Supply is activated.

CAPABILITIES AND APPLICATIONS

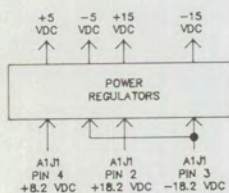
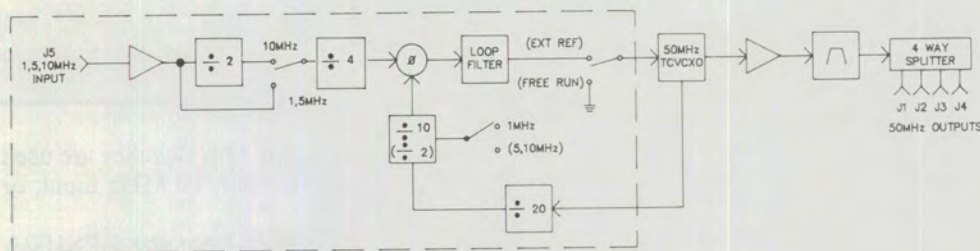
Any WJ-9040 Module requiring a frequency reference will accept the "system standard" 50 MHz signal from the SRM105A. Modules require a frequency reference when they employ phase locked loop circuitry such as that used in receiver synthesized local oscillators. The unit supplies four outputs. Typically, this number is adequate for a standard configuration of modules mounted within one EFR100 Equipment Frame.

In larger systems, a WJ-9311 HF Multicoupler may be used to distribute 1, 5, or 10 MHz to each of eight SRM105A units, thus allowing up to eight equipment frames to be locked to a common site reference. Where a SRM105A is installed and a site reference is either not available or inoperable, the unit may be switched to its "free run" mode and will continue to provide a highly stable reference frequency to the system.

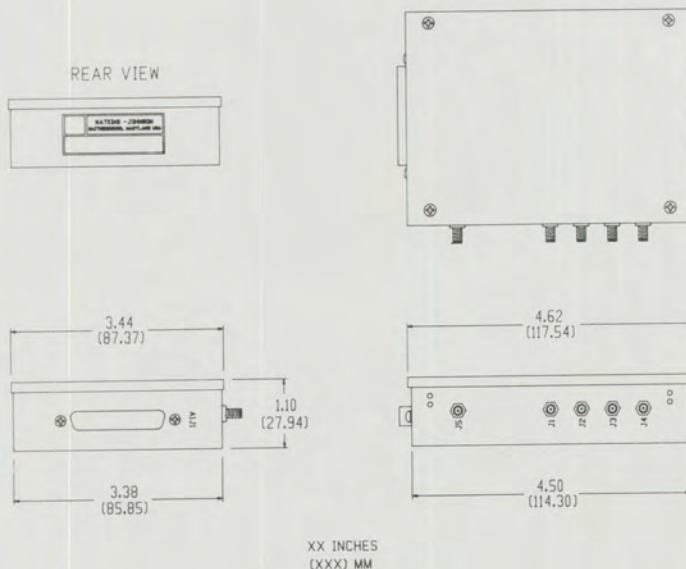
SPECIFICATIONS

Number of Outputs	Four, SMA Female Connector
Output Frequency	50 MHz Sinewave
Output Level	0 dBm, minimum; + 5 dBm, maximum
Output Impedance	50 ohms, nominal
Output VSWR	2.0:1, maximum
Output Port-to-Port Isolation	25 dB, minimum
Output Phase Noise	-140 dBc/Hz at 10 kHz carrier offset
Output Frequency Stability (In "Free Run" Mode)	± 1 ppm from 0°C to 50°C ± 3 ppm per year
Output Second Harmonic Level	30 dBc, minimum
Reference Input Frequency	1, 5 or 10 MHz through a single SMA Female Connector
Input Impedance	50 ohms, nominal
Reference Input Level	TTL (0 to 5 Vdc) CMOS (0 to 5 Vdc) Sinewave (-30 dBm to + 10 dBm)
Output Frequency Stability	Dependent on site reference stability
External Site Reference Accuracy Required	± 5 ppm
Operating Temperature Range	0°C to 50°C
Size	3.5 inches (89 mm) high by 4.5 inches (114 mm) wide by 1.0 inches (25 mm) deep
Power Consumption	2 watts
Weight	1 lb. (0.45 kg)

BLOCK DIAGRAM SRM105A



OUTLINE DRAWING SRM105A



**EPS100A
AC POWER SUPPLY**



DESCRIPTION

The WJ-9040 EPS100A AC Power Supply supplies +8.2 Vdc, ±18.3 Vdc and +29 Vdc to all WJ-9040 System Modules through the EFR100 Equipment Frame.

The unit utilizes switching supply technology, is 65% efficient and is convection cooled. Single phase supply voltages from 90 to 130 Vac and 180 to 260 Vac at 47 to 450 Hz may be used to operate the unit.

The EPS100A mounts in the rear of a WJ-9040 EFR100 Equipment Frame and employs a power line filter and short circuit protection. A pushbutton power switch/indicator is located at the rear of the unit.

CAPABILITIES AND APPLICATIONS

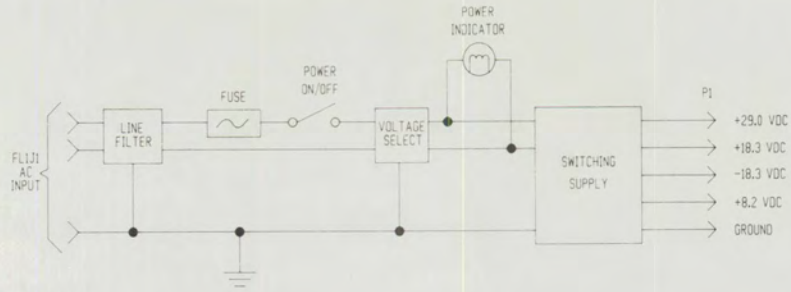
The WJ-9040 EPS100A AC Power Supply provides ±18.3 Vdc, +8.2 Vdc and +29.0 Vdc to all WJ-9040 Modules. These modules then re-regulate the voltages, thus providing isolation and extremely low supply ripple.

The WJ-9040 System definition includes constraints on total module power and total current drawn from each voltage output. For example, a quarter-rack unit's maximum allowable power consumption is 17 watts. These constraints, and a power supply mounting location which allows for convection cooling, eliminate the need for fans and blowers.

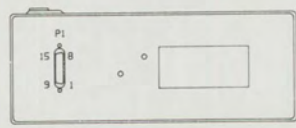
SPECIFICATIONS

Efficiency.....	65%, minimum
AC Input Voltages	90 to 130 Vac or 180 to 260 Vac
AC Input Frequency.....	47 to 450 Hz
Output Voltages.....	+29.0, +8.2, +18.3 Vdc, -18.3 Vdc
Output Ripple	100 mV peak-to-peak, maximum
Maximum Output Current	
+ 29.0 Vdc.....	0.7 A
+ 8.2 Vdc.....	6.5 A
+ 18.3 Vdc.....	1.9 A
-18.3 Vdc	1.3 A
Output Voltage Tolerance	
+ 29.0 Vdc.....	± 1.0 Vdc, maximum
+ 8.2 Vdc.....	+ 0.9, - 0.0 Vdc, maximum
+ 18.3 Vdc.....	+ 1.65, - 0.0 Vdc, maximum
- 18.3 Vdc.....	- 1.65, + 0.0 Vdc, maximum
Load Regulation	Output voltage will stay within specified tolerances for loads of 10% to 100%
Line Regulation.....	Output voltages will not change more than ± 2% over specified AC input voltage range
Cooling.....	Convection
Operating Temperature Range.....	0°C to 50°C
Weight	4 lbs. (1.84 kg)
Size	9.0 inches (229 mm) wide by 4.7 inches (120 mm) deep by 3.5 inches (89 mm) high
Maximum Possible Total Power Consumption.....	150 watts (Assuming 65% efficiency and fully loaded, maximum power consuming frame)

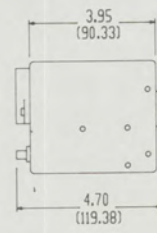
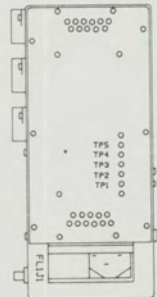
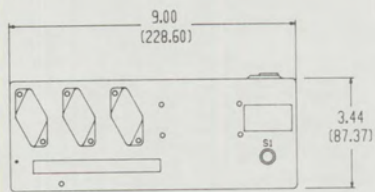
BLOCK DIAGRAM EPS100A



OUTLINE DRAWING EPS100A



REAR VIEW



WJ-8628-1 VHF/UHF ACQUISITION RECEIVER



FEATURES:

- One receiver covering 20-512 MHz frequency range
- Low power consumption
- One-quarter rack, modular construction
- Low phase noise
- Fully synthesized with 100 Hz tuning resolution
- Remotely controllable
- Tunable preselection
- Wide dynamic range
- Four IF bandwidths
- AM, FM, CW and Pulse Detection (SSB optional)
- f1 - f2 and channel scan capability

DESCRIPTION

The WJ-8628-1 VHF/UHF Acquisition Receiver is a one-quarter rack that is WJ-9040 System compatible and can be plugged into a suitably equipped EFR100 Equipment Frame. It is a fully synthesized unit that covers the 20-512 MHz frequency spectrum in steps as small as 100 Hz. Remote control may be accomplished via either IEEE-488 or RS-232C interface.

Control can also be accomplished by the WJ-8628-4 Receiver; a one-half rack unit with front panel local control or remote control.

The RF portion of the WJ-8628-1 Receiver incorporates a voltage tunable preselector with a bandwidth of 10% of the tuned frequency across the 20-512 MHz frequency range. The WJ-8628-1 Receiver thus provides excellent Image and IF rejection (80 dB), reduced LO radiation (-100 dBm), and an excellent third order input intercept point (0 dBm) while maintaining a low noise figure (10 dB).

The synthesizer portion of the WJ-8628-1 provides fast tuning speed (10 msec) while maintaining low phase noise (-95 dBc/Hz at 10 kHz offset). The synthesizer provides for a WJ-8628-1 Receiver tuning resolution of 100 Hz.

The IF portion of the WJ-8628-1 Receiver has a provision for a maximum of four (4) IF bandwidths per receiver that are customer-selected and can be changed in the field (along with the FM demodulators) for added versatility. The 3 dB bandwidths can range from 10 kHz to 4 MHz. The detection modes available include AM, FM, CW, and Pulse as standard with SSB as an option. Simultaneous AM and FM audio are available along with a selectable AM or FM video output. A signal monitor and IF output are also available.

For Further Information Please Contact:

WATKINS-JOHNSON COMPANY

700 Quince Orchard Road, Gaithersburg, Maryland 20878
(301) 948-7550 TWX: 710-828-0546 Telex: 89-8402 Cable: WJCEI

OCTOBER 1984

CAPABILITIES

The WJ-8628-1 VHF/UHF Acquisition Receiver is suitable for use as both an intercept or handoff type receiver. In the intercept mode, the unit's small size allows for up to four receivers to perform either simultaneous channel or sector scans all within a standard 19-inch equipment frame. This results in a very high probability of intercept while utilizing minimal rack space. Signals of interest may be handed off to either another WJ-8628-1 or to any of the WJ-8627-X Series VHF/UHF Handoff Receivers. All handoff operations are controlled within the WJ-9040 System by the IOM108 I/O Module.

The unit may also act as a handoff or slave receiver to the WJ-8628-4 Half Rack VHF/UHF Acquisition Receiver. In this mode, up to 34 WJ-8628-1 Receivers can be controlled through the front panel of the WJ-8628-4.

In addition, the unit is fully compatible with the WJ-8626A-4 Half Rack Receiver. A typical configuration would consist of a WJ-8626A-4 HF Receiver, a WJ-8628-1 VHF/UHF Receiver and a SPN108 speaker panel all mounted in a single 19-inch equipment frame. The result would be full 5 kHz through 512 MHz frequency coverage with front panel control through the WJ-8626-4 and audio output through the SPN108.

SPECIFICATIONS

Frequency Range	20-512 MHz
Image Rejection.....	80 dB
IF Rejection.....	80 dB
Noise Figure	10 dB
Detection Modes.....	AM, FM, CW, Pulse Standard SSB optional
Frequency Resolution.....	100 Hz
Synthesizer Tuning Speed.....	10 msec
Phase Noise.....	-95 dBc/Hz at 10 kHz offset frequency
Input Impedance	50 Ω , unbalanced
Input VSWR	2.5:1
Internal Spurious.....	-115 dBm
Third Order Input Intercept Point.....	0 dBm
Preselection	Tunable, nominal 10% BW
LO Radiation.....	-100 dBm
SM Output.....	21.4 MHz with 6 MHz nominal BW
IF Bandwidths.....	Four (4), customer selectable from 10 kHz to 4 MHz
Scan Capability.....	f1 to f2 internally, up to 99 channels through the IOM108 I/O module built into the WJ-9040 system.
IF Output.....	-20 dBm at sensitivity input level, 21.4 MHz
AM Stability with AGC	Video output changes 6 dB maximum from AGC threshold to a level 100 dB above (or maximum input of 0 dBm)
Manual Gain Control.....	100 dB
Video Output	0.35 V rms minimum into 75 Ω under sensitivity conditions
Video Response.....	DC to $\frac{1}{2}$ IF BW for FM
Audio Response.....	200 Hz to $\frac{1}{2}$ IF BW for AM
Squelch/COR.....	200 Hz to 10 kHz, 1.25 V rms into 600 Ω at sensitivity conditions.
Operating Temperature	Adjustable threshold from noise level to 50 dB above noise.
Size	COR holds a nominal 4 seconds after carrier disappears. 0°C to 50°C
Weight	5.2 inches (132.1 mm) high,
Power Consumption	4.0 inches (101.6 mm) wide,
Input Power Requirements	14.38 inches (365.3 mm) deep (WJ-9040 $\frac{1}{4}$ size unit)
External Reference Required	12 lbs. (5.44 kg) maximum
	15 watts
	+29 V, +18 V, -18 V, +8 V supplied by WJ-9040 EFR100
	50 MHz sinewave at 0 dBm with phase noise less than -115 dBc/Hz at 100 Hz, -145 dBc/Hz at 10 kHz

IF BANDWIDTH OPTIONS AND SENSITIVITY

3 dB IF Bandwidth	RF Level (dBm)
10 kHz	-105
20 kHz	-102
50 kHz	-98
100 kHz	-95
200 kHz	-92
500 kHz	-88
1 MHz	-85
2 MHz	-82
4 MHz	-79

AM – Input signal AM modulated 50% by a 1 kHz tone, will produce a minimum video output (S+N)/N ratio of 10 dB.

FM – Input signal modulated at 1 kHz rate with a peak deviation equal to 30% of selected IF BW, will produce a minimum video output (S+N)/N ratio of 17 dB. (Note: A 400 Hz rate is required for 10 kHz and 20 kHz IF Bandwidth.)

WJ-8628-1 RECEIVER CONNECTIONS

Twenty-five (25) Pin D Series Male Connector supporting the standard WJ-9040 System digital control I/O, DC Input Voltages and System Polled I/O structure.

RF Input.....SMA Female Connector
SM Output.....SMA Female Connector
Selected Video Output.....SMA Female Connector
IF Output.....SMA Female Connector
50 MHz Reference Input.....SMA Female Connector

Auxiliary I/O Connector 9 PIN SRE Female Connector

Pin Assignments:

Ground
FM Audio Auxillary Output
AM/CW/SSB Audio Auxillary Output
Squelched Audio Output
Signal Strength Output (Analog 0 to +10 V)
Carrier Operated Relay Control (open collector, 30' mA sink to ground for switching +24 Volt maximum external voltage)
Carrier Operated Squelch (0 or 5 Vdc)

WJ-8628-1 OPTIONS

SSB Demodulation

137.35

WJ-8628-4 VHF/UHF MASTER ACQUISITION RECEIVER



FEATURES

- One receiver covering 20-512 MHz frequency range with optional 500-1100 MHz frequency extender
- Full local or remote control
- One-half rack, modular construction
- Low power consumption
- Low phase noise
- 100 Hz tuning resolution, fully synthesized
- Tunable preselection
- Wide dynamic range
- Four IF bandwidths (10 kHz to 4 MHz)
- AM, FM, CW and Pulse Detection (SSB and LOG optional)
- Digitally Refreshed Display option (X, Y, Z outputs to external display)
- Master/Slave function with up to 34 WJ-8628-1 or WJ-8627-X Receivers
- Indicating Microprocessor Front Panel with 48 character alphanumeric display

DESCRIPTION

The WJ-8628-4 Receiver is a fully synthesized, microprocessor controlled receiver capable of local or remote control that tunes the 20-512 MHz frequency spectrum with a tuning resolution of 100 Hz. A frequency extender option expands spectrum coverage to 1100 MHz.

The receiver's microprocessor and general purpose keypad provide front panel control of the unit's operating parameters, and a Liquid Crystal Display module provides for a 48 character alphanumeric indication of operating status. The modular LCD features an adjustable viewing angle and backlighting circuit. An option provides circuitry to drive a digitally refreshed pan display. In addition to the keypad, frequency selection can be accomplished by a tuning knob. Another means of control is available via the WJ-9040 IOM108 I/O and its interface options: IEEE-488, RS-232C or W-J serial buss.

The WJ-8628-4 can store up to 99 channels in its memory, including frequency lock-out. Each channel stores, in addition to frequency, all receiver operating parameters and a threshold

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WATKINS-JOHNSON COMPANY

700 Quince Orchard Road, Gaithersburg, Maryland 20878
(301) 948-7550 TWX: 710-828-0546 Telex: 89-8402 Cable: WJCEI

OCTOBER 1984

DESCRIPTION

carrier-operated-squelch (COS) level. Dwell time on signals above a selected COS level, in addition to dwell on frequency once COS drops below threshold, may be independently selected for channel scans.

The WJ-8628-4 is capable of talk/listen communication within its own or other WJ-9040 equipment frames. An illustration would employ the half-rack WJ-8628-4 as the Master VHF/UHF Receiver and two quarter-rack WJ-8628-1 Receivers as the slaves in one 5.25 by 19.00 inch equipment rack. The WJ-8628-4 capabilities would then include sending receiver command information to an addressed WJ-8628-1 Receiver. The WJ-8628-4 may also recall an addressed receiver to "monitor" its current active status. The monitored receiver's operating parameters would be continuously updated and displayed on the front panel of the "Master" WJ-8628-4. After receiving the active status of the addressed receiver, the WJ-8628-4 may also "slave" the addressed receiver so that any status change made in the Master is continuously updated and handed to the slave receiver. This capability may be expanded to control of up to 34 WJ-8628-1 VHF/UHF, WJ-8627-X VHF/UHF Handoff or WJ-8626-1 HF Receivers.

The RF portion of the WJ-8628-4 Receiver incorporates a voltage tunable preselector with a bandwidth of 10% of the tuned frequency across the 20-512 MHz frequency spectrum. The WJ-8628-4 Receiver thus provides excellent image and IF rejection (80 dB), reduced LO radiation (-100 dBm), and an excellent third order input intercept point (0 dBm) while maintaining a low noise figure (10 dB).

The synthesizer portion of the WJ-8628-4 provides fast tuning speed (10 msec) while maintaining low phase noise (-95 dBc/Hz at 10 kHz offset from the carrier). The synthesizer provides a tuning resolution of 100 Hz.

The IF portion of the WJ-8628-4 Receiver has a provision for up to four (4) IF bandwidths per receiver that are customer-selected and can be changed in the field (along with the FM demodulators) for added versatility. The 3 dB bandwidths can range from 10 kHz to 4 MHz. The detection modes available include AM, FM, CW, and Pulse as standard with SSB as an option. Simultaneous AM and FM audio, selectable AM or FM video output, signal monitoring and an IF output are available. Options include Log Detection mode and a Digitally Refreshed Display output.

SPECIFICATIONS

Frequency Range	20-512 MHz 20-1100 MHz with Frequency Extender
Image Rejection.....	80 dB, min.
IF Rejection.....	80 dB, min.
Noise Figure.....	10 dB max., (11 dB with Frequency Extender)
Detection Modes	AM, FM, CW, Pulse as standard, SSB Optional
Frequency Resolution.....	100 Hz
Synthesizer Tuning Speed.....	10 msec, max.
Phase Noise.....	-95 dBc/Hz at 10 kHz offset frequency (-90 dBc/Hz with Frequency Extender)
Input Impedance.....	50 Ω , unbalanced
Input VSWR.....	2.5:1, max.
Internal Spurious.....	-115 dBm, max.
Third Order Input Intercept Point.....	0 dBm, (-1 dBm with Frequency Extender) min.
Preselection	Tunable, nominal 10% BW
LO radiation.....	-100 dBm, (-90 dBm with Frequency Extender) max.
SM Output.....	21.4 MHz with 6 MHz nominal BW
IF Bandwidths.....	Four (4), customer selectable from 10 kHz to 4 MHz
Scan Capability.....	f1 to f2, and up to 99 memory channels
IF Output.....	-20 dBm at sensitivity level, 21.4 MHz
AM Stability with AGC	Video Output changes 6 dB maximum from AGC threshold to a level 100 dB above (or a maximum input of 0 dBm)
Manual Gain Control.....	100 Db, min.
Video Output.....	0.35 V rms minimum into 75 ohms under sensitivity conditions
Video Response.....	DC to 1/2 IF BW for FM
Audio Response.....	200 Hz to 10 kHz, 1.25 V rms into 600 ohms at sensitivity condition
Squelch/COR.....	Adjustable threshold from noise level to 50 dB above noise. COR holds a nominal 4 seconds after carrier disappears.
Operating Temperature	0°C to 50°C
Size	5.2 inches (132.1 mm) high, 8.0 inches (203.6 mm) wide, 14.38 inches (365.3 mm) deep (WJ-9040 1/2 size unit)
Weight.....	25 lbs. (55.0 kg) maximum
Power Consumption.....	25 watts
Input Power Requirements	+29 V, +18 V, -18 V, +8 V Supplied by WJ-9040 EFR100
External Reference Required	50 MHz sinwave at 0 dBm with phase noise less than -115 dBc/Hz at 100 Hz, -145 dBc/Hz at 10 kHz

IF BANDWIDTH OPTIONS AND SENSITIVITY

3 dB IF Bandwidth	RF Level (dBm)
10 kHz	-105
20 kHz	-102
50 kHz	-98
100 kHz	-95
200 kHz	-92
500 kHz	-88
1 MHz	-85
2 MHz	-82
4 MHz	-79

AM – Input Signal AM modulated 50% by a 1 kHz tone, will produce a minimum video output (S+N)/N ratio of 10 dB.

FM – Input signal modulated at 1 kHz rate with a peak deviation equal to 30% of selected IF BW, will produce a minimum video output (S+N)/N ratio of 17 dB. (Note: A 400 Hz rate is required for 10 kHz and 20 kHz IF Bandwidth.)

WJ-8628-4 RECEIVER CONNECTIONS

Twenty-five (25) Pin D Series Male Connector supporting the standard WJ-9040 System digital control I/O, DC input voltages and System Polled I/O structure.

RF SMA Female Connector
SM Output SMA Female Connector
Selected Video Output SMA Female Connector
IF Output SMA Female Connector
50 MHz Reference Input SMA Female Connector

Auxiliary I/O Connector 9 PIN SRE Female Connector

Pin Assignments:

Ground
FM Audio Output
AM/CW/SSB Audio Output
Squelched Audio Output
Signal Strength Output (Analog 0 to +10V)
Carrier Operated Relay Control (open collector, 30 mA sink to ground for switching +24 Volt maximum external voltage)
Carrier Operated Squelch (0 or 5 Vdc)
AFC

WJ-8628-4 OPTIONS

SSB Demodulation

500-1100 MHz Frequency Extender
Selectable Dual Antenna (RF) Inputs
Log Detection
Digitally Refreshed Display Output

WJ-9040

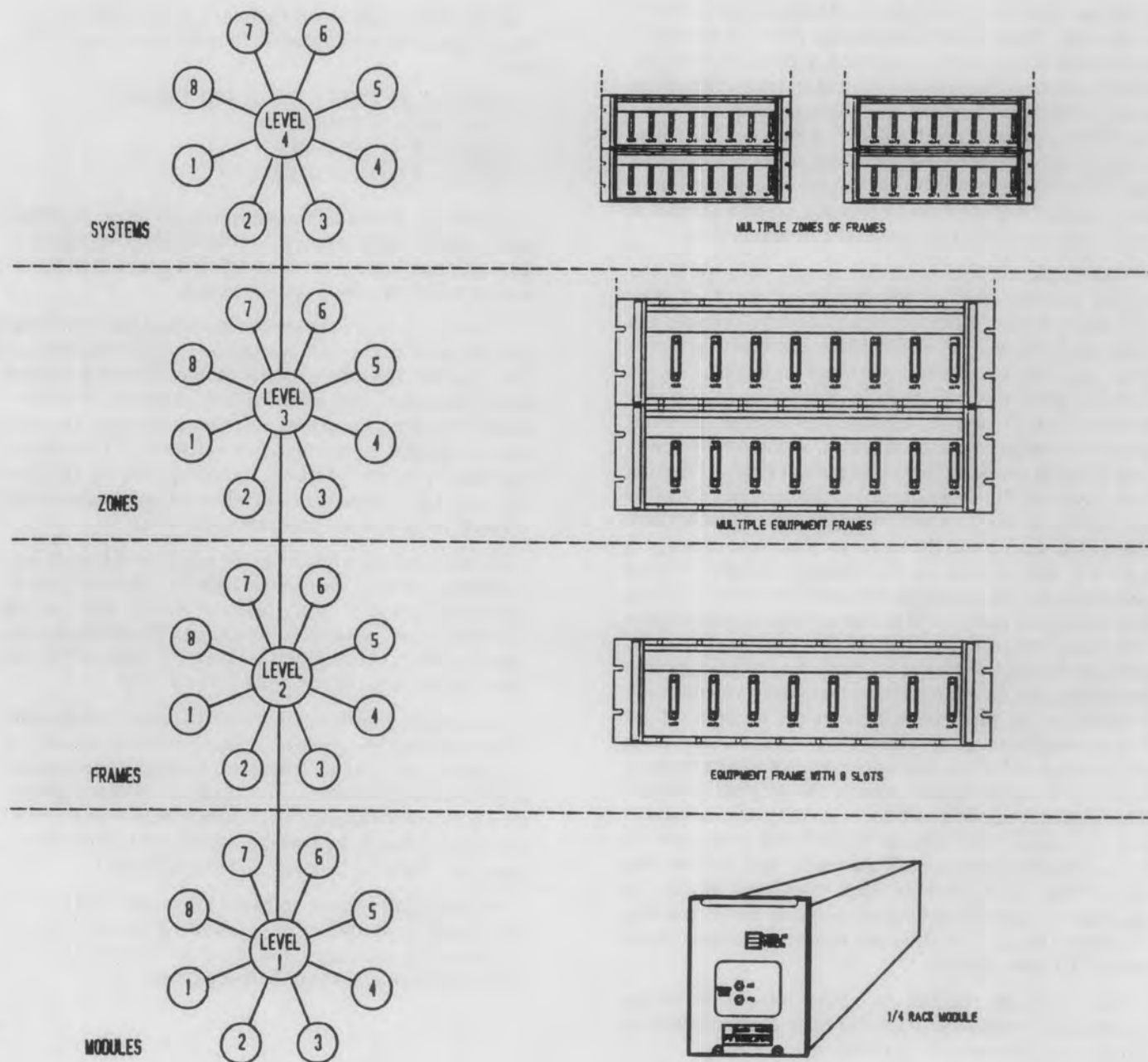
SYSTEM SOFTWARE

This section of the WJ-9040 Designer's Handbook describes the software inherent in the WJ-9040 system. It describes the overall structure of the software, each of the various system levels, how the different levels interact and how the software enhances the user interface to the system.

Software Structure

The WJ-9040 system is organized into four separate levels; the System, the Zone, the Frame and the Module. These levels are arranged in a hierarchical star network.

In this network, a particular unit, at a priority level, controls eight units of the level below it. In the WJ-9040, a System could contain up to eight different Zones, or Zone levels. In turn each Zone could consist of eight different Frames, or Frame levels, with each Frame containing up to eight different Modules. Because each level contains its own software, a user may split-up or reconfigure the WJ-9040 to meet any need. The WJ-9040 may also be configured as a sub-system with only a single Zone with up to eight Frames, or possibly just a single Frame with up to eight Modules. Figure 4-1 shows the WJ-9040 system structure.



WJ-9040 Modular Receiving System Architectural Concept
Figure 4-1.

The different levels in the WJ-9040 are connected via interface units. These units are known as the System Interface Unit (SIU), the Zone Interface Unit (ZIU) and the Backplane Interface, which resides in an equipment frame. The SIU connects up to eight different Zones to a System, the ZIU connects up to eight different Frames to a Zone, and the Backplane Interface connects up to eight different modules to a Frame. The SIU and the ZIU use a serial I/O over a 50 ohm coaxial cable to connect the System level to its Zones and the Zone level to its Frames, respectively, while the Backplane Interface uses synchronous serial data utilizing a 25 pin D-type connector to connect the Modules to a Frame.

In a WJ-9040 system there are nodes, which are locations where communication with units of other levels is possible. These nodes include the SIU and the ZIU, which have already been mentioned, and the I/O Module (IOM) which resides in an equipment frame and connects to the Backplane Interface via a 37 pin D-type connector. The IOM also connects to a ZIU or a System Controller via a 50 ohm coaxial cable, or a user selected controller via IEEE-488 or RS-232C in the case of a single frame sub-system. Each of these nodes contains software that is particularly used for the interlevel communication.

The interlevel communication is only initiated by the higher priority level of the two levels involved. The protocol for this interlevel communication involves the sending of information with hardware and software error checking. The hardware error checking appears in the form of the Universal Asynchronous Receiver/Transmitter (UART) used to transmit and receive the serial data over the 50 ohm coaxial cable. The UART does its own internal checking for errors such as Parity, Framing and Overrun. The software error checking begins when the sender of the original message creates a checksum that is sent along with the message. When the message is received, the receiver of the message creates its own checksum for that message and then compares it to the checksum that was sent. If the checksums match then the checksum is returned as the acknowledgement that the message was received correctly, however, in the event that the checksums do not match, an error acknowledgement is sent in the form of a byte equal to zero. If no acknowledgement is received back by the sender in a defined amount of time, or an error acknowledgement is received, then the sender repeats the original message. This sequence can occur a maximum of three times, at the end of which, if the message has still not been received and acknowledged correctly the sender sets an error flag to tell the operator that there has been at least a temporary failure in the communication between levels. Figure 4-2A and 4-2B show the error checking structure of the WJ-9040 System.

The messages referred to above have a particular format that is followed in the WJ-9040 system structure. This format consists of the following:

ADDRESS	Zone, Frame, & Unit #
INSTRUCTION	Specific system command
DATA	Information used in the command

CHECKSUM	Summation of all previous bytes
TERMINATOR	(all bits = 1) End of Message

The maximum length of any message is thirty-two bytes, and can include specific module instructions, application program instructions, or system instructions. The minimum length a message may be is three bytes which could contain simply an instruction, a checksum, and a terminator (e.g., the 'Request To Send' message used to ensure communication between levels). All messages return an acknowledgement and some messages require a response from the receiver of the message. This response takes the same format as shown above for the original command message.

It has been mentioned that each node contains software. This software appears in four different forms. They are:

OPERATOR INTERFACE SOFTWARE
SYSTEM SOFTWARE
MODULE SOFTWARE
APPLICATION SOFTWARE

Operator interface software resides in a WJ-9040 controller, and allows the operator to enter commands in an understandable manner and then it converts the commands to the WJ-9040 system format.

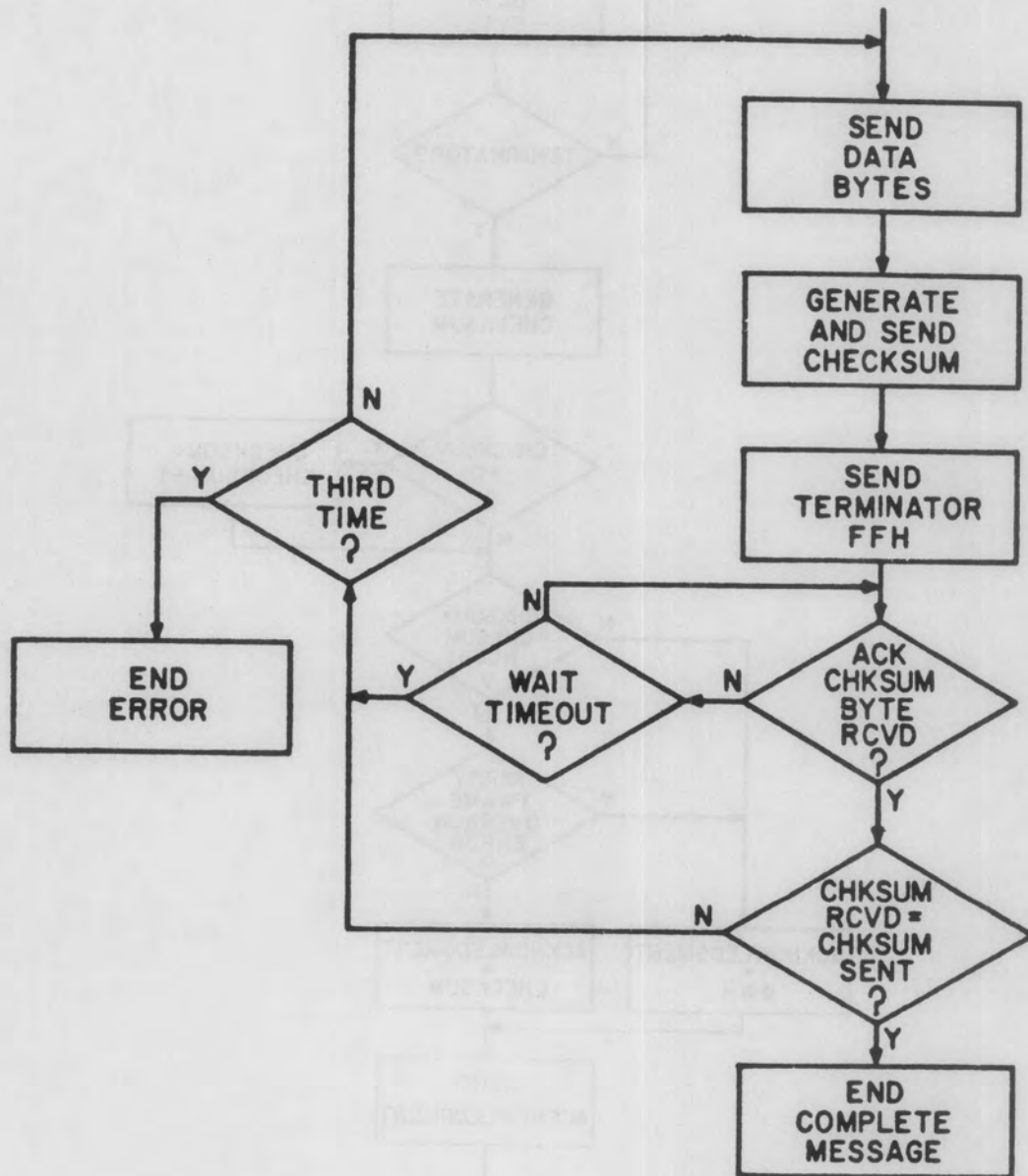
The System software resides in each of the nodes that handles interlevel communication. The System software can also take the interlevel communications and convert the commands so that a particular module can understand them. However, the system software portion of a node is more than just communication software; it controls all the housekeeping functions, including keeping the time of day, and controlling the flow of application and module programs for that particular level.

Module software resides in the equipment frames (i.e., IOM) that handles the routine updates and procedures of particular modules (e.g., receiver AFC). The module software is also used to communicate via the backplane interface with the modules to keep the operator up-to-date on the status of the units in the system.

The application software, which resides in either the Zone or Frame level, allows different modules to interact in order to perform a particular function or application. (e.g., Using a DF processor to take Lines of Bearings each time a memory channel becomes active.) (NOTE: Tasks are always done at the lowest possible level to enhance the speed at which the task can be accomplished.)

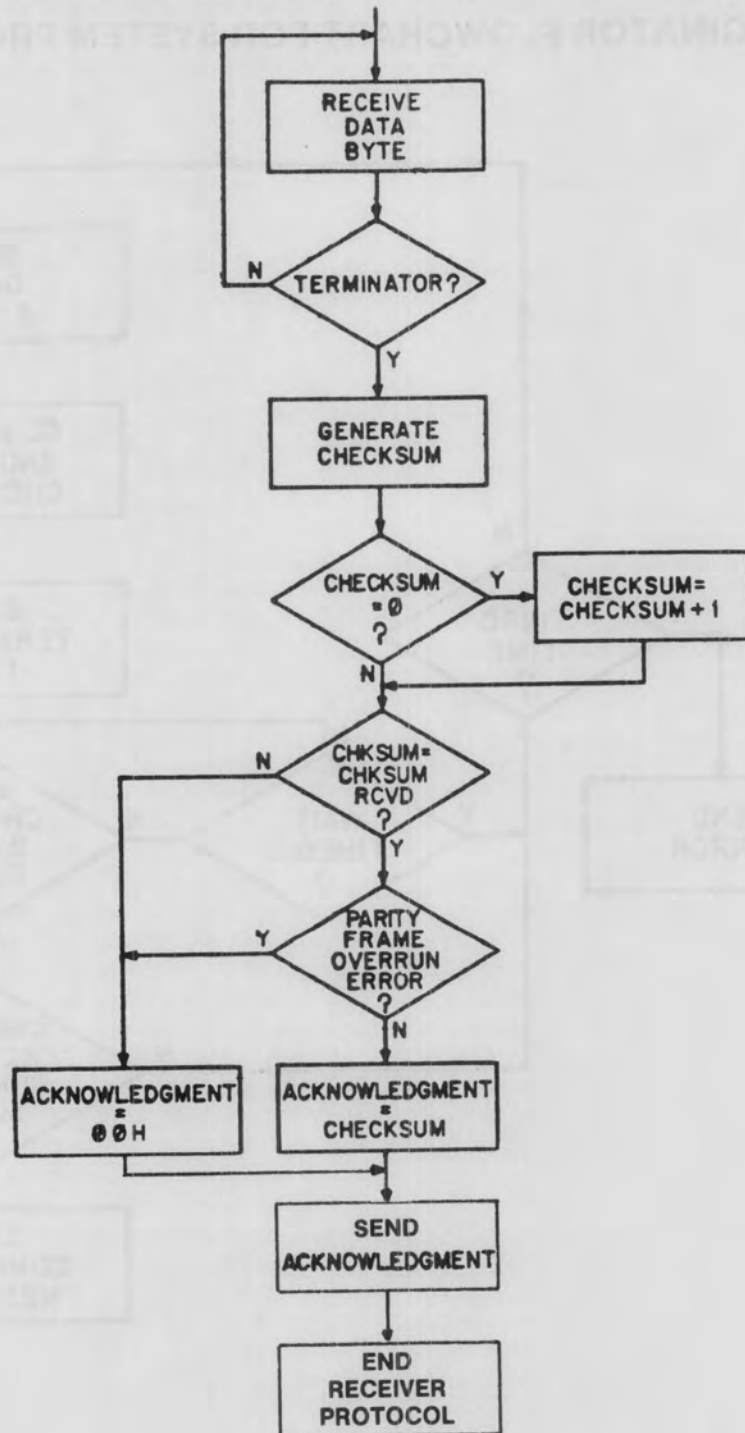
Not all of the above software types are in each level (e.g., module software). The following paragraphs will discuss what software types are in each level, and how those software types vary between levels.

ORIGINATOR FLOWCHART FOR SYSTEM PROTOCOL



WJ-9040 Modular Receiving System Error Checking Structure
Figure 4-2A.

RECEIVER FLOWCHART FOR SYSTEM PROTOCOL



WJ-9040 Modular Receiving System Error Checking Structure
Figure 4-2B.

Module Level Software

The Module level consists of the modules themselves. There are different types of modules in the WJ-9040 system. Some are 'dumb' modules (i.e., without a microprocessor and software), some are 'smart' modules (i.e., with a microprocessor and software), and some have no direct contact with the IOM at all (e.g., an X-Y Display).

The 'dumb' and 'smart' modules connect, via the backplane interface, to the IOM in an equipment frame. Both types of modules have a certain amount of communication with the IOM through the backplane. For 'dumb' modules, this communication consists of a "configurator read" and a "change complete status" (see Frame Level Software in this section for more information on configurators and backplane communication). Along with the 'configurator read' and the 'change complete status,' the 'smart' modules have messages associated with them that deal with particular aspects of the individual units.

The software that resides in the 'smart' modules is used to interface with operators (units that have an operable front panel), to communicate with the IOM, and to control the general upkeep of the particular unit it resides in. In some cases, the software also has handoff or master/slave capability to allow control of other modules by way of the IOM. This means that in some cases the module can be a version of a dedicated controller (i.e., a controller for a particular type of module only).

Frame Level Software

The Frame level, or more specifically the IOM, uses memory partitioning for its software. This partitioning is done to enhance future use of mass storage devices to download individual software packages directly into the IOM memory. The memory partitioning consists of assigned memory portions for system software, module software, application software and RAM for each of the portions.

The system software portion in the IOM is used for communication to a ZIU. The system portion reports back with module information using the WJ-9040 system protocol (see Software Structure in this section for more information on WJ-9040 system protocol) when the ZIU requests it, and decodes and executes commands when the ZIU sends them. Another function of the IOM system software is to monitor, by way of configurator codes, which modules are in the equipment frame that houses the IOM. A configurator is a sixteen bit defined code that tells the IOM what type of module is in a particular slot in an equipment frame, and gives specific details about that module (e.g., frequency range of a receiver).

The module software portion in the IOM is used for communication with the modules themselves. This is done serially through the backplane interface. The module software in the IOM also keeps track of module parameters, and updates module status when necessary.

Application software in the IOM can take one of two roles. The first is the running of an application program when the modules needed for the application program all

reside in the IOM's equipment frame, and the second is the collection of data to be used by a unit in another equipment frame. The latter is done by collecting the data needed from the module and, when requested, sending the data to the ZIU to be transferred to another unit in another equipment frame.

Zone Level Software

Like the IOM, the ZIU also contains memory partitioning. The reasons for using memory partitioning are the same as for the IOM in that a future enhancement of the WJ-9040 system may be to download applications programs from a mass storage device to allow for different scenarios. In the ZIU, the memory partitioning is divided between system software and different applications programs.

The system software portion of the ZIU handles the communication with the System level, and with the Frame levels within that Zone. The system software portion also monitors which Modules are in each of the equipment frames within the Zone in order to link different modules together to perform tasks within an application program.

The ZIU contains a mini-operating system and uses multitasking to allow the ability to run up to four different applications programs concurrently. These applications programs allow the operator to incorporate units that are plugged into different equipment frames in the performance of a particular task. These programs can also collect data for a desired period of time and then dump the collected data to a user defined device (e.g., Printer, CRT, etc.). In general, the application program portion of the ZIU routes information from one unit to another within its Zone to complete a specific task, thus enhancing the speed of execution of that task while leaving the operator free for more important work.

User Interface To System Software

The WJ-9040 system may be controlled by three different methods. The first being a user selected computer or terminal via the IEEE-488 or RS232C interfaces. The second is a Master Receiver, which can control an entire Zone as well as the receiver built into it. And the third is a WJ-9040 system controller, which would be able to control all the modules in the WJ-9040 system setup.

The system controllers and the Master Receivers both display details regarding particular units or applications programs, along with descriptions and error messages to enable the operator to control the system or sub-system with greater ease. A user selected controller may also have these features, and more, depending on the software written for that particular controller.

The external I/O, via IEEE-488 or RS232C, can be connected to the system by way of the SIU in a system, the ZIU in a single Zone sub-system, or the IOM in a single Frame sub-system. (NOTE: The WJ-9040 system is setup to receive commands in an ASCII format over the IEEE-488 or RS232C interfaces). Control of the WJ-

9040 system by a user-selected controller (e.g., a computer) allows the user to easily manipulate the data being collected by the system in any way that the user so desires. A computer controlling the system also allows the collected data to be presented in any number of forms while leaving the WJ-9040 system free to collect more data. Command protocol and data format information for controlling the modules and frames on the IEEE-488 and RS232C digital busses are included in the section three (System Hardware) data sheets. Automatic range checking is performed by smart modules and error messages generated and passed to the frame IOM.

A Master Receiver (e.g., WJ-8626A-4 or WJ-8628-4) is a half-rack front panel receiver with the capability to connect, via 50 ohm coaxial cable, to either a ZIU or an IOM. This capability allows the Master Receiver to control other receivers in other equipment frames. Because the Master Receiver can only control receivers, it is a form of dedicated controller. In addition to being a controller, the Master Receiver also has a receiver inside of it, allowing the operator to locate desired signals before handing the status off to a slave receiver. Another advantage to using a Master Receiver is that it fits right into the system in an equipment frame as a half-rack module and is already set to the WJ-9040 system protocol, thus speeding up the control of other modules.

A WJ-9040 system controller is a unit that can be connected to a SIU to control an entire system, a ZIU to control a single Zone, or an IOM to control a single equipment frame via a 50 ohm coaxial cable. The difference between this type of controller and the Master Receiver is that the system controller can control any type of remotely controllable module that can be plugged into the system. The system controller also uses the WJ-9040 system protocol so that the speed is about the same as a Master Receiver. The advantage to using a system controller would be the speed and vast flexibility involved in controlling any type of remotely controllable module in the system. The speed advantage includes canned programs, such as applications programs, that can be run faster and more efficiently than programs residing in an external controller (i.e., computer connected via IEEE-488 or RS232C), although an external controller has more of a capacity for data storage.

The three controllers discussed above all have advantages depending on the need of the user. In general, however, all three controller types offer similar features, such as the ability of easy access to the system by a human operator in both command input to the system, and data collection and retrieval from the system. With these controller types, the operator may select features, functions and applications that can be translated into WJ-9040 system commands, and then configure the output to a desired format and send it to a desired output device, such as a printer, a CRT, the display of a controller, or a computer via the IEEE-488 or RS232C.

In summation, the WJ-9040, because of its abundance of software at each of the nodes, can be a very powerful

tool that can be reconfigured to meet specific functions while requiring only a minimum number of operators to operate the system, using a controller of their choice.

WJ-9040

SYSTEM DESIGN GUIDELINES

Rev. A, 8/84

SYSTEM DESIGN GUIDELINES

In order to effectively employ the advantages of the WJ-9040 System concept, it is important to understand how this concept can be translated into hardware and software configurations to meet particular mission profiles. The **System Design Guidelines** presented will illustrate by example how to easily build a system in terms of:

- Matching the Configuration to the Mission
- Determining System Capability Requirements
- Module Selection
- System Interface
- Configuring Rack Elevations
- Environmental Considerations
- Power and Weight Schedules
- System Installation

A System Design Worksheets section is provided to aid the system designer in these tasks.

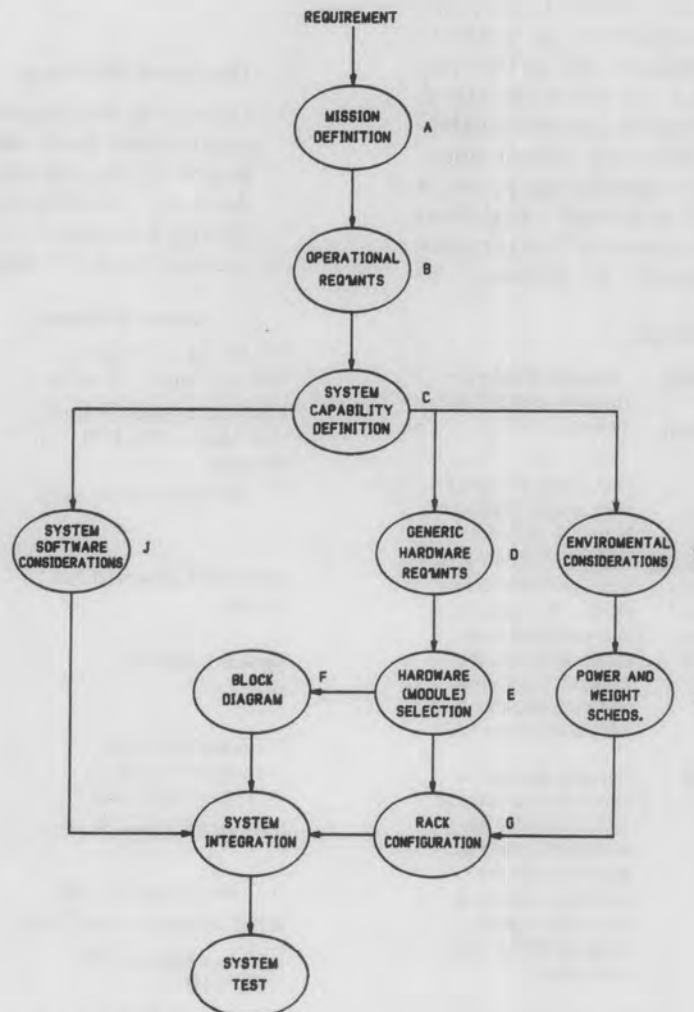
Mission Vs. System Configuration

In general, mission tasking will dictate operational

requirements (system functions), module selection (hardware) and software considerations. The system designer's initial effort is the mission tasking. This aspect usually starts with determining whether the requirement is COMINT, SIGINT, DF, a particular ESM function or a combination of these activities. Further, a definition of the frequency range, type of control (manual operator control, remote digital control or a combination of both) must be established. Also, the platform and its environment should be considered in the initial definition stage so that as the system configuration is established it will ultimately match environmental and human engineering requirements.

Configuration Examples

Once these definitions are established it is a relatively straightforward effort to determine detailed system design. To illustrate this point, the following example is given which provides typical decision paths between mission and system configuration.



WJ-9040 SYSTEM DESIGN DECISION PATHS

Figure 5-1.

SYSTEM DESIGN GUIDELINES

Rev. A, 8/84

Example:

A. Mission Definition:

Airborne, communications signal collection over the 5 kHz to 440 MHz frequency range.

B. Operational Requirements:

Manual, operator controlled collection system to provide the following:

1. Manual and semi-automatic signal acquisition over the full 5 kHz to 440 MHz frequency range.
2. Signal hand-off and monitor capabilities.
3. Operation from 400 Hz, 115 Vac aircraft prime power.
4. Self-contained, transportable configuration for rapid carry-on/carry-off installation.
5. Hard copy printout of signal and system status data for after mission analysis.

C. System Capability Definition:

At this point, capabilities of a system to meet the requirements are to be established. In order to accomplish this, the system designer uses the information presented in Sections 3.0 and 4.0 of the Handbook. This information presents the features, capabilities and specifications for individual system equipments. By making reference to specific equipment, it becomes a matter of selecting module capabilities which best match system requirements. For the given mission example, one proceeds as follows:

D. Generic Hardware Requirements:

Requirement	Needed Capability	Generic Hardware
Airborne COMINT System	Transportable, Carry-on/ Carry-off, 2-man	Transit Case(s) Based System
Signal Acquisition in 5 kHz-500 MHz band with AM, FM, CW, and SSB detection modes.	Manual and automatic signal acquisition using scan mode technique over full frequency range. Hand-off of acquired signals to monitor receivers.	Dedicated receivers for each major frequency band; i.e., LF/HF and VHF/UHF, with appropriate detection modes, IF bandwidths and scan/hand-off modes of operation. Manual, front panel and automatic keypad controlled operation.
Signal Monitoring	Monitor multiple hand-off signals simultaneously.	Suitable number of hand-off receivers for each frequency band with appropriate outputs for recorder control/monitoring and visual signal analysis. OEM Tape recorders.

System Control	Manual control with keypad access for mode programming and system status monitoring	System Controller to control operational mode and programming of simultaneous and independent functions. Part of Master Receiver function.
Signal Analysis	(1) Real Time, visual signal analysis (2) After mission analysis	(1) HF-FFT and DXY CRT display (2) VHF/UHF-DXY CRT spectrum display. (1) Data Logger/ Printer with hard-copy out put providing signal parameters and system status.
Ancillary Functions	RF, IF, video and audio distribution. DC power generation.	RF Multicouplers, IF, video and audio select units and appropriate equipment power supplies to accept AC prime power input.

E. Hardware Selection:

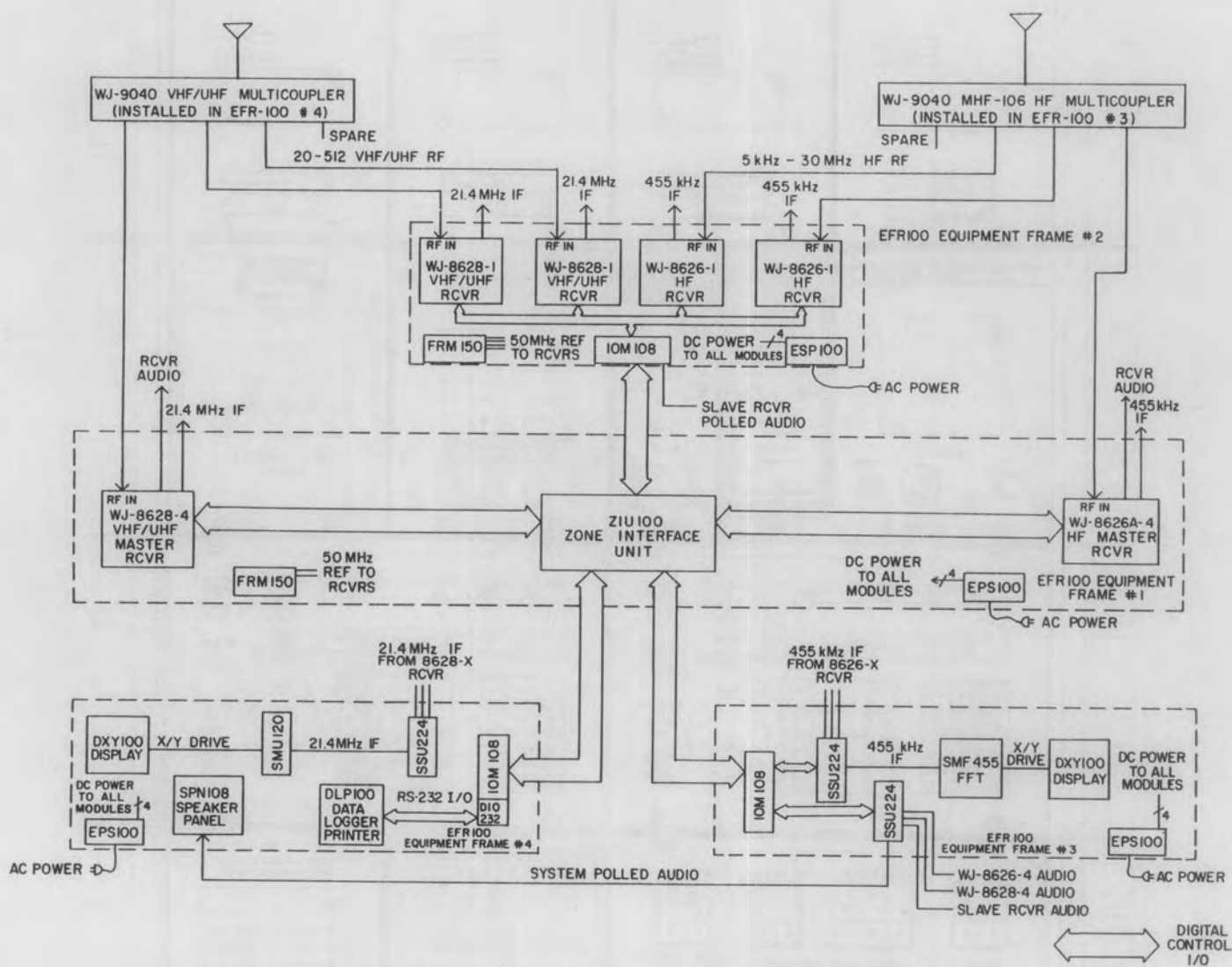
Once the system capability needs and generic hardware requirements have been defined, the system designer begins the task of actual hardware selection. This is done by matching capability needs and resultant generic hardware to WJ-9040 module features and specifications. For above Example:

Generic Hardware	Module Selection
LF/HF Signal Acquisition, Master/ Hand-off Receiver	WJ-8626A-4 LF/HF Receiver (5 kHz- 30 MHz)
VHF/UHF Signal Acquisition, Master/ Hand-off Receiver	WJ-8628-4 VHF/UHF Receiver (20-500 MHz)
LF/HF Hand-off Receivers	4 each WJ-8626A-1 LF/HF Receivers (5 kHz-30 MHz)
VHF/UHF Hand-off Receivers	4 each WJ-8628-1 VHF/UHF Receivers (20-500 MHz)
System Controller	Use keypad/display control features of LF/HF and VHF/UHF Master Receivers
HF Signal Monitor, Frequency vs. time vs. amplitude display	FFT455 and DXY100 display unit
VHF/UHF Signal Monitor	DXY100 Display driven by SMU120 Display Drive Unit.
RF Distribution, LF/HF	MHF106 Multicoupler
RF Distribution, VHF/UHF	MVU106 Multicoupler
IF Select Unit LF/HF, VHF/UHF	2 each SSU106 signal select units
Data Logger Printer	DLP100 Data Logger/ Printer
Microprocessor	IOM108

F. Subsystem Block Diagram

Since the exact module compliment is now established, the next step is to prepare a detailed block diagram of all system elements to illustrate signal

flow, interface connections to "outside" equipments and interfacing between system modules. For above Example, the resultant diagram applies.



5 kHz-500 MHz Signal Surveillance System
Block Diagram

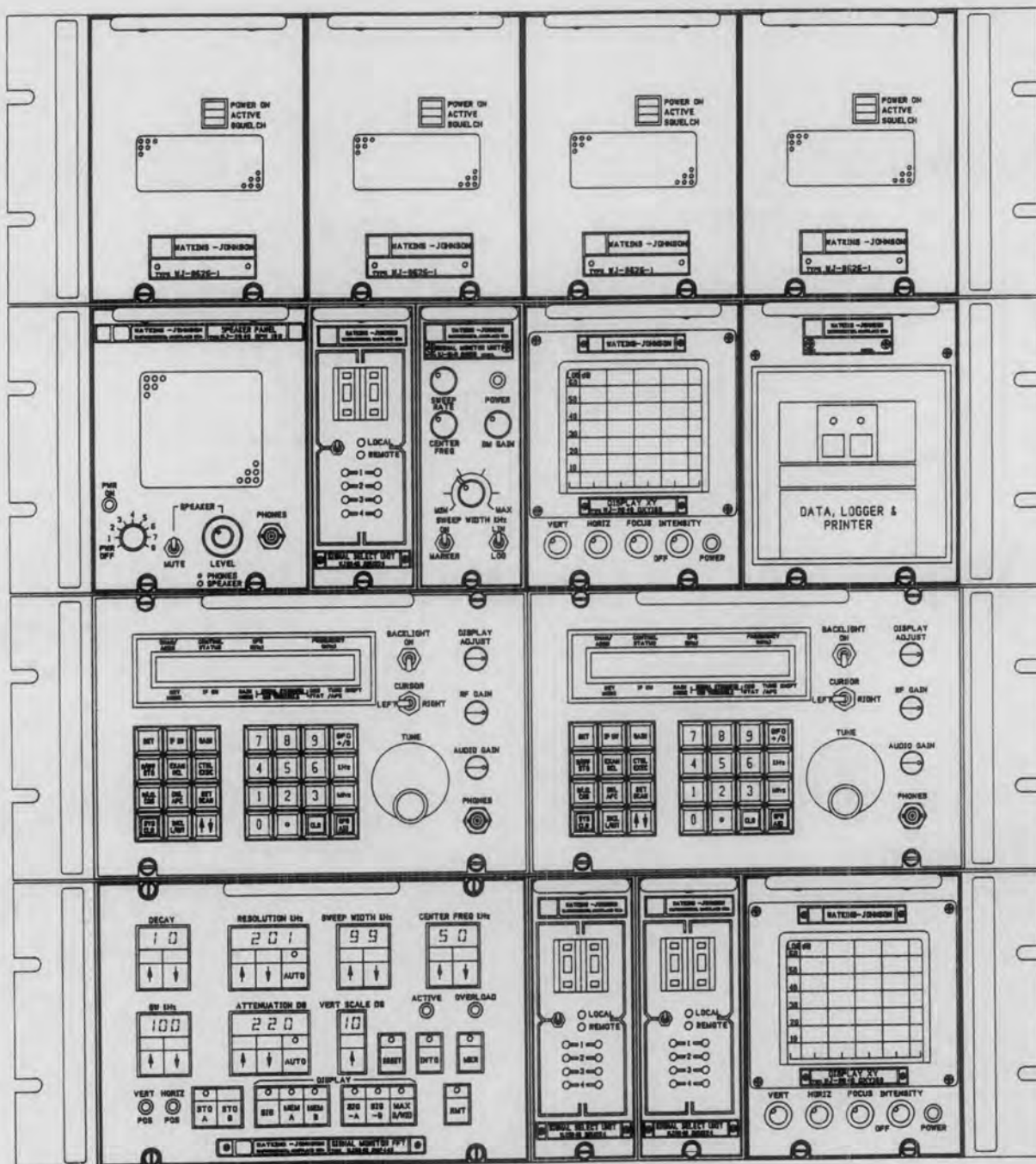
Figure 5-2.

G. Rack Configuration

The system is racked in such a way as to minimize IOM and FRM Modules and to ease operation. For example, the third rack, shown in the figure below, does not require an IOM108 or FRM150 Module. The DLP100 installed in the rack requires connection to a RS-232 Interface which is installed in an IOM108 Module. However, any available IOM108 in the system may be used. Also, by not installing receivers

in this rack, an FRM150 Frequency Reference Unit is not required.

A System Racking Diagram is an important step in determining equipment (particularly frames, FRMs, IOMs) required. While performing this step, the designer should refer to the "Required Equipment" section of the Module Data Sheets and should use the "Stick-Ups" located in the pocket of this handbook.



Typical Rack Configuration
Figure 5-3.

H. Environmental Considerations

The WJ-9040 System is primarily designed for strategic missions in sheltered platforms. The system is capable of operating over a 0°C to 50°C temperature range. For rugged applications such as ship, submarine or aircraft platforms, it is recommended that the system be installed in a standard 19" shock mounted transit case such as those manufactured by Thermodyne International, Ltd. This type case works well in absorbing shock and vibration and numerous WJ-9040 systems have been installed and deployed in rugged areas using this technique.

I. Power and Weight Schedules

In any Receiving System, it is important to consider power requirements and weight limitations. This information is available for each system component on the supplied data sheets.

Total system weight is arrived at by adding the individual module weights, including frame, power supply and I/O module.

Total system power is arrived at by adding the individual power requirement (in watts) of each module together. In addition, power supply inefficiencies must be taken into account. The efficiency of each type (AC to AC, DC to DC, etc.) of power supply is given on the appropriate data sheet. Total system power required is calculated as follows:

$$\text{Total System Power (Watts)} = \frac{\text{Summation of Module Power (Watts)}}{\text{Power Supply Efficiency (\%)/100}}$$

J. System Software Considerations

1. Local receiver subsystem control: If the COMINT system contains operator positions, a convenient means of control is via the front panel keypad/display of the HF and VHF/UHF Receivers (WJ-8626A-4 and WJ-8628-4).

No external software needs to be developed since the front panel of the 1/2 rack receivers automatically generates firmware commands to the 1/4 rack handoff receivers.

It may be advantageous to download new setups or memory information from an external computer. Provision for this is provided by specifying IEEE-488 options for each frame.

2. Larger systems or systems which process the output of signal processing modules may likely require a CRT/keyboard/CPU control of the system. Command protocol for controlling WJ-9040 modules via the IEEE-488 bus are contained in section three (System Hardware).

Specialized computer control systems may be developed and customized by the user. Detailed information on each module's signal and digital interface is contained in the section three (System Hardware) data sheets. Additional documentation may be available by contacting the factory.

The WJ-9040 System software architecture is discussed in detail in section four (System Software) of this handbook.

APPLICATION NOTE

OPERATIONAL SCENARIOS

As demonstrated in previous sections of this handbook the process of applying specific equipment hardware to an operational requirement is accelerated when a system designer has at his disposal a family of receiving components which are common in control, power requirements and mechanical considerations.

The objective of this section is to illustrate the operational attributes of a unified systems approach in terms of operability, configuration flexibility, system growth and system expansion. The vehicle we will use to convey these attributes is the "Applications Note". An Application Note is analogous to a condensed "White Paper" in that it demonstrates a capability by applying it to a specific problem or requirement. In this handbook the requirements will be hypothetical, though based on actual situations.

APPLICATION NOTE

HF MASTER/SLAVE SUBSYSTEM

APN 5.1

Rev. A, 9/84

INTRODUCTION

This, being the first Application Note, will employ a relatively basic WJ-9040 subsystem. It is a single equipment frame HF subsystem which exhibits many of the features found in all WJ-9040 systems.

The scenario to be used in this Application Note involves a HF SIGINT collection and analysis system which has the following operational requirements:

- Frequency and memory scanning of the HF frequency spectrum
- Monitor and recording capability of two emitters simultaneously

Using the methodology described in Section 5.0, the systems designer can take these operational requirements and compose a WJ-9040 configuration capable of accomplishing the required task.

SYSTEM DESCRIPTION

The initial configuration (see Figure 1) consists of the master receiver (WJ-8626A-4), one slave receiver (WJ-8626A-1) and the SPN108 speaker panel. These are front-mounted modules which reside in the WJ-9040 EFR100 equipment frame. A power supply, frequency reference and input/output module (EPS100, FRM150, IOM108, respectively) are resident rear-mounted modules in this configuration. Following are the system mechanical specifications:

Weight	55 lbs
Height	5.25 inches
Width	19 inches
Depth	20 inches
Power Consumption	45 watts

The WJ-8626A-4 receiver/controller is the focal point of control in this collection system. The integral 48-character alphanumeric display allows for a comprehensive means of readily effecting control and gaining status of system operating parameters. Automated control is realized because all components of the system are under control of a common interface bus.

One WJ-8626A-1 HF receiver is included for monitor purposes. The master (WJ-8626A-4) receiver can manipulate all parameters of the slave (WJ-8626A-1) receiver via its own front panel controls. The master receiver can handoff parameters, take over continuous control, or simply monitor the status of the slave receiver. In the monitor mode, the operator is provided with a real time report of receiver activity. All operating parameters which are subject to change, i.e., signal strength and COS status, are continuously updated and displayed on the master receiver display. The receiver settings, i.e., tuned frequency, IF bandwidth, AGC mode, etc. are also displayed.

Audio distribution is accomplished using the WJ-9040 polled audio facility. When a receiver is active, or under control of the master receiver, the microprocessor based input/output module (IOM108) automatically switches the audio from that receiver to the WJ-9040 SPN108

speaker panel. The merit of this feature is far more obvious in a larger system where a single operator is responsible for monitoring several receiver channels.

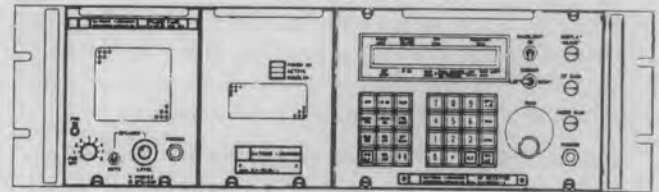


FIGURE 1

OPERATION

Using the front panel controls of the master receiver (WJ-8626A-4), the operator initializes the system prior to beginning collection. Up to 99 memory locations may be loaded with the parameters of known emitters. In addition, a threshold level is stored in each memory location which allows the receiver to ignore noise and other interference and move through all memory channels in less than two seconds. The start and stop frequencies of up to four frequency segments are also stored to accommodate frequency scan routines.

A conceivable mission scenario would commence when the operator initiates back-to-back memory and frequency scan routines. Following is a sequence of events that might follow and typical responses taken by an operator working in the WJ-9040 environment.

After completing one cycle of the memory scan, the frequency scan begins. Immediately the receiver stops scanning and begins the preprogrammed dwell period. While the receiver dwells the operator realizes that the signal being detected is coming from an onboard communications transceiver. The operator inputs the command to "lockout" that emitter from further acknowledgement and continues the routine. The next time the receiver stops the operator quickly analyzes the signal and determines that it is of interest and decides to hand it off and study it further. The handoff command is entered and all operating parameters are passed to the slave receiver (WJ-8626A-1). This quickly frees up the master receiver and the scan continues. Meanwhile, the audio from the handoff receiver is being recorded. The Carrier Operated Relay (COR) drive signal is keeping the recorder on when the emitter is on the air and turning it off during dead time thus making efficient use of tape resources. While performing the scanning routines, the operator can check on the status of the monitor receiver. By activating the "monitor" mode the alphanumeric display is filled with pertinent information relative to the status of the monitor receiver. Real time signal strength and Carrier Operated Squelch (COS) data is included in the status report. Simultaneously, the audio is polled and made available at the headphone jack and speaker of the SPN108. Based on the status report the operator may choose to retune the receiver. A single key stroke will place the receiver into the slave mode and the operator then has full control of the slave receiver.

APPLICATION NOTE HF MASTER/SLAVE SUBSYSTEM

APN 5.1

Rev. A, 9/84

COMPUTER CONTROL

The computer control section of this and future Application Notes will deal with interfacing the WJ-9040 to an external controlling and processing device, i.e., mini computer, personal computer, etc. Specifically, the configuration composed in a given Application Note will be placed under the control of the external device, and pertinent aspects of that interface will be discussed.

The WJ-9040 system can communicate externally via one of two standard interface bus formats; the IEEE-488 parallel and RS-232C serial. Typically, the IEEE-488 interface is used when all components of the system are co-located and distance between devices kept to a minimum. The merits of the IEEE-488 bus include relatively high speed data rates and extended addressing. When excessive distances preclude the use of the IEEE-488, the RS-232C can be implemented. When the RS-232C interface is used in conjunction with a modem, voice grade telephone line and/or satellite link, the distance allowed between equipment is almost unlimited.

Using "English-like" ASCII commands, the external device, hereafter to be called the computer, can control all functions of the system and has access to operating status. In the HF Master/Slave subsystem, the memory channels can be uploaded into the subsystem prior to the mission and downloaded to the computer afterwards. There is an additional feature that the computer can take advantage of in this subsystem. The computer can set up channel scan routines in the slave receivers (WJ-8626A-1), as well as in the master receiver (WJ-8626A-4). An obvious benefit of this feature is the increase in the probability of intercept. A hundred memory channels can be visited in half the time required by one receiver scanning alone. In addition, an extra 100 memory channels are available in the IOM108 which may be accessed by the computer, bringing the total number of available memory channels to 200. In assisting, or acting in the place of an operator the computer can make decisions such as qualifying signals of interest vs. interference (lockouts) based on RF frequency, time of day (TOD) and signal strength.

In subsequent Application Notes, we will build more sophisticated WJ-9040 subsystems which will exploit the benefits of computer controlled systems to an even greater degree. Technological advances in digital processing will be displayed in the Fast Fourier Transform (FFT) spectrum analyzer and the modulation recognizer modules in the next Application Note.

APPLICATION NOTE SYSTEM EXPANSION

APN 5.2

Rev. A, 9/84

INTRODUCTION

As dictated by changing operational requirements, the WJ-9040 can be reconfigured and/or expanded upon with a minimum of time and effort. This is due to the very nature of the WJ-9040 concept. At the equipment frame level there are eight logical ports, as opposed to physical ports. This means that modules can be installed anywhere in the frame and the IOM108 will poll the eight ports and sense the type of module in each slot. The same holds true at the Zone, System and Site levels. Operationally, this enables the system to be quickly reconfigured as requirements change.

Expansion is a feature that was implemented at the conception stage of the WJ-9040 system development. The smallest WJ-9040 system consists of a EFR100 equipment frame loaded with WJ-9040 compatible modules and the largest system would include 512 equipment frames with as many as 4096 modules. This expansion is achieved without an extensive system integration effort.

BASIC SYSTEM

For example, say the outcome of the previous mission (discussed in APN 5.1) yields the following new information about the signal environment:

- high signal density is causing intermodulation problems
- one monitor receiver is not enough to handle excess activity
- increased activity around the high end of the HF spectrum implies that extended frequency coverage may uncover new threats
- auto logging is needed to facilitate after mission processing

The impact on the system capability definition is assessed and the following additions are required:

- automatic preselection in all receivers
- one additional handoff receiver
- a 20 MHz - 100 MHz receiver
- a data logger printer

Finally, the hardware selection is made and the following additional modules are installed into the new configuration:

- WJ-9040 DLP100 Data Logger Printer
- WJ-8626-1 HF Handoff Receiver
- WJ-8627-2 20 - 100 MHz Receiver
- WJ-9040 PHF103 Preselector

Figure 1 depicts the new WJ-9040 system configured to meet the new requirements. As a result of the common control architecture exhibited in the WJ-9040 system, these additional modules may be installed into any slot of either equipment frame.

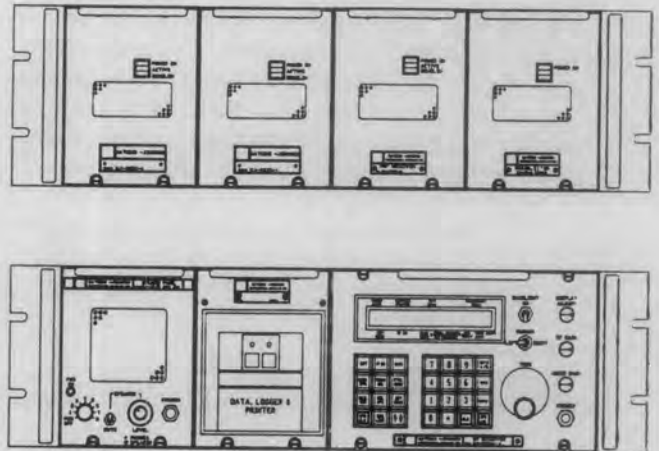


FIGURE 1

EXPANDED SYSTEM

Presently, there are a number of special purpose modules available for the WJ-9040 which enhance the overall capability of the receiving system. These modules allow the operator to do real time signal processing and immediately act on information that would otherwise take days or weeks to acquire.

The system illustrated in Figure 2 includes the following additional modules:

- WJ-9040 SMF455 FFT Analyzer
- WJ-9040 MRU108 Modulation Recognizer
- WJ-9040 SSU224 Signal Select Unit
- WJ-9040 DXY100 X-Y Display

Adding these modules to the previous configuration (Figure 1B) enhances the overall system capability immensely. The system has been transformed from a semi-automatic raw data collection system to an integrated signal processing and analysis work-station. All accomplished with the inclusion of one additional equipment frame and four modules.

The FFT, when used in conjunction with the WJ-9040 DXY100 comprise a digitally refreshed spectrum display capable of providing an extremely high resolution representation of signal activity. Very fast sweep speeds are achievable when viewing narrowband signals.

The WJ-9040 MRU100 modulation recognizer is a device which digitizes receiver IF and performs a number of algorithms to determine the type of modulation used on a given signal. The MRU100 can recognize AM, FM, CW, FSK, BPSK, QPSK, SSB and complex modulation types with a high confidence factor. Once determined, the resultant data is routed back to the operator where he can act on it.

APPLICATION NOTE SYSTEM EXPANSION

APN 5.2

Rev. A, 9/84

The WJ-9040 SSU224 is a wideband digital switch which is used to route IF in this system. This unit accepts commands from the WJ-8626A-4 via the equipment frame input/output module. The SSU224 is used to automatically route IF from the addressed receiver to the modulation recognizer and to the FFT analyzer.

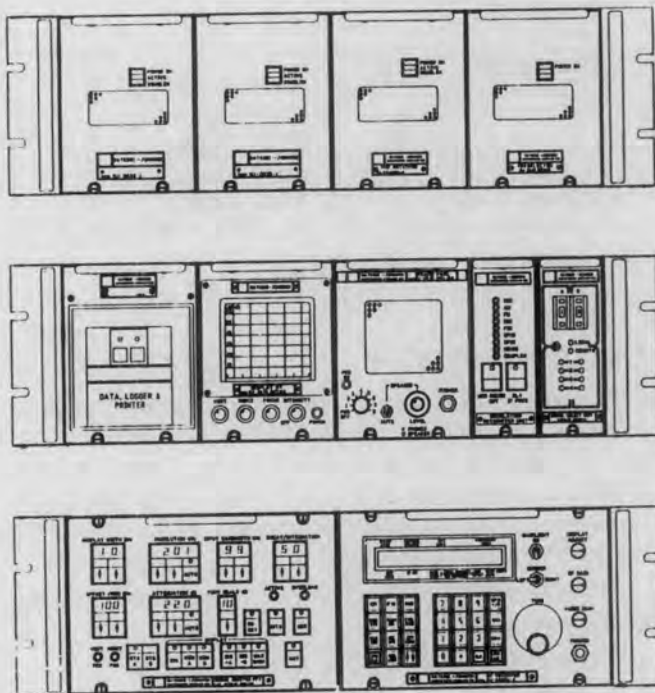


FIGURE 2

From a control standpoint the basic system (Figure 1) is very similar to the one discussed in the first Application Note. The expanded system has some new features which the computer can take advantage of. In earlier systems, the computer could only perform a handoff if the type of modulation was known prior to the mission and was loaded into memory. Otherwise, with as many as five detection modes to choose from, the chances were good that the receiver would be set to the wrong mode. This would result in, at best, distorted audio going to the recorder. With the use of the modulation recognizer (MUR100), the WJ-9040 can switch in the appropriate detection mode based on the input from the MRU, thus enabling an effective handoff by the computer. The MRU also enables the computer to sort the signal environment by modulation type or search the spectrum for a specific type of signal, i.e., FM, FSK, PSK, CW, etc.

The Fast Fourier Transform (FFT) analyzer outputs a high speed stream of digital data which could also be useful to the computer. Peculiar types of signals, such as the ones categorized as "COMPLEX" by the modulation recognizer could be further analyzed and/or stored by the computer.

COMPUTER CONTROL

Discussing computer control in this Application Note will reveal some new and interesting aspects of the WJ-9040 system. One aspect deals with the way in which a computer addresses a WJ-9040 system and the other brings out the digital signal processing capability. Initially, we will touch on the addressing issue.

Since both systems consist of more than one equipment frame, a Zone Interface Unit (ZIU) is required. This will have an impact on the external controller. In situations where a system is comprised of multiple stand alone receiving components, an interface board or module must be placed in each device. This is costly in both dollars and available bus addresses. The WJ-9040 is different in that regard. A system will never have more than one external I/O port per equipment frame. In the case of the 1/8 rack modules such as the modulation recognizer, one IEEE-488 address is enough to communicate with eight units. In systems where a ZIU is used, the external I/O port on the ZIU can serve as a single control point for the entire zone. In terms of 1/4 rack modules, (receivers for instance) that works out to be 32 receivers occupying a single IEEE-488 address.

**SYSTEM POWER
and
WEIGHT WORKSHEET**

SYSTEM NO. _____

DATE _____

CUSTOMER _____

DESCRIPTION _____

RACK #

MODULE	POWER	WEIGHT
TOTAL		

**STICK-UP MODULES
and
FRAME ELEVATION WORKSHEETS**

Directions

The stick-up modules and frame elevations are for your use in configuring your own WJ-9040 Modular Receiving System.

The modules are backed with a special adhesive which enables you to position and reposition them as you work out your system requirements.

Should you need additional stick-up modules and frame elevations for more complex systems, please feel free to request them from the Sales Department of CEI Division, Watkins-Johnson Company.

WJ-9040 SYSTEM DESIGNER'S WORKSHEET
RACK ELEVATIONS
FOR MODULE "STICKUPS"

