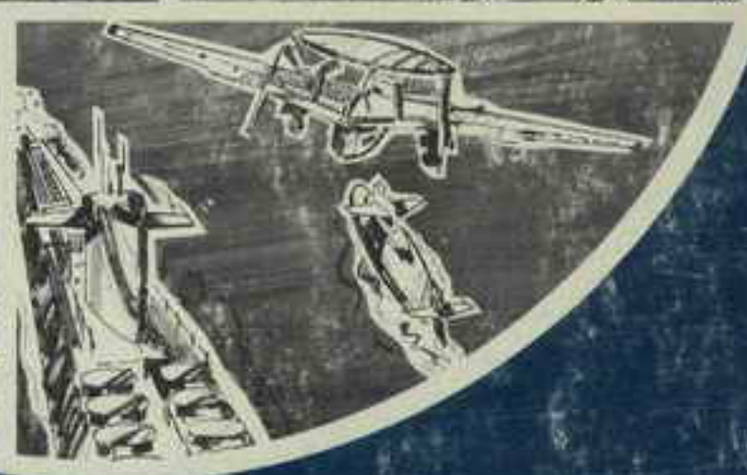
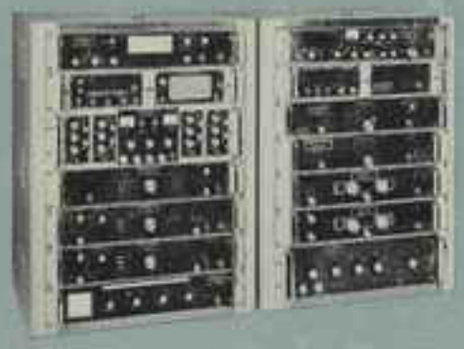
RECEIVERS, RECEIVING SYSTEMS and ANCILLARY EQUIPMENT





WATKINS-JOHNSON COMPANY

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Introduction

Watkins-Johnson was formed in December, 1957, to engage in research, development and production of advanced electron devices and electronic systems. Now employing more than 1200 people, the Company is a diversified electronics firm with manufacturing facilities in the U.S. and overseas. Corporate offices are located in Palo Alto, California. Additional facilities are located in Scotts Valley, near Santa Cruz, California; the Washington Science Center of Rockville, Maryland, near Washington, D.C.; Windsor, England, 30 miles west of London; Munich, Germany; and Rome, Italy.

Watkins-Johnson offers the world's largest selection of receiving equipment for surveillance, direction finding and countermeasures. This array of precision products covers frequencies from 1 kHz to 18 GHz and includes units with built-in signal monitors and counters. Separate signal monitors, demodulators, frequency extenders, converters, preamplifiers, multicouplers, antennas, digital readouts and other accessories (such as speaker units, meter panels and mounting frames) are also available. The excellent field reliability of W-J products results from a combination of conservative design and careful performance of in-house manufacturing operations.

The Company also offers a proven capability for developing entire special-purpose reconnaissance and surveillance systems on a turnkey basis. These systems incorporate the latest state-of-the-art components and systems concepts, including computer operation, remote control, unparalleled sensitivity and dynamic range, optimum human engineering, operation in extreme environments, MIL-SPEC documentation, on-schedule production at a high rate, and effective field support. The products shown in this catalog represent a small cross-section of W-J's proprietary line. For complete details on the many modified and special equipments available, contact our local Representative or W-J Applications Engineering.

Watkins-Johnson - Palo Alto facility

Watkins-Johnson - Rockville facility

General Sales Information

ORDERING INFORMATION — UNITED STATES

Purchase orders for W-J products in this catalog may be placed with Applications Engineering or Customer Service at the Palo Alto location, or Sales at Rockville.

QUOTATIONS

Customers may obtain quotations on any of W-J's products by contacting Applications Engineering or Customer Service at the Palo Alto location, Sales at Rockville, or the local Representative and outlining requirements.

SHIPPING

Shipments are normally made by surface carriers FOB point of shipment to the customer's place of business. Premium transportation methods used by W-J ensure safe, quick and dependable service.

FIELD RETURNS

If it is necessary to return a product, contact Applications Engineering or Customer Service at the Palo Alto location, Sales at Rockville, or our local Representative and give full details.

SERVICE

W-J maintains an experienced group of Applications Engineers at the home office and in the local sales offices to assist in answering technical questions about our products and their application. The services of our engineering and technical staff are also available.

ORDERING INFORMATION — OVERSEAS

Watkins-Johnson International, a subsidiary of W-J, operates sales offices in Palo Alto, California; Rockville, Maryland; the United Kingdom, West Germany, and Italy. There are Representatives' offices located throughout Europe, the Mediterranean, Japan and Canada. The locations of these offices are shown on the opposite page. Orders may be placed with any sales office or the representative office nearest you.

SALES REPRESENTATIVES

DOMESTIC

ALABAMA
Gentry Associates, Inc.
Rm. 422, 2109 W. Clinton
Huntsville 35805
Telephone: (205) 534-9771

CONNECTICUT
See Massachusetts

DISTRICT OF COLUMBIA
Watkins-Johnson
6006 Executive Blvd.
Rockville, Md. 20852
Telephone: (301) 881-3300
TWX: 710-824-9603
Telex: 89-2558
Cable: WJCEI

FLORIDA
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550 N. Bumby Avenue
Orlando 32803
Telephone: (305) 841-7740

GEORGIA
Gentry Associates, Inc.
P. O. Box 13513, Station K
Atlanta 30324
Telephone: (404) 233-3816

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See Alabama

MAINE
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Rockville, 20852
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TWX: 710-824-9603
Telex: 89-2558
Cable: WJCEI

MASSACHUSETTS
Lancer Associates
16 Adams Street
Burlington 01803
Telephone: (617) 272-6445

MISSISSIPPI
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NEW HAMPSHIRE
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(Albany, Syracuse, Utica, Schenectady)
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6666 Old Collamar Road
E. Syracuse 13057
Telephone: (315) 437-6666

NEW YORK
(Rochester, Buffalo Area, Niagara Falls)
Ossman Instruments, Inc.
2425 Clover Street
Rochester 14618
Telephone: (716) 271-4565

NEW YORK
(Ithaca, Binghamton, Endicott, Oswego, Corning)
Ossman Instruments, Inc.
Vestal Parkway East
Vestal 13850
Telephone: (607) 785-9947

NEW YORK
(Wappinger Falls, Poughkeepsie, Troy)
Ossman Instruments, Inc.
P. O. Box 207
Wappinger Falls 12590
Telephone: (914) 297-7777

NORTH CAROLINA
Gentry Associates, Inc.
116 E. O'Neal Ave.
Burlington 27215
Telephone: (919) 227-2581

RHODE ISLAND
See Massachusetts

SOUTH CAROLINA
See North Carolina

TENNESSEE
See Alabama

TEXAS
(San Antonio Area)
John W. Casey, III
Route 10, Box 189
San Antonio 78216
Phone: (512) 694-2911

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See Massachusetts

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6006 Executive Blvd.
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Telephone: (301) 881-3300
TWX: 710-824-9603
Telex: 89-2558
Cable: WJCEI

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Racal Electronics Pty., Ltd.
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Telex: 20365
Cable: RACALAUST SYDNEY

BELGIUM
Telindus N. V.
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Brussels 18
Telephone: 44.48.26/27
Telex: 22760
Cable: INKOHA-BRUSSELS

CANADA
Electromechanical Products
Markham Road
Agincourt, Ontario
Phone: AXminister 3-7011

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Telephone: ASTA 7071
Telex: 5749
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AIRTRADE-COPENHAGEN

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Telegram: HEDOY-Helsinki
Telex: 12-1110

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Cable: WJDBM-MUNCHEN

HOLLAND
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Koning en Hartman N. V.
Koperwerf 30
The Hague
Telephone: 67.83.80
Telex: 31528
Cable: INKOHA-THE HAGUE

INDIA
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16-B Connaught Place
New Delhi-1
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Cable: OCRAP-NEW DELHI

ISRAEL
STG International Ltd.
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Tel-Aviv
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Telex: 033-229
Cable: SLOTUGI-TEL-AVIV

ITALY
Watkins-Johnson Internat'l
Piazza G. Marconi, 25
Roma-Eur, Italy
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Telex: 16435
Cable: FEIRING-OLSO

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SWITZERLAND
Megex G. M. B. H.
8048 Zurich
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Watkins-Johnson Company

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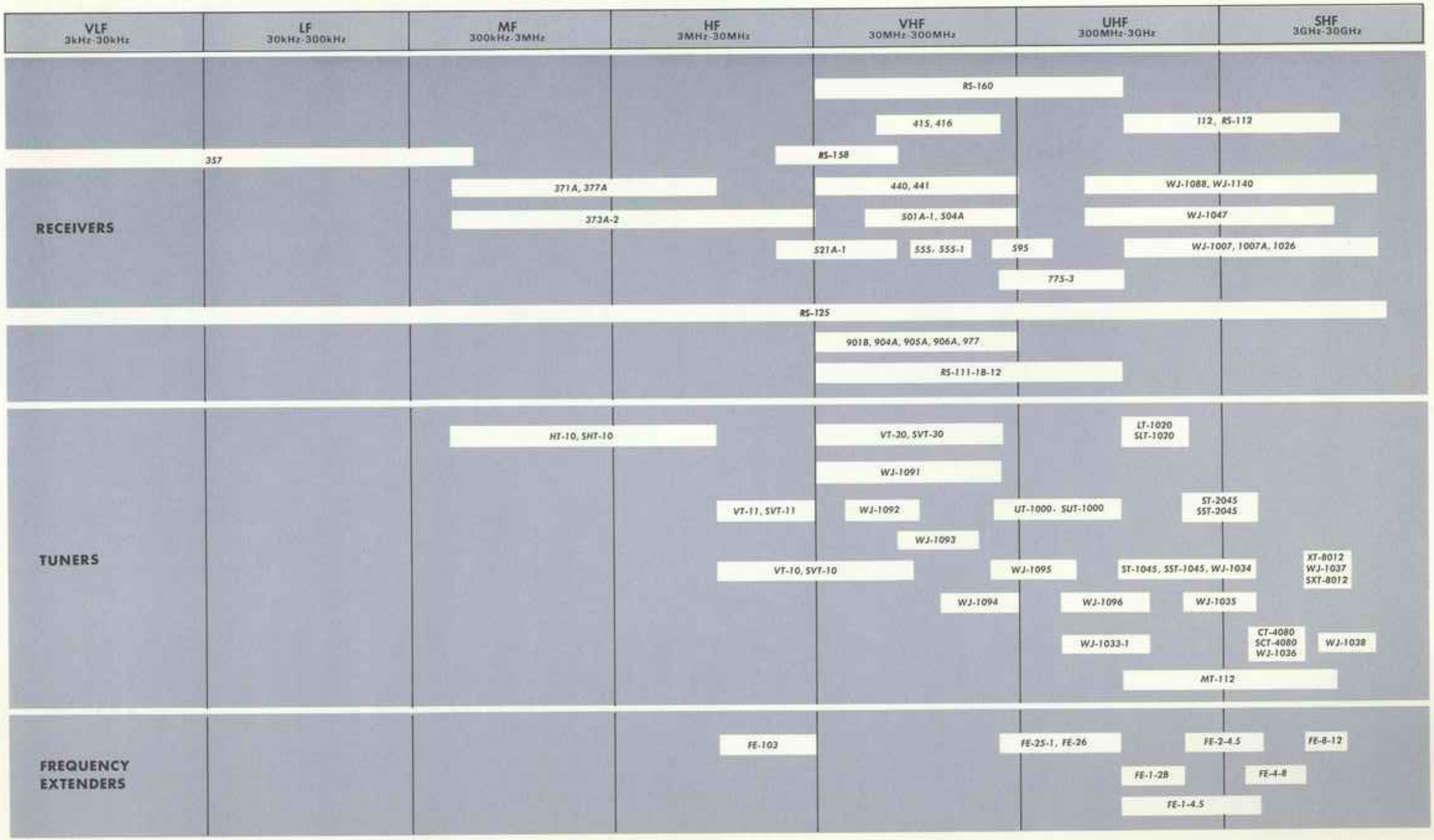
3333 Hillview Ave., Stanford Industrial Park, Palo Alto, Calif. 94304 (415) 326-8830 TWX: 910-373-1253 TELEX: 34-8415 CABLE: WJPLA

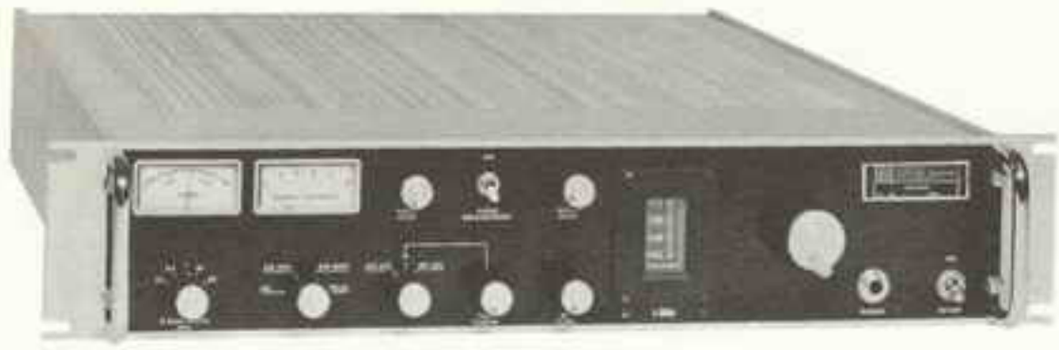
Receiver Selection Guide



NOTE: See page 40 for summary of antennas recommended for use with these receivers.

112 MICROWAVE RECEIVER

For reception of AM, FM, and pulse signals in the 1 to 12 GHz range. Four modular tuning heads are available. any one of which can be mounted in the receiver at a time. TH-120 tuning head covers 1-2 GHz; TH-240, 2-4 GHz; TH-480, 4-8 GHz; TH-812, 8-12 GHz. Five IF bandwidths: 100 kHz and 2, 4, 10, and 20 MHz. For other equipment covering this frequency range, see the MT-112 Tuner and DM-112 Demodulator shown in a subsequent section. The MT-112 includes all four tuning heads; DM-112 has IF bandwidths listed above plus a built-in signal monitor.

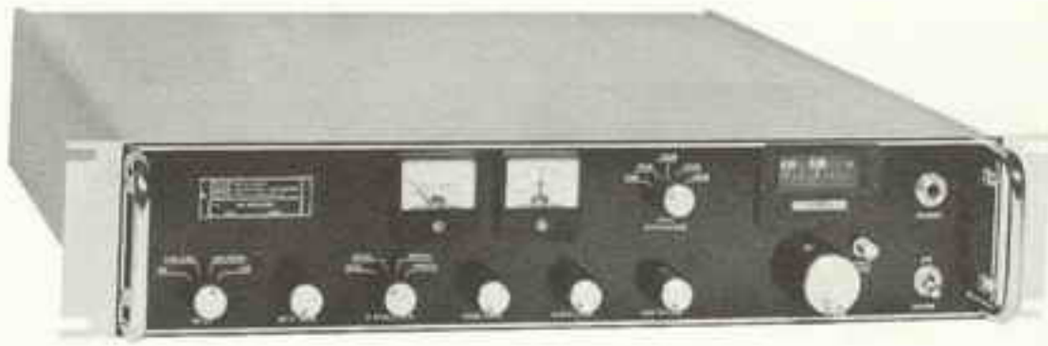


357 RECEIVER

Covers the 1 kHz to 600 kHz frequency range in a single band. Four IF bandwidths: 150 Hz, 1 kHz, 3 kHz, 6 kHz. Four-digit Nixie displays frequency to which receiver is tuned. Digital automatic frequency control (DAFC) circuit stabilizes receiver's local oscillator to ±10 Hz of the desired frequency.

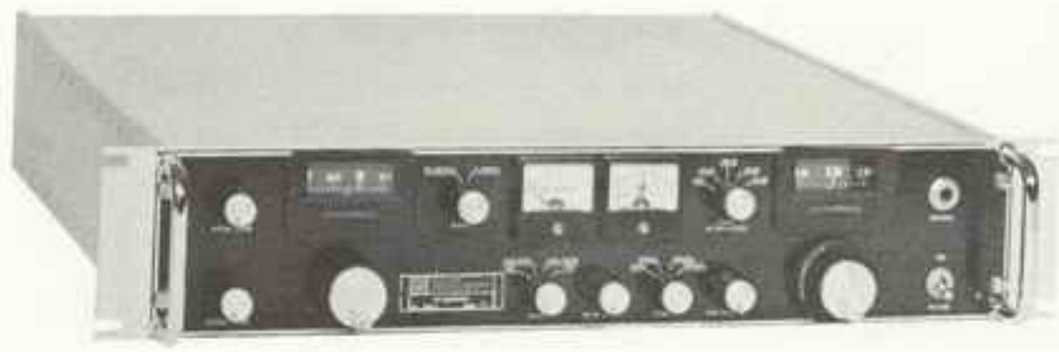
371A HF RECEIVER

HF Receiver featuring wide bandwidth covers 500 kHz to 10 MHz in one band. Designed for FM, AM, or CW reception over entire range. Particularly suitable for RFI detection and predetection recording. Includes IF bandwidths of 6, 20, 100, and 400 kHz.



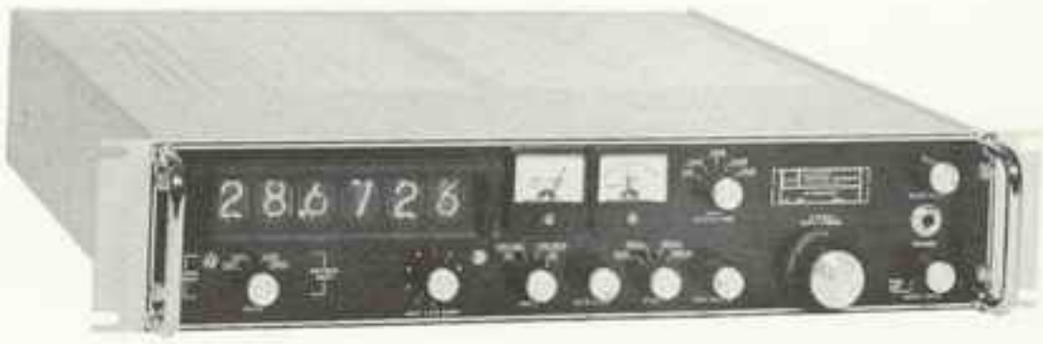
373A-2 HF RECEIVER

Similar to 371A except a second tuning range of 10 MHz to 30 MHz is added. Also includes X-Y outputs for recording signal strength versus frequency.



377A HF RECEIVER

Similar to 371A Receiver except the mechanical dial has been replaced by a digital counter. Six-digit Nixie display of frequency. Digital automatic frequency control (DAFC) circuit stabilizes receiver's oscillator to ±100 Hz of desired frequency.



415 Shown

415, 416 RECEIVERS

Single-channel, crystal controlled receivers available to cover the following frequency ranges: 60-90 MHz, 75-110 MHz, 90-130 MHz, and 110-150 MHz. Any one of four frequencies within a range may be selected by a front-panel switch. Type 415 for AM reception has IF bandwidth of 50-kHz (standard) or 100 kHz (optional). Type 416 designed for pulse reception has IF bandwidth of 2 MHz. Units mount in EF-401 through EF-404 Equipment Frames.

440 Shown

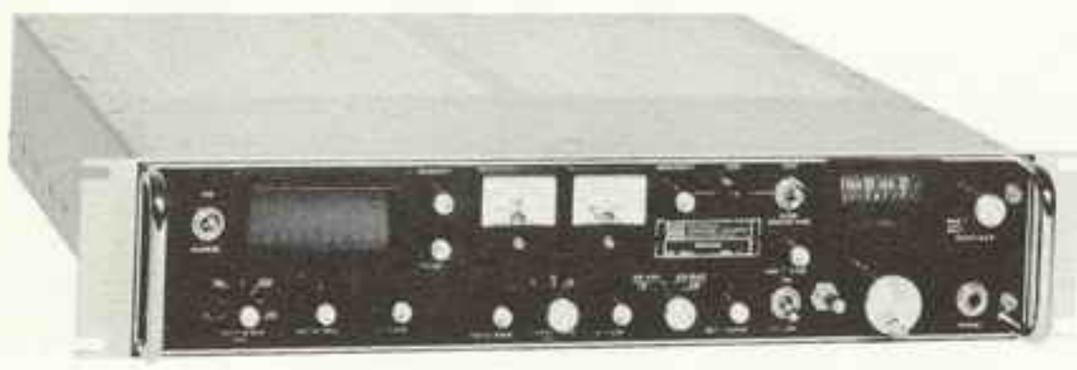
440, 441 RECEIVERS

Single-channel, crystal-controlled receivers are available to cover the following ranges: 30-48 MHz, 45-72 MHz, 70-105 MHz, 100-160 MHz, 150-220 MHz, and 210-260 MHz. Specify 440 for AM reception; 441 for FM reception. IF bandwidth available as either 20 kHz or 50 kHz. Up to six receivers plug into EF-506 Equipment Frame for rack operation or single receiver into PEC-401 Portable Equipment Case for battery operation.

501A-1 Shown

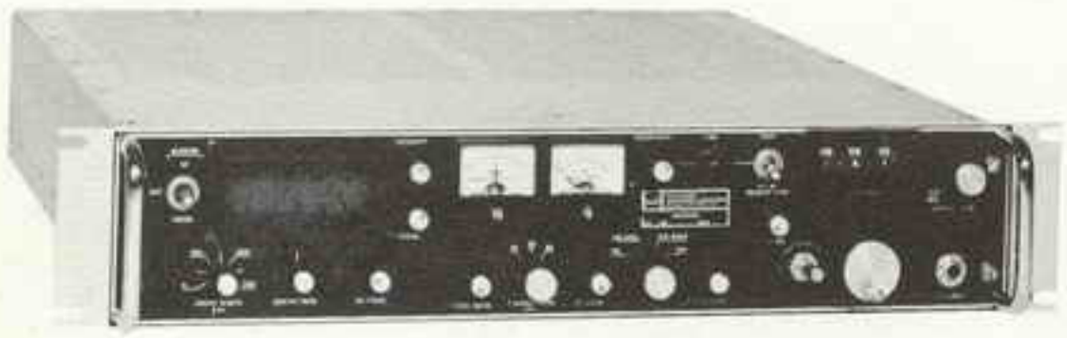
501A-1, 504A VHF RECEIVERS

General purpose receivers provide AM, FM, and CW reception from 54 MHz to 260 MHz in single band. Two IF bandwidths; 10 kHz and 300 kHz. 501A-1 includes AFC; 504A includes crystal marker oscillator.



521A-1 RECEIVER

AM, FM, and CW reception from 20 MHz to 80 MHz. With the 555 and 595 Receivers, designed for reception of narrowband communication signals. Three IF bandwidths: 4 kHz, 10 kHz, and 50 kHz. Built-in signal monitor has maximum sweep width of 300 kHz and maximum resolution of 2.5 kHz. DAFC compatible. Includes COR and variable BFO.



555-1 Shown

555, 555-1 RECEIVERS

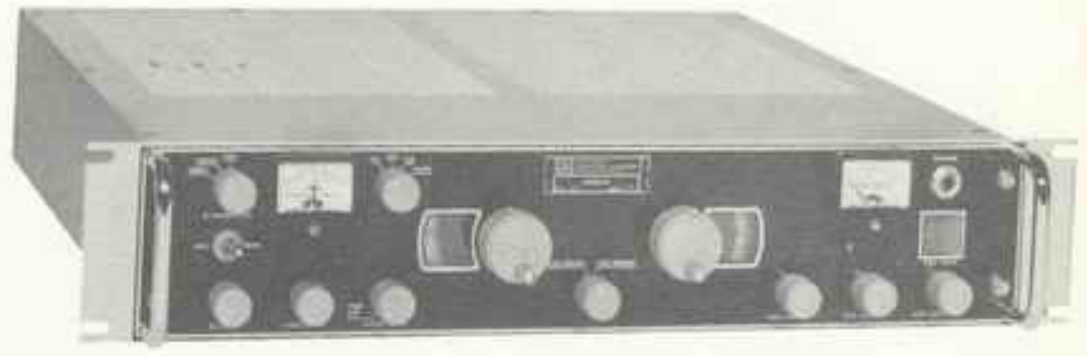
Type 555 similar to 521A-1 except tuning range is 90 to 180 MHz and IF bandwidths are 10 kHz, 20 kHz, and 50 kHz. Type 555-1 has 90-180 MHz tuning range and IF bandwidths of 4 kHz, 10 kHz, and 50 kHz.

595 RECEIVER

Similar to 521A-1 except frequency range is 220 to 440 MHz, and IF bandwidths are 10, 20, and 50 kHz.

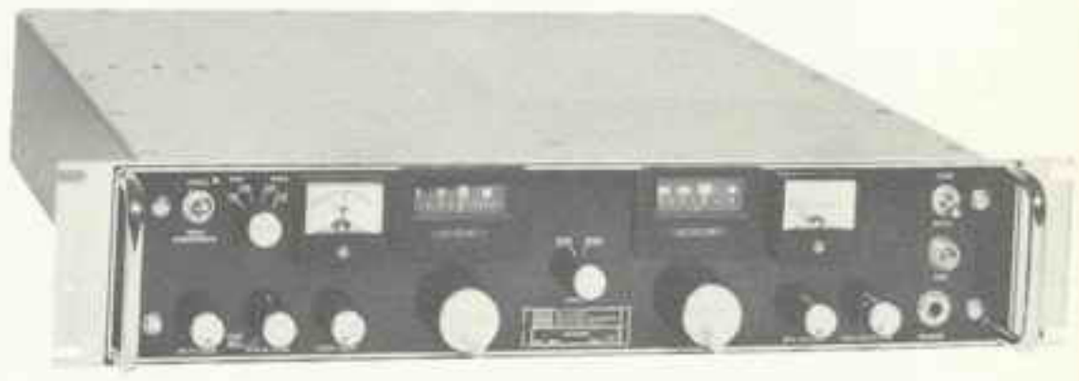
775-3 UHF RECEIVER

Multi-purpose receiver. For AM, FM, CW and pulse signals in UHF range of 235 to 1000 MHz. Carrier operated relay (COR) circuit. IF bandwidths: 100 kHz, 500 kHz, 4 MHz.



901B, 904A, 905A, 906A VHF RECEIVERS

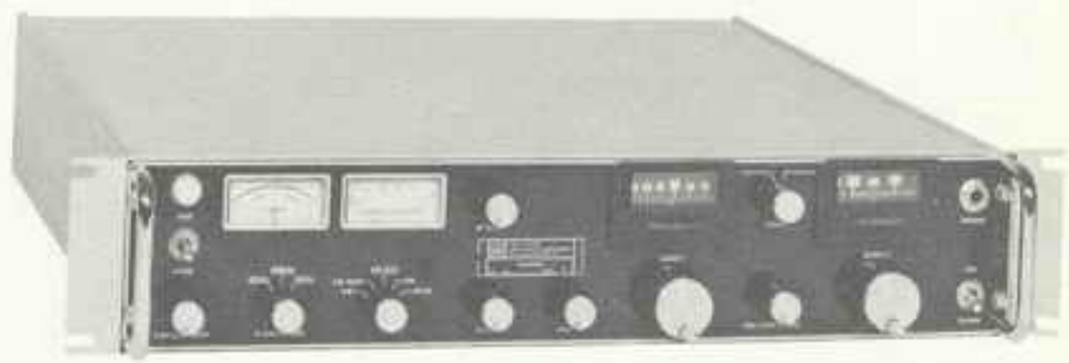
General purpose VHF receivers covering 30 MHz to 300 MHz in two bands. 904A and 906A include crystal marker oscillators providing marker pips at 1 MHz and 5 MHz. 905A and 906A contain carrier operated relay. All have IF bandwidths of 20 kHz and 300 kHz.



905A Shown

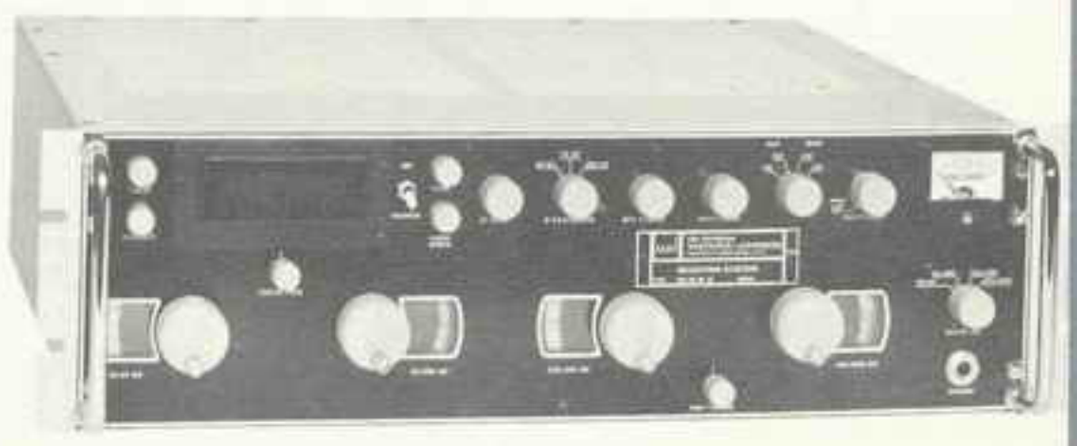
977 VHF RECEIVER

For reception of AM, FM, CW, and pulse signals in VHF frequency range of 30 to 300 MHz. All solid state, with dual gate MOS field-effect transistors for wide dynamic range. Three IF bandwidths: 60 kHz, 300 kHz, and 3 MHz. Pulse AGC circuit permits operation on pulse widths as narrow as 1 microsecond with pulse repetition rates as low as 50 pps. Ideal when wide bandwidth and pulse reception is required. Can be used with DRO-300A or DRO-302A-2 for digital readout and digital automatic frequency control.



RS-111-1B-12 VHF-UHF RECEIVING SYSTEM

For complete coverage of the frequency range from 30 to 1000 MHz in four bands: AM, FM, CW operation. Displays RF signals with built-in signal monitor which has center frequency crystal marker to aid tuning. Front panel signal strength meter. Four IF bandwidths: 20 kHz, 75 kHz, 300 kHz, and 2 MHz. The 2 MHz bandwidth IF provides separate AM and FM outputs and operates continuously; others are selectable.



Type RS-160 PAN-MAN

The RS-160 Pan-Man Receiving System consists of a family of related products which can be configured in a variety of ways. A basic system could include a 205 Receiver, a DRO-308 Counter, and an SM-7301 Signal Display. There are six tuning heads (VH-series and UH-series) available which provide coverage from 30 to 1000 MHz; a seventh tuning head will soon be available to provide coverage from 2 to 30 MHz. A DRX-308 Extender is available to extend the range of the basic counter from 300 MHz to 1000 MHz. The TSU-160 Tuner Switching Unit allows up to seven tuning heads to be installed at one time and switched on and off by a front panel control. There are three marker units available: the VM-101, UM-101, and UM-160. The three types are for manual receivers with 21.4 MHz, 60 MHz, and 160 MHz intermediate frequencies. Each marker unit can operate with up to four receivers.

THE TYPE 205 RECEIVER is the heart of the system. This voltage-tuned unit has manual, panoramic, and sector tuning modes and provides AM, FM, pulse reception. In the PAN mode, the entire range of the installed tuning head is swept. The sweep rate can be varied by a front panel control. In the SECTOR mode, any segment of the tuner's frequency range can be swept based on the manual tuned frequency and the setting of the sector width control. In the MAN mode, the entire range of the tuning head can be manually tuned. IF bandwidths of 10 kHz, 50 kHz, 300 kHz, and 1 MHz are provided. Any one of the four IF bandwidths can be selected when the receiver is in the MAN mode. In the PAN and SECTOR modes, the optimum IF bandwidth is automatically selected by the receiver.

THE TYPE SM-7301 SIGNAL DISPLAY functions as an RF Pan Display when the 205 Receiver is in the PAN or SECTOR mode and as an IF Pan Display when the receiver is in the MAN mode. A five-inch display tube is used.

When the receiver is in the PAN mode, the entire frequency range of the installed tuner is displayed. A portion of the beam will be intensified. The intensified portion is displayed when the receiver is switched to the SECTOR mode.

If the receiver is placed in the MAN tuning mode, the SM-7301 operates as an IF Pan Display with four calibrated sweep widths available for selection: 30, 100, and 500 kHz, and 3 MHz. Under these conditions either a linear or loga-

Receiving System

rithmic vertical display may be selected.

THE TYPE DRO-308 COUNTER greatly enhances system versatility and ease of operation. It provides a six-digit readout of the receiver's manually tuned frequency up to 300 MHz. In the PAN and SECTOR tuning modes, the readout indicates the center of the selected sector. Thus when the mode is switched from PAN to SECTOR, the exact center of the CRT display on the SM-7301 is the frequency display on the DRO-308. The display indicates the nearest 1-kHz increments in the MANUAL mode, and the nearest 10-kHz increment in the PAN and SECTOR modes.

With the DRO-308 it is possible to apply digital automatic frequency control (DAFC) to the 205 Receiver when operated in the MAN mode. With DAFC the receiver can be locked in 1-kHz increments to any frequency within its tuning range with long-term stability approaching that of the counter's internal reference source.

THE TYPE DRX-308 DIGITAL READOUT EXTENDER is a companion unit to the DRO-308 Counter. It extends the readout range and DAFC capability of the basic counter to 1000 MHz for operation with the UH-series Tuning Heads.

THE TYPE TSU-160 TUNER SWITCHING UNIT is an accessory device which mounts directly below the 205 Receiver. It connects to the 205 through the opening normally used to install a tuning head. The TSU-160 can contain from one to seven of the tuning heads normally used with the 205 Receiver. A front-panel switch selects any installed tuner for operation. A flexible arrangement has been provided to connect antennas to the various tuning heads. With suitable antennas and seven tuning heads, coverage can be provided from 2 MHz to 1000 MHz and any band within that range can be instantly selected for operation.

The TYPES VM-101, UM-101, and UM-160 MARKERS provide a visual indication of the tuned frequency of up to four manual receivers each. The VM-101 is for use with manual receivers which have a 21.4-MHz IF. Similarly, the UM-101 is used with 60-MHz IF receivers and the UM-160 with 160-MHz IF receivers. They allow the receiving system operator to instantly identify the signals being monitored by all manual receivers within the display range. This identification is made through beam intensification of the SM-7301 CRT at the tuned frequency of a manual receiver.

The RS-160 operates from a primary power source of 115/230 Vac, 50-60 Hz. Systems to operate from 400 Hz are available on special order. The components are designed for standard 19-inch rack mounting with the exception of the tuning heads which mount in the 205 Receiver and the DRO-308 counter which mounts in the frame of the SM-7301. The system can be supplied in an EF-160 series Equipment Cabinet similar to the one shown in the photograph. Several different cabinets are available to provide the vertical space needed by the various system configurations.

SPECIFICATIONS

SM-7301 SIGNAL DISPLAY
Display Modes: RF Pan Display for Pan and Sector modes; IF Pan Display for Man mode
Sweep Widths: 30, 100, 500 kHz, and 3 MHz
IF Pan Resolution: 30 and 100 kHz sweep widths, 2 kHz; 500 kHz and 3 MHz sweep width, 20 kHz

DRX-308 READOUT EXTENDER
Frequency Range: For use with tuning heads covering 300 MHz to 1000 MHz

MARKER UNITS
Inputs: Four

Type	Marker Range	Offset
VM-101	30-300 MHz	21.4 MHz
UM-101	235-1000 MHz	60 MHz
UM-160	235-1000 MHz	160 MHz

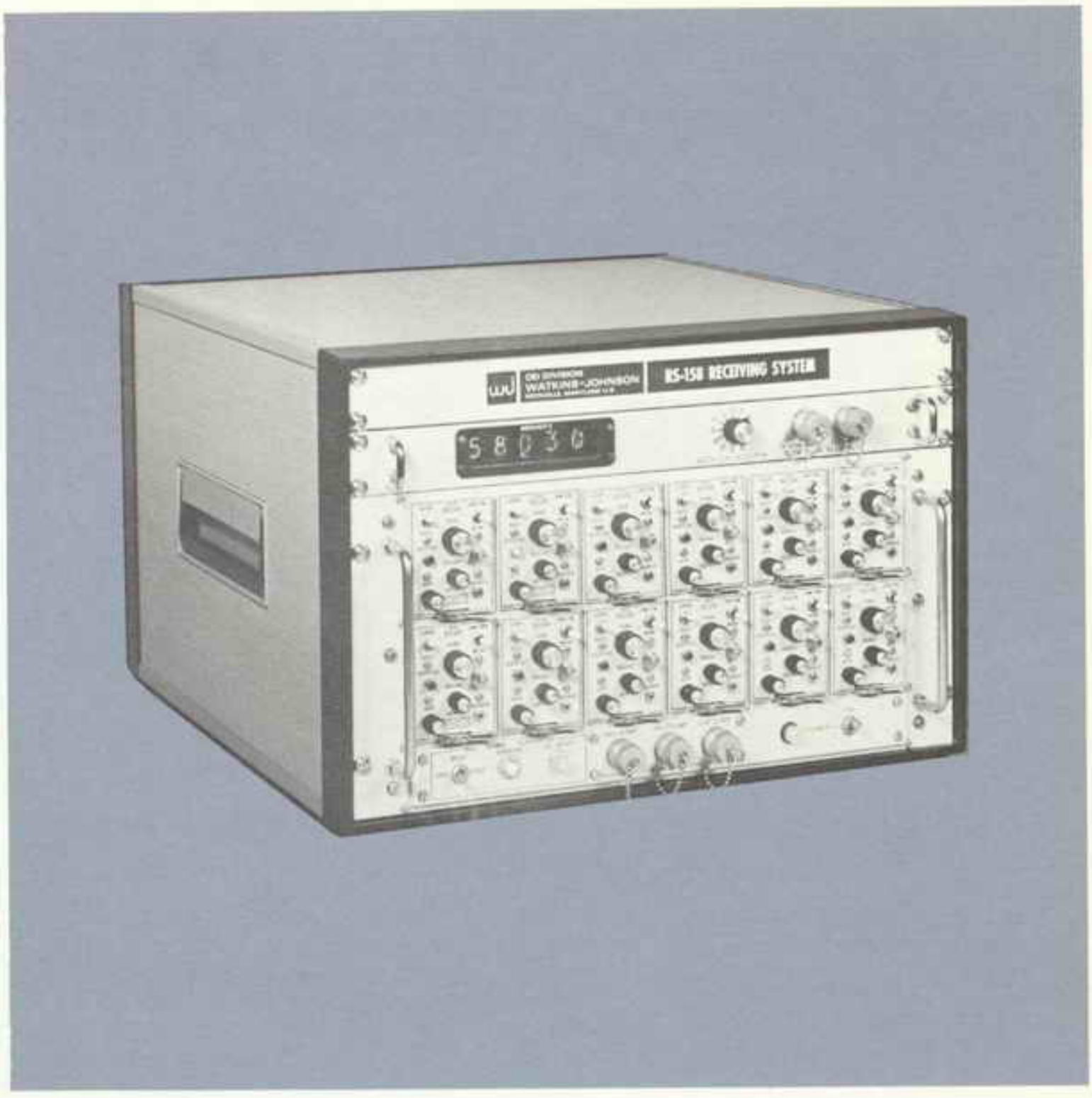
TSU-160 TUNER SWITCHING UNIT
Plug-in Tuning Heads: Seven, maximum
Selection of Tuning Head: By front panel switch

205 RECEIVER
Types of Reception: AM, FM, pulse
Frequency Range: 30-1000 MHz in 6 bands
IF Bandwidths: 10, 50, 300 kHz and 1 MHz
Tuning Modes: Panoramic, Sector, or Manual
Sweep Rate: 0.1 to 25 Hz

TUNING HEADS
Ranges: VH-11, 30-60 MHz; VH-12, 60-120 MHz; VH-13, 100-180 MHz; VH-14, 180-300 MHz; UH-11, 250-500 MHz; UH-12, 500-1000 MHz

DRO-308 READOUT
Display: 6-digit readout to nearest 1 kHz in Man mode and to nearest 10 kHz in Pan and Sector modes.
Accuracy: Man mode, +1, −0 kHz (one count); Pan or Sector modes, +10, −0 kHz
DAFC (Man mode): Single-digit control with 500 Hz increments held to zero
Range: For use with tuning heads covering 2 MHz to 300 MHz

Type RS-158 Receiving System



RECEIVING SYSTEM

The system consists of 12 independent, single-channel type 410 Receivers and a time-shared type DRO-270 Counter in a type EF-158 Modular Equipment Frame.

The 410 Receivers are continuously tunable and designed for narrow-band AM and FM reception in the 20 MHz to 80 MHz frequency range. An IF bandwidth of 10 kHz is provided using a crystal filter. IF bandwidth of 20 kHz (410-2) or 50 kHz (410-3) are also available.

The system utilizes the latest solid-state design techniques such as dual gate MOS field-effect transistors in critical RF amplifier stages and integrated circuit amplifiers in both the IF amplifier and signal processing circuits. A unique AOR (activity operated relay) circuit provides audio squelch only when both a carrier and modulation are present. Mounted on the front panel of the receivers are a DAFC switch, frequency set, and AOR threshold controls, a phones jack with a level control, and a local oscillator output connector which is used with a built-in test signal generator, and an AM-FM mode switch.

Continuous frequency stabilization of all twelve receivers is by means of DAFC (digital automatic frequency control) circuit. The DAFC circuit functions in conjunction with a five-digit DRO-270 Counter to lock the local oscillator of each receiver to a preset frequency. The DAFC circuit stabilizes the local oscillator and acts as a frequency synthesizer to provide 6000 channels spaced 10 kHz apart in the 20 to 80 MHz band. Thus, each receiver can be locked to any of the 6000 channels with crystal-controlled stability without the necessity of providing 6000 crystals to cover all of the channels. The preset frequency of the receivers is held to within ±1 kHz

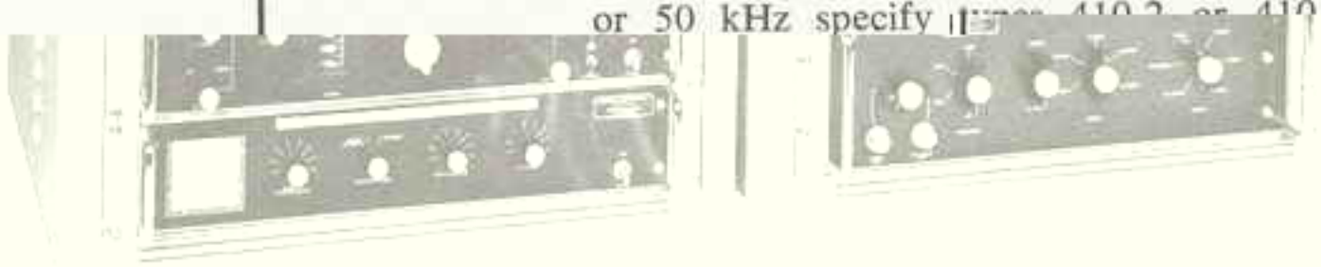
SPECIFICATIONS

MULTICOUPLER

Number of Output Channels	12
Noise Figure	5 dB, maximum
Gain	6 dB, nominal
Isolation Between Outputs	38 dB, minimum
Input Impedance	50 ohms, unbalanced
Input VSWR	2:1, maximum

410 RECEIVER

Frequency Range	20 to 80 MHz
Noise Figure	6 dB, maximum
Image Rejection	60 dB, minimum
IF Rejection	60 dB, minimum
Intermediate Frequency	10 MHz
IF Bandwidth	10 kHz, standard. For 20 kHz, or 50 kHz specify [illegible] 410-2, or 410-3



RECEIVING SYSTEM

The RS-125 Receiving System is a versatile arrangement of equipment which provide AM, FM, CW, and pulse reception over a frequency range as wide as 500 kHz to 12 GHz. Because of this wide frequency range and the variety of

A counter-frequency extender combination gives a direct six-digit readout of the tuned frequency from 500 kHz to 1000 MHz. In addition, it provides digital automatic frequency control over this same range so that the tuners cov-

EQUIPMENTS

TUNERS

Model	*R*
HT-10, SHT-10	500 kHz-10
VT-11, SVT-11	10-30
VT-20, SVT-20	10-90
VT-30, SVT-30	30-260

Type RS-112 Microwave

The RS-112 Microwave Pan-Man Receiving System provides the capability for automatically sweeping the RF spectrum from 1 to 12 GHz while simultaneously receiving specific signals within the microwave region using associated manual receivers. Continuous four-band simultaneous pan operation is achieved by separate tuning heads to cover the 1–2, 2–4, 4–8, and 8–12-GHz bands. Components which may be used in the RS-112 are:

Type MPP-101 Microwave Pan Preselector
Type PTM-101 Pan Tuner Module
Type PS-103 Power Supply
Type LIF-107 Log IF Demodulator
Type MC-103 Master Control
Type PD-602 Pan Display
Type EF-602 Equipment Frame
Type PD-102 Pan Display
Type PD-201 Pan Display
Type MT-112 Microwave Tuner
Type DM-112 Demodulator
Type 112 Microwave Receiver
Type SM-1622 Signal Monitor

The RS-112 system approach has been designed to provide maximum flexibility in a microwave sweep system at the lowest possible cost. For the user, a number of advantages are immediately apparent:

Operationally, simultaneous sweeping of the four bands, rather than sequential sweeping, provides a greater intercept probability as there is four times the frequency coverage in a given sweep period. Thus, there is a greater probability of detecting signals which appear intermittently.

The independent manual receiver capability permits a high degree of versatility in the system in that the pan function is not interrupted while analysis and monitoring of specific signals takes place.

The system's modular concept enables it to be easily tailored to meet special requirements at little or no cost to the customer.

Its building-block concept permits easy expansion of the system at a later date or reconfiguration to meet new requirements.

The manually-operated components of the system can be broken out and used independently of the pan system.

Conversely, a customer who already has manual components can assemble a pan-man system at low cost.

Separate antenna inputs are provided for each band with each connecting to a YIG preselector. The tunable preselectors with their associated local oscillators, mixers, IF preamplifiers, power supplies, etc., are designed for remote mounting to minimize antenna cable losses. There are three units which make up the pan tuner package: The MPP-101 Microwave Pan Preselector, the PTM-101 Pan Tuner Module, and the PS-103 Power Supply. All three units are built in the standard 19-inch rack mounting configuration with each occupying 3.5 inches of vertical space. The MPP-101 contains a YIG preselector for each band along with the necessary YIG driver circuitry. The mixers, LO's, and IF preamps are contained in the PTM-101. Operating voltages for both the MPP-101 and PTM-101 are provided by the PS-103.

Dual two-ball YIG filters are used on all bands to permit the addition of a preamplifier, if desired, following initial preselection. Tuning current for all preselectors is derived from a common sawtooth generator located in the MC-103 Master Control Unit. This same generator provides the sweep for the local oscillators and the horizontal sweep for the master and remote pan displays. Thus, by using a common sweep source, synchronization is obtained between all sweep functions in the four bands.

Signals in all bands are converted to a 160-MHz center frequency IF and fed to a logarithmic IF demodulator unit, the LIF-107. This unit has a sep-

PAN-MAN Receiving System

arate IF strip for each band, with each strip's bandwidth tailored to the particular band. Bandwidths extend from 2 MHz for the 1–2-GHz band to 12 MHz for the 8–12-GHz band. All strips have a dynamic range in excess of 60 dB. The detected video from each strip is fed through a five-output distribution amplifier with one of the outputs going to the PD-602 Pan Displays and four available for remote pan displays.

The MC-103 Master Control Unit and Type PD-602 Pan Displays provide the operator with a visual presentation of signal activity from 1 to 12 GHz, as well as the ability to monitor the operation of up to 16 Type 112 manual microwave receivers or four Type MT-112 manual microwave tuners. There are four dual-trace CRT's in the master display—one for each band. The bottom trace of each display is the RF pan presentation for that entire band. The top trace of a display is the IF pan spectrum of a selected manual receiver or tuner. Push-button switches on the MC-103 are used to select a manual receiver for display. This switch also places a marker on the RF pan trace which indicates where the manual receiver is tuned. The marker is implemented by means of an intensified spot on the RF pan trace at the tuned frequency.

The MC-103 provides for connecting four manual receivers per band, but this capability can be easily expanded by adding the necessary switching. As now designed, 16 Type 112 manual receivers could be connected to the system—four per band. If MT-112 manual tuners are used up to four can be connected, but there would still be the same amount of manual coverage since each MT-112 contains a separate tuner for each of the four bands. The system permits mixing of 112 receivers and MT-112 tuners.

The master control also has a sweep-rate control so that the rate of scan can be varied from 5 to 30 sweeps per second. Since the sweep for all four bands is derived from this common source, the sweep rate is the same for each band.

In the manual monitoring positions a standard 112 receiver and SM-1622 signal monitor could be used with a half-rack sized PD-201 remote RF pan display. If the MT-112 manual tuner and DM-112 demodulator are used, then the full-rack sized PD-102 remote pan display would be provided in this configuration. The MT-112 contains the four tuners developed for the 112 receiver covering 1 to 12 GHz. This configuration makes it possible to have all four microwave bands available at the flip of a switch, rather than having to change the drop-in tuning heads used in the 112. The DM-112 provides the five IF bandwidths found in the 112, with the addition of the SM-1622 signal monitor electronics in the same package.

The PD-102 and PD-201 remote RF pan displays are electrically identical, differing only in the mounting configuration. The PD-102 is designed for standard 19-inch rack mounting and the PD-201 is built in a half-rack package for mounting in an equipment frame such as the EF-201C. A front-panel switch selects the band to be displayed if the remote manual receiver is a type 112. The switch also has an AUTO position which can be used if the remote unit is a MT-112. With the switch in this position the pan display is the same band being used in the MT-112. In essence, with the remote RF pan display switch in the AUTO position, the band switch on the MT-112 controls the pan display. Both the PD-102 and PD-201 indicate the tuned frequency of the associated manual receiver or tuner by means of a positive-going step in the base line of the CRT trace.

SPECIFICATIONS

MICROWAVE PAN TUNER SECTION

Frequency	4 bands operating simultaneously
Band A	1–2 GHz
Band B	2–4 GHz
Band C	4–8 GHz
Band D	8–12 GHz
Input Impedance	50 ohms, nominal
Noise Figure	20 dB, maximum
Image Rejection	60 dB, minimum
IF Rejection	80 dB, minimum
Conducted LO Radiation	80 μV, maximum
Output Impedance	50 ohms
Overall Bandwidth:	
Band A	2 MHz
Band B	4 MHz
Band C	8 MHz
Band D	12 MHz
Overall Gain	20 dB, nominal
Gain Variation	±3 dB, maximum
Tuning Voltage:	
Low Frequency Band Edge	+10V
High Frequency Band Edge	−10V
Linearity (volts vs. frequency)	0.5%
Dimensions (each unit)	3.5 inches high, 19 inches wide, and 16 inches deep
Input Power (PS-103)	115 or 230 Vac, 50–400 Hz

PAN DISPLAY SECTION

Inputs	Three: vertical, horizontal, and Z-axis
Input Impedance	100kΩ
Input Bandwidths	1 MHz
Input Voltage	±10V, maximum
CRT phosphor	P31
Display Area	8 cm vertical, 10 cm horizontal
Connectors	BNC
Controls	Intensity, focus, vertical position, horizontal position, scale illumination, power on-off
Input Power	115 or 230 Vac, 48–440 Hz
Power Consumption	50 watts
Dimensions	5.25 inches high, 8.5 inches wide, and 17.5 inches deep

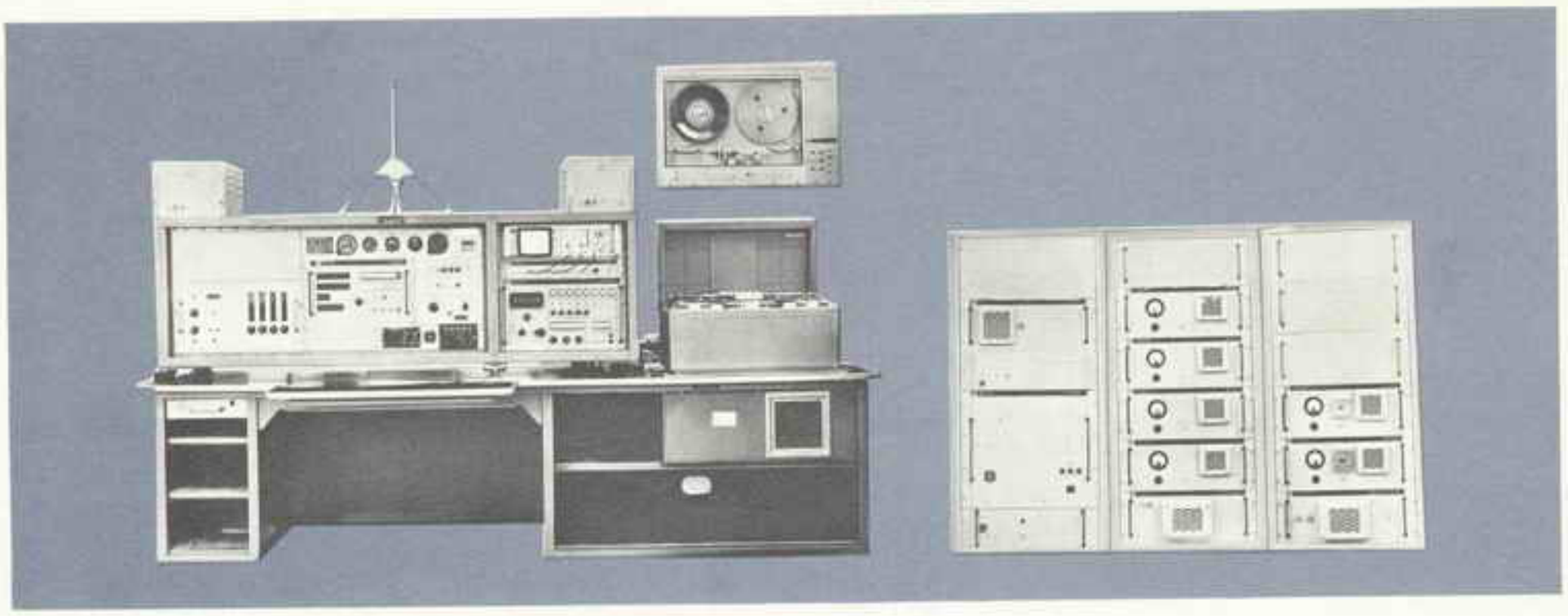
Receiving Systems

WJ-1026 Electronically Swept Receiving System

The WJ-1026 is an electronically swept panoramic/manual superheterodyne receiving system with preselection and RF preamplification. It receives, detects and displays signals in the 1 to 18 GHz frequency range. Since the tuners and preamplifiers are constructed for operation in extreme environmental conditions (up to 500 feet from the control and display unit), this system is particularly suitable for airborne and shipboard applications.

WJ-1047 DUAL-CHANNEL RECEIVING SYSTEM

The WJ-1047 is a Dual-Channel digitally tuned superheterodyne receiving system for airborne applications, with easy adaptability to shipboard, mobile or fixed-station use. Particularly suitable for DF and ELINT applications, this system covers the frequency range from 0.5 to 12 GHz.



WJ-1088 AIRBORNE RECEIVING SYSTEM

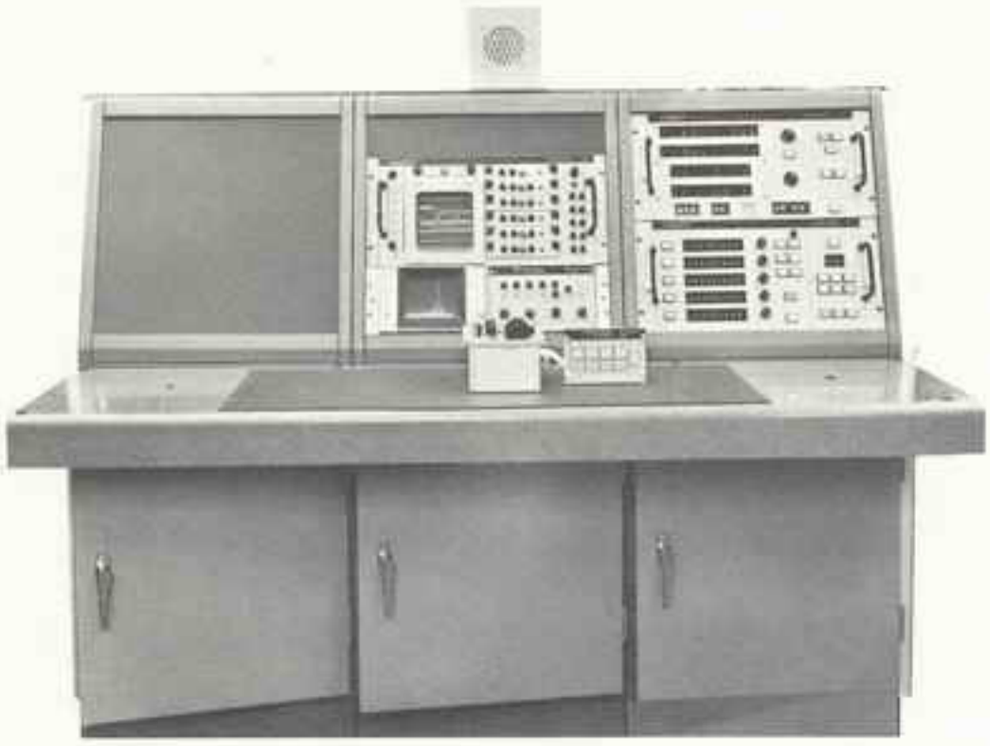
Designed to provide antenna pattern analysis, the WJ-1088 is an airborne receiving system operating in the 0.4 to 17.5 GHz frequency range. The system converts signals into digital information describing signal strength and frequency, equipment status, navigation data, and mission data. The data is then recorded for later analysis by computer. The system is suitable for several applications, including definition and analysis of the geographical configuration of a primary and several secondary frequencies being emitted from an antenna.

WJ-1154
FREQUENCY SYNTHESIZER

In applications where very high frequency accuracy and stability are required, the W-J family of synthesizers may be utilized as local oscillators. Available in all of the standard bands as well as in octave band models, these synthesizers offer all digital BCD tuning that is compatible with Watkins-Johnson receivers. The WJ-1154 frequency synthesizer is shown and specified.

SPECIFICATIONS

	Typical	*Guaranteed*
Frequency Range		1.0 to 12.4 GHz
Frequency Steps		1 MHz
Frequency Accuracy		5 parts in 10^7, or as determined by external frequency standard
Power Output		1 mW (0 dBm) (min.) leveled—±2 dB across the band (1 to 12.4 GHz) unleveled—5 mW min. at 1 GHz, 25 mW min. at 2 GHz, 10 mW min. at 6 GHz, 1 mW min. at 12.4 GHz
Harmonic Suppression		
1 to 2 GHz (2nd harmonic)	—20 dB	
2 to 12.4 GHz	—50 dB	
Fundamental Suppression (applicable for 2 to 12.4 GHz outputs)	—40 dB	
Non-Harmonic Spurious	—70 dB	
Noise Spectrum		
1 to 2 GHz	—70 dB/kHz at ±100 kHz	
8 to 12.4 GHz	—50 dB/kHz at ±100 kHz	
Programming Response Time	The synthesizer is capable of being programmed to any frequency in the 1 GHz to 12.4 GHz range in 100 msec or less. The switching speed is approximately 8 msec/GHz with a minimum value of 0.5 msec.	
Program Input	Local — BCD thumbwheel switch Remote — External BCD commands	



WJ-1007A Shown

WJ-1007 and WJ-1007A MICROWAVE COLLECTION SYSTEMS

These microwave electromagnetic surveillance systems are capable of receiving, detecting and analyzing state-of-the-art electromagnetic emissions in the frequency range of 1 to 18 GHz. Basically, four signal functions are supplied by each system: acquisition, control, analysis, and preparation of data for recording. Each function is represented by one or more modules.

The systems are capable of detecting and categorizing the parameters of currently used types of electromagnetic emission. Sufficient system flexibility and automatic digital computer functions are included to insure rapid signal acquisition and analysis. Data resulting from signal analysis is printed out and transmitted directly without manual or visual translation by the operator.

The entire 1 to 18 GHz frequency spectrum is covered with a continuous sweep. To give maximum signal-to-noise ratio throughout the spectrum and to provide optimum system flexibility, the spectrum is divided into five standard microwave bands. There is no mechanical tuning involved within these bands, nor mechanical switching required between bands. Fully-electronic tuning is a result of incorporation of YIG filters as preselectors and in oscillators. Dual-conversion synthesizer-controlled local oscillators provide frequency accuracy and resettability greater than 1 part in 10^8 . . . instantaneously available without phase lock loop and associated adjustments and lock-up lags. A memory module is included to permit programing the spectrum such that certain frequencies may be recalled, or bands of frequencies automatically locked out.

Other features of these systems include digital frequency tuning (manual and automatic); direct digital readout of frequency, pulse repetition rate, and pulse length; panoramic display of the entire frequency spectrum (in five bands) with integral photographic capability; spectrum analysis with 100 kHz resolution; bandwidth, IF mode, and signal type selection; and antenna control for direction finding with separate display unit (optional).

Although the Microwave Collection Systems have been initially designed for airborne application, their modular construction makes them equally suitable for use in mobile vans or fixed station equipment. Each system, less antenna drive units and cables, occupies a volume of approximately 18 cu. ft. and weighs less than 850 lbs. Solid-state circuitry is used throughout except for low-noise traveling-wave tubes and display tubes.

1007A SPECIFICATIONS

Frequency Range	1–18 GHz
Noise Figure	
L-Band (1 to 2 GHz)	9.5 dB max.
S-Band (2 to 4 GHz)	11.5 dB max.
C-Band (4 to 8 GHz)	13.5 dB max.
X-Band (8 to 12 GHz)	14.5 dB max.
Ku-Band (12 to 18 GHz)	18.5 dB max.
Image Rejection	70 dB min.
Local Oscillator Radiation	—80 dBm min.
Single Signal Spurious Free Dynamic Range	50 dB min.
Frequency Accuracy	3 parts in 10″
IF Bandwidths, front panel selectable	1, 5 and 20 MHz
RF Input VSWR	1:5:1.0
Sweep speed, front panel selectable	0.3 to 300 GHz/sec.
Input Power	115 Vac, 48–420 cps

DISPLAYS

ANALYSIS INDICATION

An Analysis Indicator Unit is provided to present a visual display of pulse width, pulse repetition period, and frequency.

PULSE WIDTH

The pulse width readout has a capability of displaying pulses ranging from 0.1 to 999.9 μsecs in width. Readout accuracy is within 0.1 μsec. This accuracy is derived from a 10 MHz crystal timing oscillator.

PULSE REPETITION INTERVAL

The pulse repetition interval readout has a capability of displaying intervals corresponding to PRI's of 50 to 20000 Hz. The accuracy of the pulse repetition interval readout is maintained within 1 percent. One μsec resolution accuracy is derived from a decade count-down of the oscillator.

FREQUENCY

The frequency readout is automatic with precision of 100 KHz, absolute resettability and accuracy of 3 parts in 10^9. When the receiver is stopped on a signal, the operator can manually center the signal on the IF Pan Display to determine frequency components to the precision stated herein.

DIRECTION FINDING PRESENTATION (optional)

The DF presentation is supplied by a modified IP-36/APA-69. Presentation is of the polar type of amplitude versus bearing. Modifications to the DF Display Unit are made by Watkins-Johnson Company.

TRUE BEARING

Additional gearing to the manual cursor drives a 360 degree shaft encoder. In this manner cursor position is converted to BCD digital format indicating true bearing to within 1 degree.

DF VIDEO

Automatic switching of Sin-Cos video from up to three antenna pedestal resolvers is provided under control of the Digital Tuning Unit.

SPECTRUM DISPLAY

A five-gun display unit is provided for displaying signals in the five sequential microwave bands of amplitude versus frequency when in the sweep mode and five simultaneous signal amplitude versus time traces in the pulse analysis mode.

EXTERNAL GRATICULE

Graduated linear frequency scales are provided on the external graticule for visual determination of frequency in normal, full sweep operation. Scales are accurately calibrated to allow correct frequency reading to within 5%.

SCOPE EXPAND

When the tuning scan is narrowed, the display may be expanded to cover the entire graduated scale (with the aid of horizontal gain and position controls).

LOGGING SCALE

Logging scales calibrated from 0 to 100% are provided on the external graticule for frequency interpolation of expanded presentations.

STROBE MARKER

A manually-controlled strobe marker of the notch type is provided for each trace. When a strobe-lock button is depressed, the tuner stops on the strobe marker frequency and digital readout of the frequency occurs (on the Analysis Indicator Unit).

PULSE ACCURACY

Pulse width can be measured within ±0.1 μsec accuracy for pulses from 0.1 to 5 μsecs in width and within ±1.0 μsec accuracy for pulses from 5 to 50 μsecs, and ±10 μsecs for pulses from 50 to 500 μsecs.

PULSE REPETITION FREQUENCY DISPLAY ACCURACY

Pulse repetition frequency can be measured from 20 to 20,000 pulses per second with an accuracy of 10%.

FOCUS AND INTENSITY

Separate focus and intensity controls are provided for each trace.

DC BLANKING

Each trace is provided with automatic DC blanking. In this manner phosphor burns are eliminated on unused traces.

REAR VIEW CAMERA (optional)

Trace photography through an optical port in the CRT is automatically accomplished by depressing a front panel camera button.

IF PAN DISPLAY

The IF Pan Display Unit presents, on a linear 8 x 10 cm graduated scale, frequency activity within the receiver bandwidth when the receiver is stopped or manually tuned.

BANDWIDTH

The IF Pan displays the selected IF bandwidth such that its horizontal scale is 2 MHz/cm, 0.5 MHz/cm, or 100 kHz/cm when in the calibrated sweep width positions of 20, 5 and 1 MHz. Sweep width vernier and offset controls permit small sectors of the sweep to be expanded.

SENSITIVITY

IF Pan bandwidths of 50 kHz, 200 kHz or 1 MHz can be selected independently of sweep width selection.

CALIBRATION MARKERS

A set of calibration markers are derived from a 1 MHz reference from the synthesizer circuit. Markers spaced at 0.5 MHz, 1 MHz and 5 MHz can be independently selected and amplitude controlled. A center marker at 60 MHz can also be selected.

COMPUTER CONTROL

Computer-controlled operation is an optional feature of the WJ-1007A and WJ-1140 microwave collection systems. Computer interfaces have been established, and hardware is in the field operating with a number of different, general-purpose digital computers. Both receiver control (with such functions as sweep speed, bandwidth selection and frequency coverage) and data storage are available in the computer controlled mode. This allows a computer library of signal parameters to be established and cataloged.

WJ-1140 MODULAR MICROWAVE RECEIVING SYSTEM

A flexible microwave receiving system that provides acquisition and analysis capabilities in the 0.5 to 18 GHz frequency range is available from Watkins-Johnson. Designated the WJ-1140 series, this receiver system is capable of operating under severe environmental conditions, including wide temperature variations, high relative humidity, and high levels of shock and vibration. The input power requirements conform to those outlined in MIL-E-16400. Some of the numerous applications for this receiving system include, but are not limited to, ECM receivers, ELINT receivers, surveillance receivers, broadband communications receivers, and tracking receivers.

The flexibility of this modular receiver is enhanced by the availability of a wide variety of peripheral equipment, which can be utilized to meet specific design requirements. The receiver is electrically organized in a manner that allows each of the peripheral function equipments to be completely self sufficient. The only required interconnects are those that carry control and/or signal information between equipments. Addition or removal of the peripheral equipment can be accomplished for any configuration desired with no degradation in overall system capability.

SPECIFICATIONS

Frequency Range	0.5 to 18 GHz
Noise Figure	
P-Band (0.5 to 1 GHz)	15 dB
L-Band (1 to 2 GHz)	15 dB
S-Band (2 to 4 GHz)	15 dB
C-Band (4 to 8 GHz)	18 dB
X-Band (8 to 12 GHz)	18 dB
Ku-Band (12 to 18 GHz)	18 dB
Image Rejection	60 dB minimum
Local Oscillator Radiation	—80 dBm, minimum
Single Signal Spurious Free Dynamic Range	50 dB minimum
Frequency Accuracy	0.1%
Incidental FM	10 kHz, peak to peak
IF Bandwidth, front panel selectable	1, 5 or 20 MHz
RF Input VSWR	1.5:1.0
Sweep Speed, front panel selectable	1, 5, 10 or 50 GHz/Second
1 dB Compression Point	—12 dBm
Input Power	115 VAC, 48 to 420 cps, @ 2.5 Amp
Outputs	
Linear Video	0.2 to 2.0 volts into 90 ohms
Log Video	0.2 to 2.0 volts into 90 ohms
Stretched Log Video	0.2 to 2.0 volts into 90 ohms
Blanking	0 to +4.0 volts into 1000 ohms
Horizontal	0 to +5.0 volts into 1000 ohms
Size[1], tuners and demodulator	A1D cases
Weight	
Tuners, each	25 lbs.
Control Unit	2 lbs.
Demodulator	18 lbs.
Display	2 lbs.
Temperature[2]	0 to +50° Centigrade
Altitude[2]	15,000 ft.
Shock[2]	Bench Handling

NOTES:
1. A1C case size available if optional external power supply is used.
2. MIL-E-5400, Class II available.

The basic receiver, shown in block diagram form below, consists of the required radio frequency tuners, the control unit, the frequency display, the demodulator, and the junction box (if required). These modular units are described as follows.

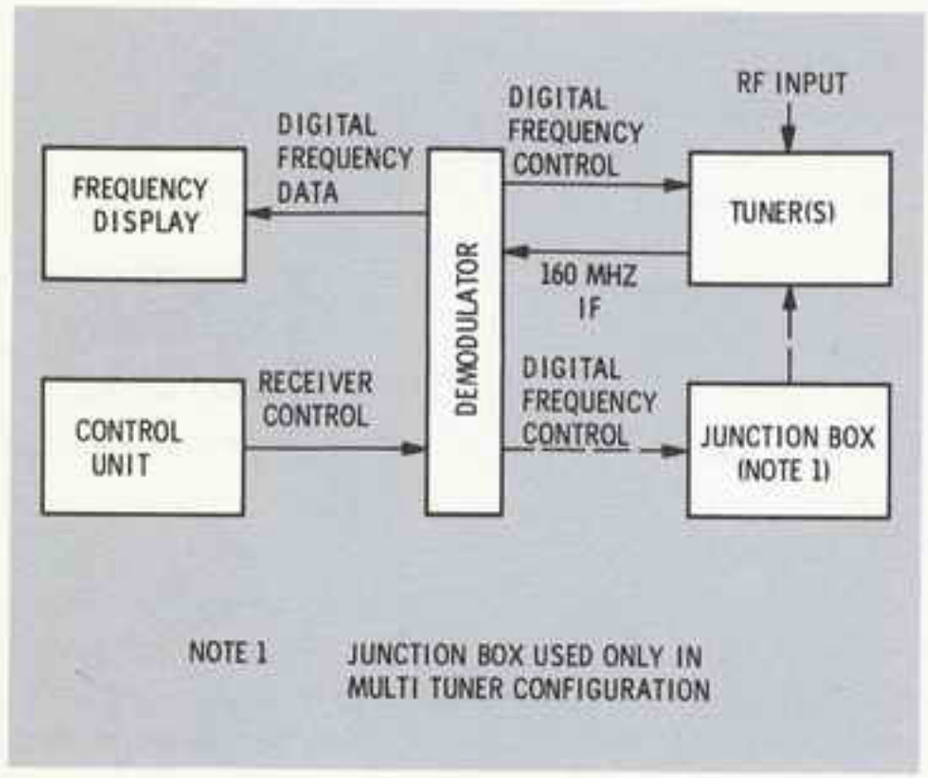
Each RF tuner, shown in the block diagram below, is the equivalent of the RF to IF circuitry of a superheterodyne receiver; each consists of an RF preselector, synthesized local oscillator and mixer preamplifier. Tuner RF to IF gain, which is on the order of 20 dB, allows the units to be located remotely from the control unit and the demodulator.

The receiver control unit is the primary operator/receiving system interface equipment. All of the controls for the basic receiver configuration are contained in the receiver control unit. All of these controls, with the exception of the band select pushbuttons, have self explanatory engraving to define their function.

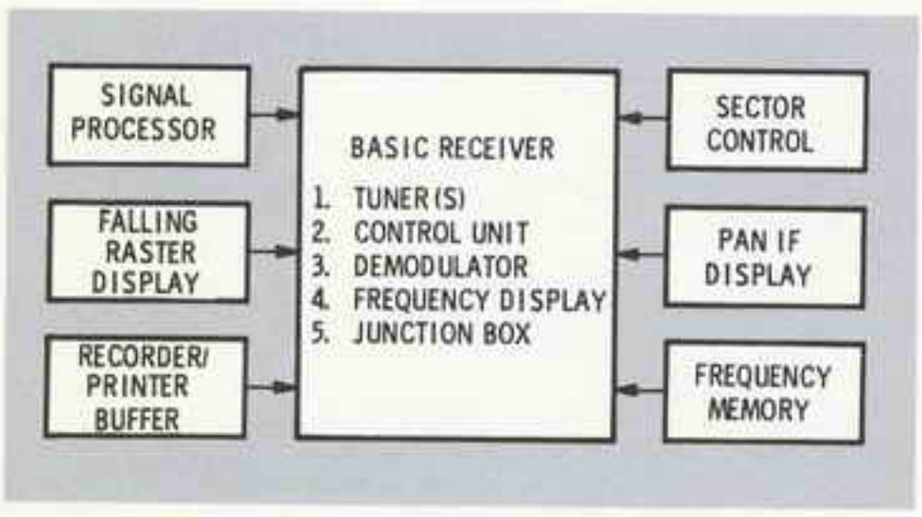
The function of the NIXIE frequency display is to inform the operator of the receiver of the frequency to which the equipment is tuned. The display is driven by the digital tuning word that is being used to program the tuner in use. This digital tuning word is used to provide a signal for the NIXIE tubes in the display.

The demodulator, shown in block diagram form below, serves the purpose of removing the intelligence carried on the 160 MHz IF. The outputs of the demodulator are used to drive display and other peripheral equipment.

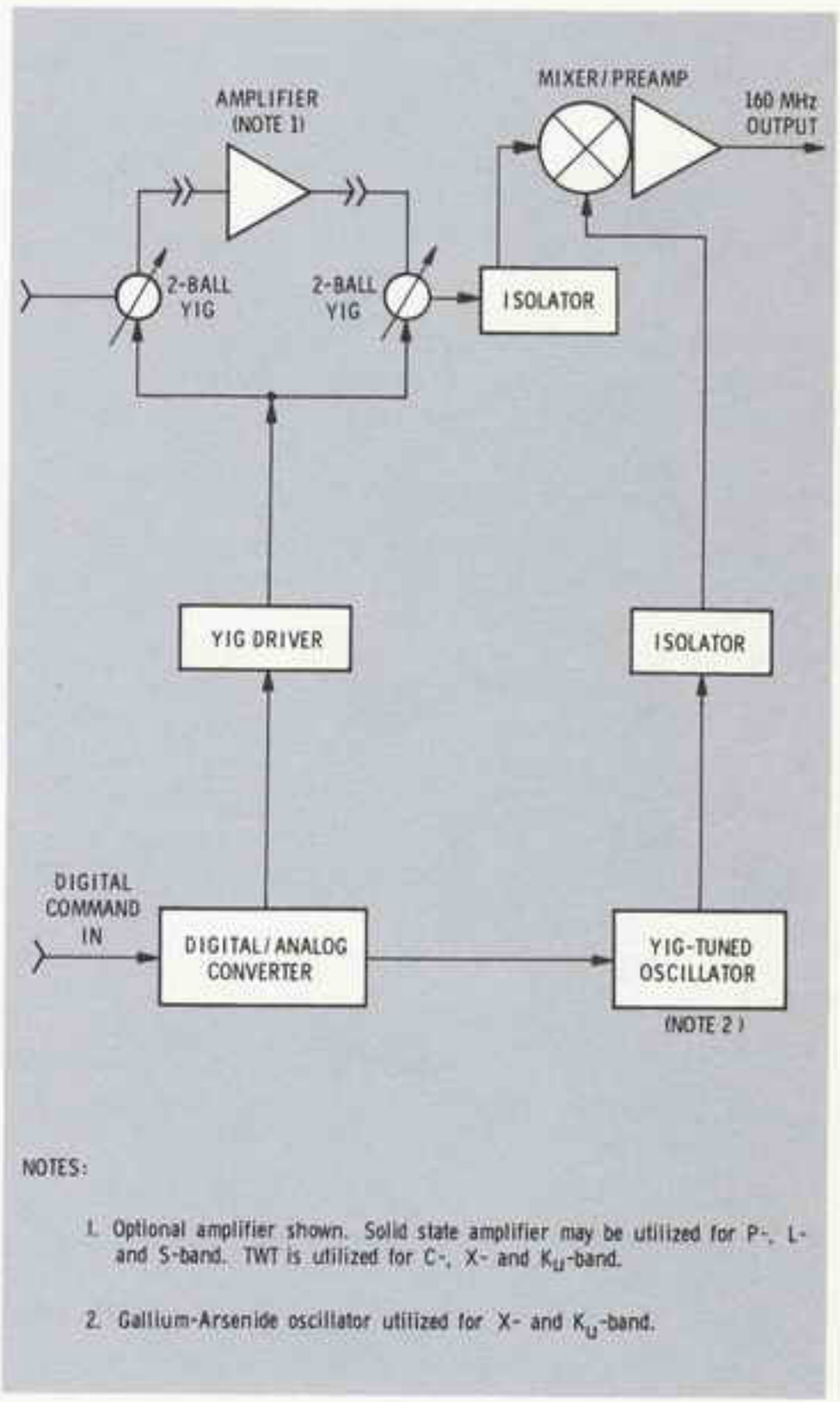
The basic receiver and selected peripheral equipment are shown in block diagram form below. Each piece of equipment is described in the table on page 21.



Basic Receiver



Basic Receiver and Selected Peripheral Equipment



Tuner Block Diagram

BASIC RECEIVER CONTROL GROUP

PART NUMBER	NOMENCLATURE	FUNCTION
C-100/WJ1140	RECEIVER CONTROL UNIT	Control of all receiver functions including: A. Sweep speed B. IF bandwidth C. Analog IF gain (linear IF amp only) D. Step IF attenuator E. Sweep stop/sweep start F. Joystick frequency up/down G. Manual tuning
ID-100/WJ1140	NIXIE FREQUENCY DISPLAY	Nixie readout of frequency to which receiver is tuned.
MD-100/WJ1140	DEMODULATOR	Demodulation of IF signal supplied by the tuner. Outputs of the demodulator are: A. Linear video B. Log video C. Stretched log video D. Sweep voltage ramp for displays E. Blanking signal for displays F. Raw 160 MHz IF signal for use with pan IF displays

PERIPHERAL OPTIONS

BASIC RECEIVER TUNERS

PART NUMBER	NOMENCLATURE	FUNCTION
TN-200/WJ1140	TUNER, P-BAND	Provides preselection in specified band and conversion to IF. Sweeping YIG-tuned preselection and LO. Preamplifiers are provided for through preselector/postselector jacks on front panel. Single conversion tuner.
TN-300/WJ1140	TUNER, L-BAND	Same as above
TN-400/WJ1140	TUNER, S-BAND	Same as above
TN-500/WJ1140	TUNER, C-BAND	Same as above
TN-600/WJ1140	TUNER, X-BAND	Same as above
TN-700/WJ1140	TUNER, Ku-BAND	Same as above

NOTES:

1. Tuners are also available in the following configurations:

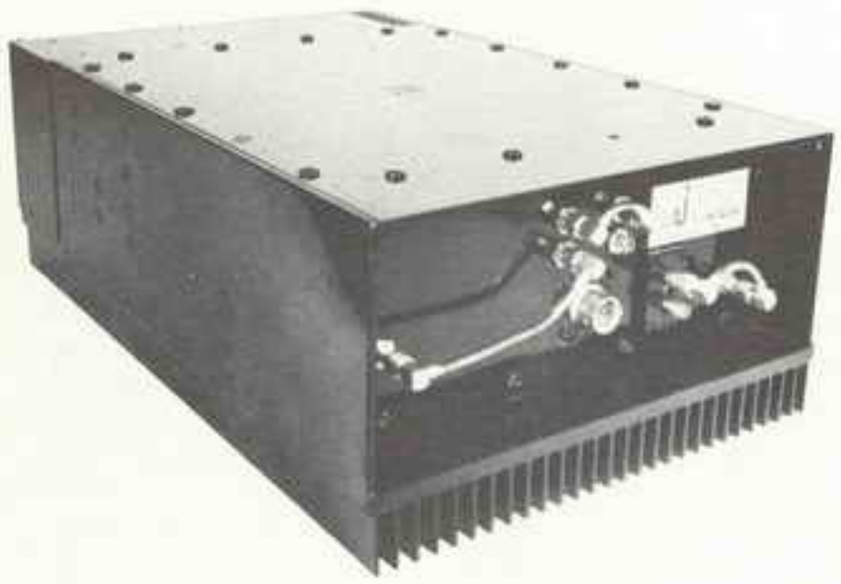
A. Single channel, dual conversion
B. Dual channel, dual conversion
C. Dual channel, single conversion

PART NUMBER	NOMENCLATURE	FUNCTION
IP–100/WJ1140	IF PAN DISPLAY	Panoramic display of activity in the IF passband. Display has variable sweep speed, variable dispersion and baseline clipping. Markers can be added as option.
IP–200/WJ1140	SPECTRUM DISPLAY	Activity indication of signals in the RF spectrum being covered by the receiver. Display has capability of presenting all six tuners in a "displaced by band" configuration. Also used as time base analysis display when receiver is not sweeping.
IP–300/WJ1140	FALLING RASTER DISPLAY	Display uses storage oscilloscope to integrate RF activity in a frequency (horizontal) versus time (vertical) versus amplitude (intensity) presentation.
CS–100/WJ1140	SECTOR CONTROL	Controls upper and lower limit of tuner frequency coverage for limited band applications. Thumbwheel front panel switches set limits by direct frequency reading adjustment.
MU–100/WJ1140	MEMORY UNIT	Memory unit has 16 addresses and is of scratch pad type flip-flop instead of magnetic cores. Frequency lockout or recall can be controlled from memory unit.
ID–200/WJ1140	ANALYSIS DISPLAY	Nixie readout of frequency, pulse repetition interval (PRI) and pulse width of signal to which receiver is tuned. Also contains threshold control for stopping receiver as a function of signal amplitude.
IO–100/WJ1140	COMPUTER/RECORDER INTERFACE	Provides for interface of digital general purpose computer to receiver. All functions controlled by C-100/WJ1140, receiver control unit, can be controlled by computer. In addition, sector control can be controlled by computer. Recorders of various types, including magnetic tape, hard teletype copy and paper punch are also interfaced through IO-100/WJ1140.
CM–100/WJ1140	PREPROCESSOR/SORTER	Performs sorting function on input signals using frequency, PRI and pulse width as criteria. Can be used to eliminate or accept only those signals meeting a set of selected parameters.
PP–100/WJ1140	MULTI-TUNER POWER SUPPLY	Provides power for several tuners. Allows power supplies to be removed from tuners to reduce size and weight.
O–100/WJ1140	SYNTHESIZED LO LOCK BOX	Provides phase locking circuitry to acquire and stabilize local oscillators in tuners. Gives tuners a frequency accuracy of 0.5 parts in 10^8. Available in individual or multiband configurations.
NONE	JUNCTION BOXES	Provide hard wired interfaces for connecting various modules together.
NONE	CABLING	Provides interconnecting cabling for various configurations of receiver.

Tuners

The tuners listed in the chart at left can be used in a variety of receiving systems to cover the frequency range from 500 kHz to 18 GHz. These tuners convert the input signals to standard IF frequencies for amplification and demodulation. Tuners with an "S" prefix have built-in motor drive to provide either complete or sector scanning of the band in operation.

ST-1045A Shown



WJ-1033, -34, -35, -36, -37 & -38

A series of miniature microwave tuners designed to cover 0.5 GHz through 18 GHz and operate under severe environmental conditions. Continuous octave coverage, high tuning accuracy and minimum power consumption are featured in these all-solid-state-component tuners. No external cooling is required.

WJ-1091, -92, -93, -94, -95 & -96

A series of VHF/UHF (30 MHz to 1 GHz) scanning superheterodyne tuners with channelized preselection. This unique method of RF preselection eliminates the need for varactors and variable inductors, and makes the tuners ideal as receiver front ends for reconnaissance and ELINT applications.

TUNER SPECIFICATIONS

Model	*Bands*	*Range*	*Maximum Noise Figure*	*IF Output*	*Minimum Bandwidth*
HT-10, SHT-10	1	500 kHz–10 MHz	7dB	21.4 MHz	400 kHz
VT-11, SVT-11	1	10–30 MHz	6dB	21.4 MHz	2 MHz
VT-10, SVT-10	2	10–30 MHz	7dB	21.4 MHz	2 MHz
		30–90 MHz	7dB	21.4 MHz	2 MHz
WJ-1091	1	30–50 MHz	6dB	21.4 MHz	300 kHz
VT-30, SVT-30	2	30–60 MHz	6.5dB	21.4 MHz	3 MHz
		54–260 MHz	6.5dB	21.4 MHz	3 MHz
WJ-1092	1	50–100 MHz	7dB	21.4 MHz	300 kHz
WJ-1093	1	100–170 MHz	7.5dB	21.4 MHz	300 kHz
WJ-1094	1	170–250 MHz	9dB	21.4 MHz	300 kHz
UT-1000, SUT-1000	2	235–500 MHz	11dB	21.4 MHz	6 MHz
		490–1000 MHz	14dB	21.4 MHz	8 MHz
WJ-1095	1	250–500 MHz	10dB	21.4 MHz	300 kHz
WJ-1096	1	500–1000 MHz	12dB	60 MHz	300 kHz
WJ-1033-1	1	500–1000 MHz	18dB	160 MHz	20 MHz
LT-1020, SLT-1020	1	0.95–2.05 GHz	18dB	21.4 MHz	8 MHz
ST-2045, SST-2045	1	1.95–4.5 GHz	18dB	21.4 MHz	8 MHz
ST-1045, SST-1045	2	0.95–2.05 GHz	18dB	21.4 MHz	8 MHz
		1.95–4.5 GHz	18dB	21.4 MHz	8 MHz
WJ-1034	1	1–2 GHz	15dB	160 MHz	30 MHz
WJ-1035	1	2–4 GHz	15dB	160 MHz	30 MHz
CT-4080, SCT-4080	1	4–8 GHz	18dB	21.4 MHz	8 MHz
WJ-1036	1	4–8 GHz	20dB	160 MHz	35 MHz
XT-8012, SXT-8012	1	8–12 GHz	18dB	21.4 MHz	8 MHz
WJ-1037	1	8–12 GHz	20dB	160 MHz	25 MHz
MT-112	4	1–2 GHz	10dB	160 MHz	20 MHz
		2–4 GHz	18dB	160 MHz	20 MHz
		4–8 GHz	18dB	160 MHz	20 MHz
		8–12 GHz	18dB	160 MHz	20 MHz
WJ-1038	1	12–18 GHz	20dB	160 MHz	30 MHz

MICROWAVE TUNER AND DEMODULATOR

MT-112

DM-112

The MT-112 Microwave Tuner and DM-112 Demodulator operate together to provide AM, FM, and pulse reception in the 1 GHz to 12 GHz frequency range. The MT-112 uses four tuning heads and converts signals in this frequency range to a 160-MHz IF output. The frequency ranges are: 1 to 2 GHz, 2 to 4 GHz, 4 to 8 GHz, and 8 to 12 GHz. All four tuning heads are installed in the MT-112 and any one can be selected for operation by a front-panel switch. The 160-MHz output from the selected tuner is available at a common output jack.

The common 160-MHz IF output from the MT-112 is normally used as the input to the DM-112 Demodulator. This unit has five IF bandwidths: 100 kHz, 2 MHz, 4 MHz, 10 MHz, and 20 MHz. The DM-112 includes a built-in signal monitor operating from the 160-MHz IF input. The signal monitor has a maximum sweepwidth of 20 MHz; its sweep rate is continuously variable from 5 Hz to 25 Hz. Predetection outputs are provided at 160 MHz and at the second IF of 21.4 MHz. Additional outputs include video, audio, tuner AGC, tuner AFC, and 21.4 MHz signal monitor.

For other equipment in this range, please refer to the earlier description on the 112 Receiver.

FREQUENCY EXTENDERS

FE-26 Shown

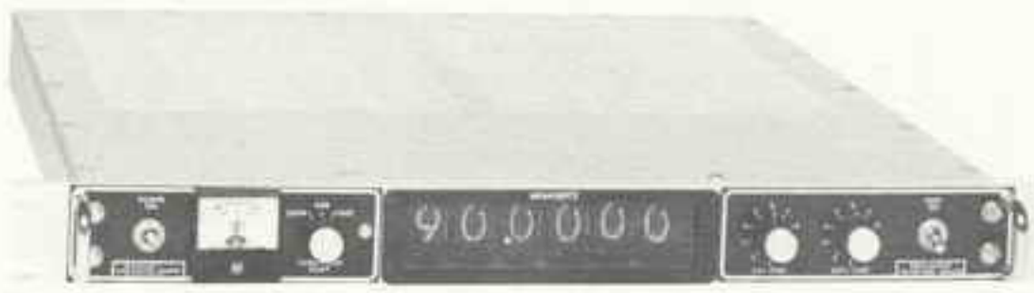
The frequency coverage of VHF receivers such as the 501A, 901B or 977 may be extended to include HF, UHF and SHF regions through the use of frequency extenders. Types FE-1-2B, FE-2-4.5A, FE-1-4.5A, FE-8-12 have a tunable four-section YIG preselector for each band. FE-26 has built-in Signal Monitor which provides a visual display of signals in a band 3 MHz around the received signal.

FREQUENCY EXTENDER SPECIFICATIONS

Model	*Bands*	*Range*	*Maximum Noise Figure*	*IF Output*
FE-103	1	10-30 MHz	6 dB	60 MHz
FE-25-1	2	235-500 MHz	10 dB	60 MHz
		490-1000 MHz	12 dB	
FE-26	2	235-500 MHz	10 dB	60 MHz
		490-1000 MHz	12 dB	
FE-1-2B	1	1-2 GHz	18 dB	160 MHz
FE-2-4.5A	1	1.95-4.5 GHz	18 dB	160 MHz
FE-1-4.5A	2	0.95-2.05 GHz	18 dB	160 MHz
		1.95-4.5 GHz	18 dB	160 MHz
FE-4-8	1	4-8 GHz	18 dB	160 MHz
FE-8-12	1	8-12 GHz	18 dB	160 MHz

DRO-290A DIGITAL READOUT

Companion unit for 521A Receiver. Provides 6-digit display of received frequency. Provides a readout range of 20 MHz to 90 MHz with a 10 MHz offset. Features dual DAFC (digital automatic frequency control) when used with 521A receiver. Has a ±100 Hz resolution. Compact unit occupies only 1.75 inches of vertical space.



DRO-300A DIGITAL READOUT

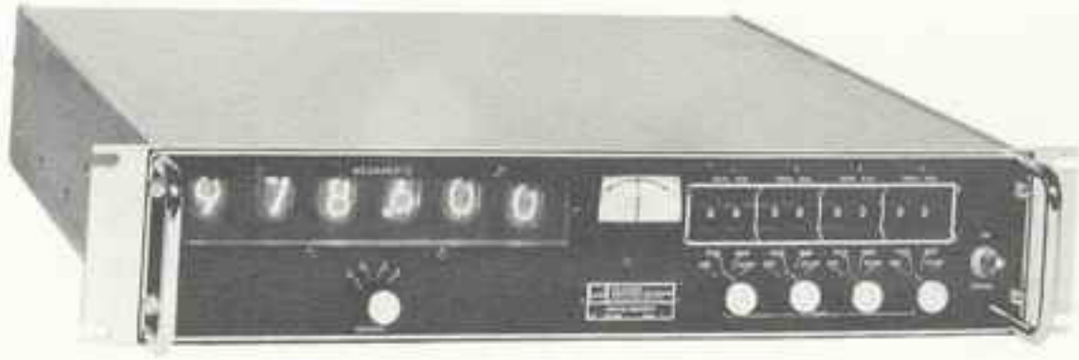
Advanced design provides a six-digit display in 1.75 inches of vertical space. For operation over the range of 30-300 MHz with receivers having a 21.4-MHz IF. Resolution is ±100 Hz from 10 kHz to 30 MHz and ±1 kHz from 30 MHz to 300 MHz. With DRX-1000 Readout Extender, can indicate frequencies up to 1000 MHz. Includes DAFC to lock VHF receivers to desired frequencies in 1-kHz increments.

DRO-302A-2 DIGITAL READOUT

Indicate tuned frequency of receivers having a 21.4 MHz IF over the frequency range of 30 MHz to 300 MHz. 6-digit display. Provisions for changing internal preset so that tuned frequency of HF receivers can be indicated down to 10 kHz. Resolution of ±100 Hz in 10 kHz to 30 MHz range; ±1 kHz, 30-300 MHz range. Features digital automatic frequency control (DAFC) and BCD output. Half-rack size mounts in EF-101 or EF-201C frame.

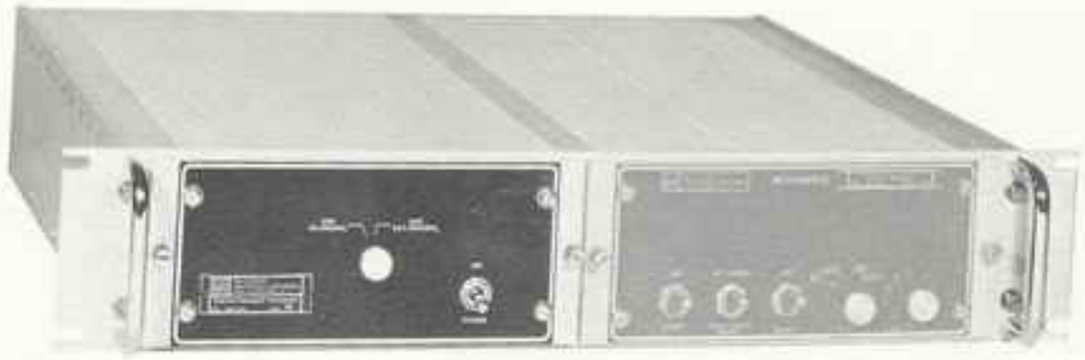
DRO-307 DIGITAL READOUT

Time-shared counter for readout of up to 4 VHF receivers. Readout range from 30 to 300 MHz with 21.4-MHz offset. Resolution is ±1 kHz. DAFC voltages from last two digits available for all receivers. Continuously updated BCD output of tuned frequency of each receiver available on command.



DRX-1000 READOUT EXTENDER

Extends range of DRO-300A or DRO-302A digital readout to 1000 MHz when used with CEI Division UHF receivers. Also extends DAFC capability. Half-rack size, 3½" high by 7.9" wide. DRO-302A and DRX-1000 can be used together in equipment frame EF-201C for standard 19-inch rack mounting.

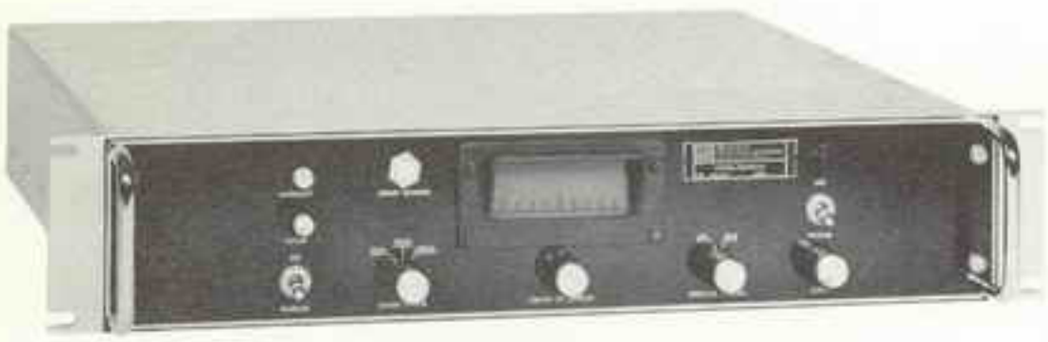


SM-1622 SIGNAL MONITOR

Companion unit for 112 Microwave Receiver and other receivers or tuners with 160-MHz IF. The sweep width is continuously variable to 20 MHz. The sweep rate is variable from 5 Hz to 25 Hz. Mounts in EF-101 or EF-201C Equipment Frame.

SM-4301B SIGNAL MONITOR

Compact unit operates from 21.4-MHz IF output from receiver. Normally used with 415 or 416 Receivers. Has sweep width of 0-3 MHz, continuously variable with a 25 Hz sweep rate. All active elements are solid state except for CRT. Mounts in EF-401 through EF-404 Equipment Frames.

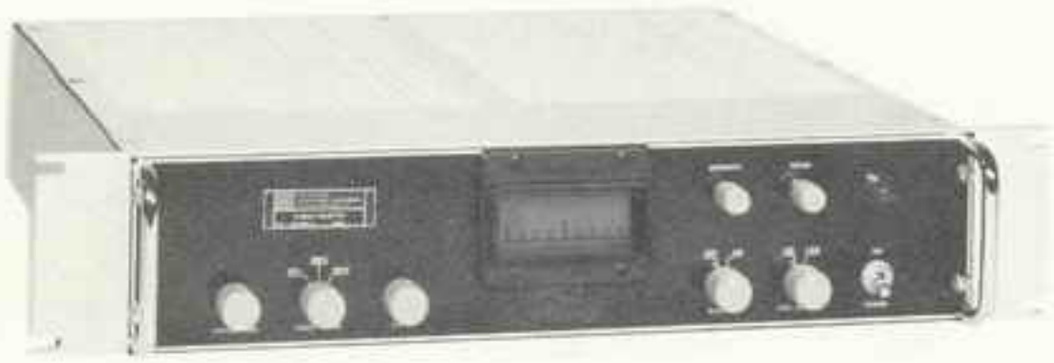


SM-8421 SIGNAL MONITOR

Operates from a 2-MHz IF output to provide visual display of signals in a band around the received signal. Sweep widths: 3 kHz, 15 kHz, 50 kHz. Operating accessory for VLF receivers such as the 357.

SM-8511 SIGNAL MONITOR

For use with HF receivers having a 500-kHz IF center frequency such as Collins 51S-1. Provides visual display of signals in a band around the received frequency. Sweep widths: 5, 20, 50, 200 kHz.



SM-8512 SIGNAL MONITOR

For use with HF receivers having a 455-kHz IF center frequency such as the R-390. Provides visual display of signals in a band around the received frequency. Sweep widths: 5, 20, 50 kHz, switch selectable.

SM-9304A SIGNAL MONITOR

Designed for use with CEI Division VHF and UHF receivers. Input response matches receiver 21.4-MHz mixer output response. Result provides a flat sweep width of 3 MHz. Variable sweep rate control provided to obtain optimum resolution at the sweep width being used. Half-rack unit mounts in EF-101 or EF-201C frame.

SM-9404A SIGNAL MONITOR

Operates from 21.4-MHz input. For use primarily with tuners having flat response at signal monitor output. Maximum sweep width is 4 MHz. Sweep rate continuously variable from 5 Hz to 25 Hz. Advanced design is all-solid-state except for the CRT. Mounts in EF-101 or EF-201C.

SM-9804A SIGNAL MONITOR

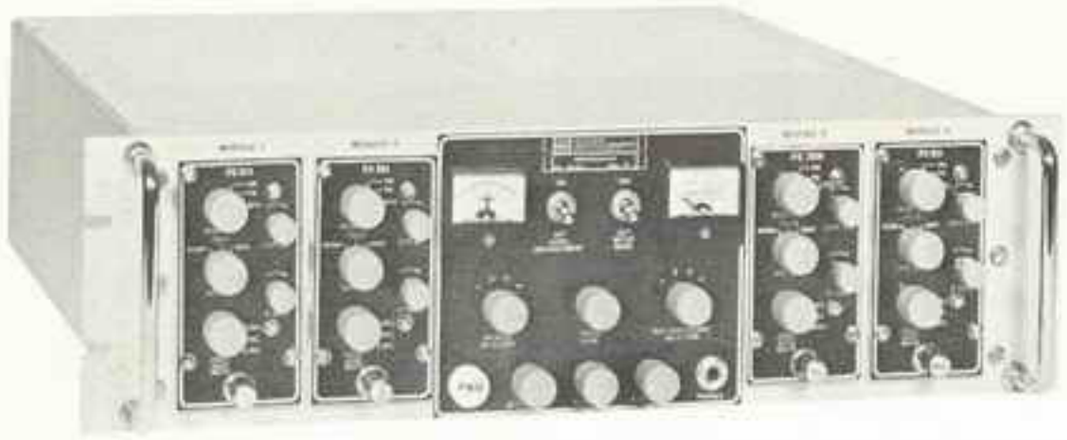
For use with wide bandwidth tuners (UT, LT, ST, CT, XT Series) installed in a receiving system such as the RS-125. Provides a visual display of signals in a band around the received signal. Operates from a 21.4-MHz input; response is flat to 8 MHz. Features solid state design, variable sweep width and sweep rate, and simplified maintenance. Requires EF-101 or EF-201C for mounting.

SM-9805A SIGNAL MONITOR

Input frequency is 21.4 MHz; input response is flat. Provides sweep width from 0 to 8 MHz. Sweep rate continuously variable from 5 to 20 Hz. This unit features a large CRT display with a choice of P1 or P7 persistence. The CRT is 2⅝ inches high and 4⅝ inches wide; overall panel height has been maintained at 3½ inches.

SM-9832A SIGNAL MONITOR

Operates from a 30-MHz IF output from a receiver and provides a visual display of signals in a band around the received signal. Has a built-in marker at 30 MHz which is actuated by a front-panel switch. Employs the latest solid-state design, offers high reliability, and low power consumption. Mounts in EF-101 or EF-201C frame.



DM-4CA DEMODULATOR

Accepts plug-in modules to provide AM, FM, CW, and pulse demodulation from a tuner providing a 21.4-MHz IF input signal (such as HT, VT, UT, LT, ST, CT, and XT series). Accepts 4 IFD modules or 3 IFD modules and 1 special-purpose module.

IFD-1000C Shown

IF DEMODULATOR MODULES

Provide AM, FM, and CW demodulation from an incoming 21.4-MHz IF signal. Units with bandwidths narrower than 100 kHz employ crystal filters and discriminators. Ten models available with bandwidths as follows: IFD-5C, 5 kHz; IFD-15C, 15 kHz; IFD-50C, 50 kHz; IFD-500C, 500 kHz; IFD-1000C, 1 MHz; IFD-2000C, 2 MHz; IFD-4000C, 4 MHz; IFD-8000C, 8 MHz.

AGC-BC/C, AGC-PS/C AGC MODULES

Special AGC modules operate from demodulated output of an IFD module. AGC-BC/C box car unit provides sample-and-hold, peak-type AGC voltage from an incoming pulse video signal, or averaged-type AGC from incoming AM or CW signal. AGC-PS/C pulse stretching unit provides peak-type AGC voltage from an incoming pulse video signal, or averaged-type AGC from CW signals.

IFD-LOG LOGARITHMIC AMPLIFIER

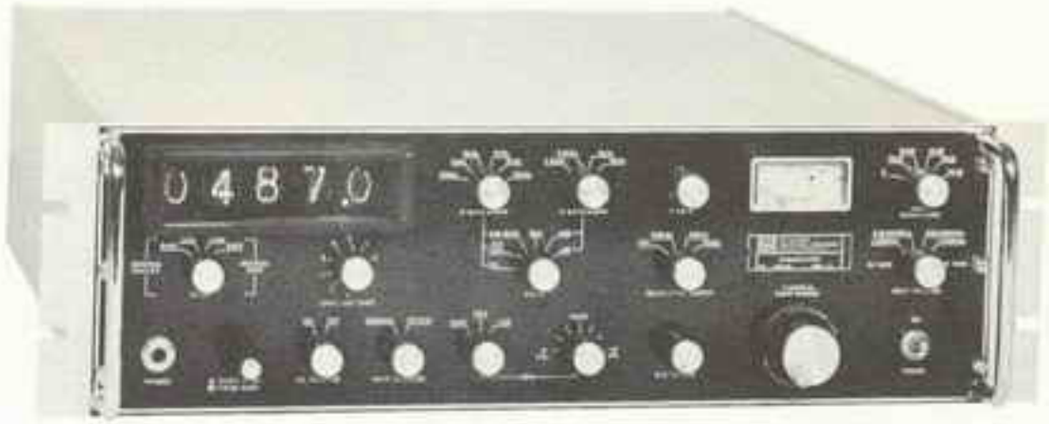
Special plug-in module designed for the reception of pulse-type signals. Gain adjusts instantaneously to prevent overload. Has wide dynamic range to accurately relate output pulse amplitude to signal level. Has wide bandwidth for use with fast-rise-time pulses.

NS-101BA NOISE SILENCER

Special plug-in module provides AM and CW demodulation from a 21.4-MHz center frequency input. Reduces pulse-type noise by using wideband limiting techniques prior to filtering.

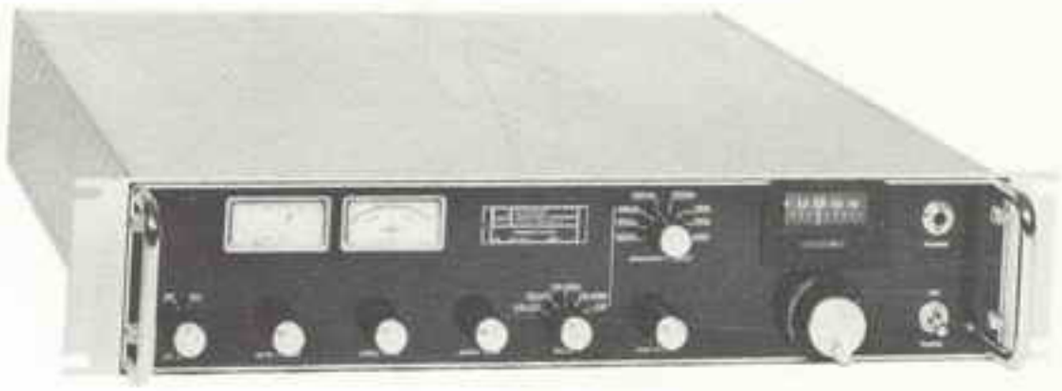
DMS-105 TUNABLE DEMODULATOR

Designed to demodulate AM, FM, SSB, CW, MCW, and FSK signals in the 1 kHz to 1600 kHz frequency range. Four IF bandwidths for SSB signals: 2.5, 3.5, 4, and 8 kHz. Six IF bandwidths for the remaining modes: 150 Hz, 1, 5, 7, 8, and 16 kHz. Built-in counter features 10 Hz resolution and DAFC which will lock the local oscillator to any 10 Hz increment in the tuning range.



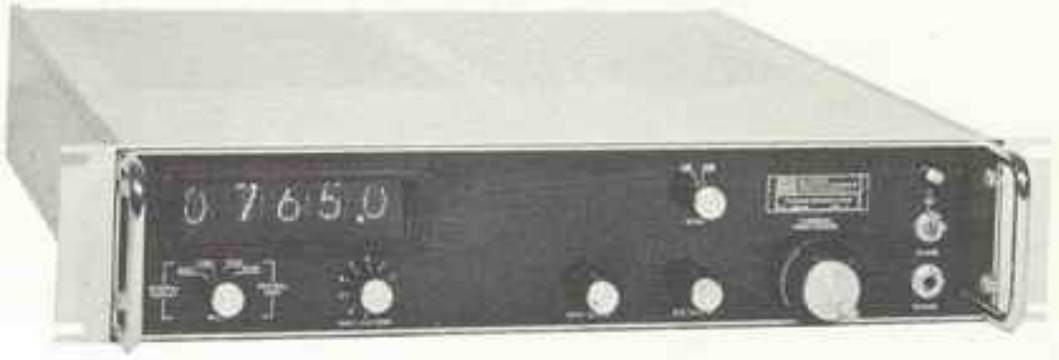
DMS-107 TUNABLE DEMODULATOR

Provides AM, FM, CW, and pulse reception in the 100 kHz to 10 MHz frequency range. Used to perform spectrum analysis of complex signals from the output of wideband tape recorders. Digital automatic frequency control (DAFC) from a DRO-302A-2 or DRO-320 counter can be used to lock the DMS-107 to any 100 Hz increment in the tuning range. Eight IF bandwidths provided: 20, 50, 100, 300, 500 kHz, and 1, 2, and 3 MHz.



DMS-109 TUNABLE DEMODULATOR

Provides SSB demodulation over frequency range of 5 kHz to 1 MHz. Either upper or lower sideband can be selected by front-panel switch. IF bandwidth is 2.8 kHz. Unit includes a built-in counter with five-digit display and digital automatic frequency control (DAFC). Using DAFC, the demodulator local oscillator can be locked to any desired 10 Hz increment in the tuning range.



OTHER DEMODULATORS

A variety of demodulators, both fixed and tunable, are available in addition to those already described. Some representative models are tabulated below.

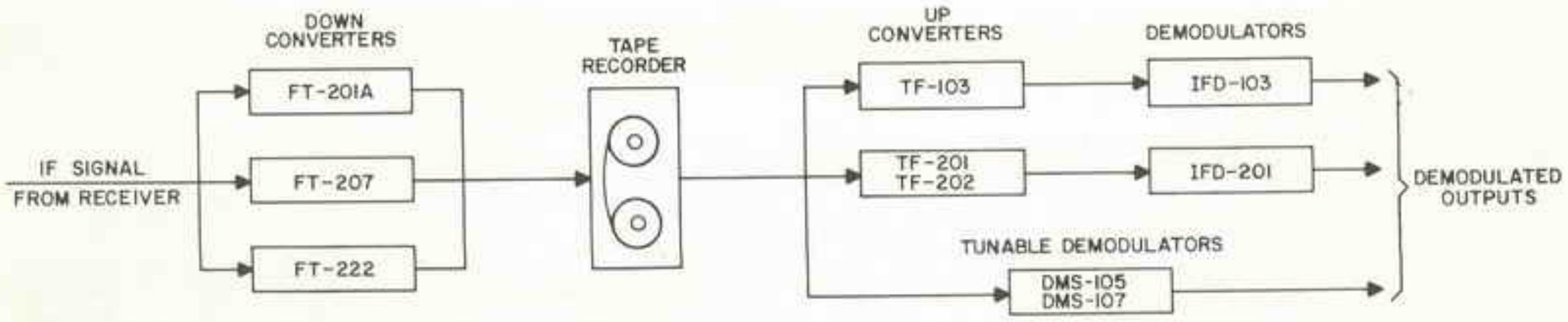
Model	*Center Frequency/ Tuning Range*	*Capability*	*IF Bandwidths*
DM-22A	21.4 MHz	AM	1.5 MHz
DM-160	160 MHz	AM, FM, pulse	350 kHz, 1.5 MHz, 4 MHz
DM-161	160 MHz	AM, FM, pulse	1, 5, 10, 20 MHz
DM-212	160 MHz	AM, FM, pulse	10, 20 MHz
DMS-201	0.5-10 MHz	CW, FSK	1, 3 kHz

Predetection Recording Systems

Predetection recording is a technique for recording an RF carrier and its associated sidebands in which the RF signal is heterodyned to lie within the frequency capabilities of a tape recorder. When playing back the recorded information, the system heterodynes the tape recorder output up to the input center frequency of a demodulator. As shown in the illustration below, there are four essential units in a typical predetection record/playback system: a down converter, a tape recorder, an up converter, and a demodulator. The down (IF-to-tape) converter accepts the IF center frequency from a receiver and produces an output center frequency compatible with the tape recorder being used. The up (tape-to-IF) converter receives the output of the tape recorder and heterodynes it to the input center frequency of the associated demodulator. The demodulator provides the desired bandwidth selection and detection capabilities.

Predetection recording offers advantages over other methods. First, incoming signals can be stored without prior knowledge of the type of modulation employed (AM, FM, CW, pulse) or the nature of the modulating signal. Second, the ability to record modulation components extending to very low frequencies is inherent in predetection recording and very difficult to obtain otherwise. Third, the gain stability and amplitude linearity of the tape recorder are less important than in post detection recording.

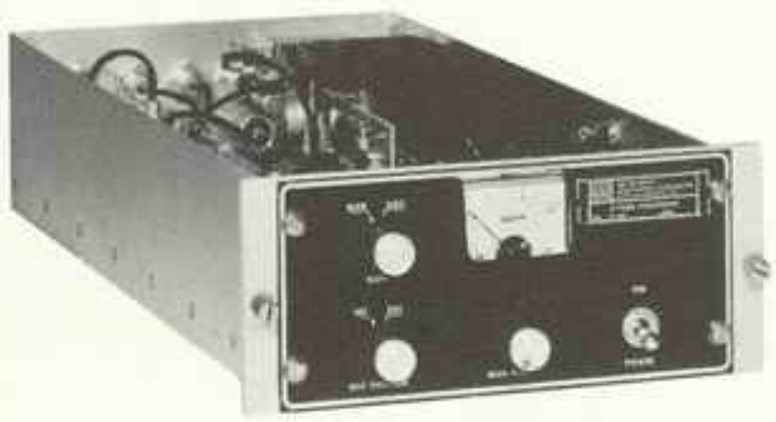
The diagram below shows several typical components available for use with tape recorders of three different bandwidths.



Block Diagram, Predetection Recording and Playback System

FT-201A IF-TAPE CONVERTER

Accepts 21.4-MHz IF output from receivers and translates this signal to one which can be recorded. For use with tape recorders with a frequency cutoff of 1.5 MHz. Data bandwidth: 100 kHz to 1.4 MHz. Output center frequency is 750 kHz. The FT-201A is a half-rack size which mounts in an EF-101 or EF-201C frame.



FT-207 IF-TAPE CONVERTER

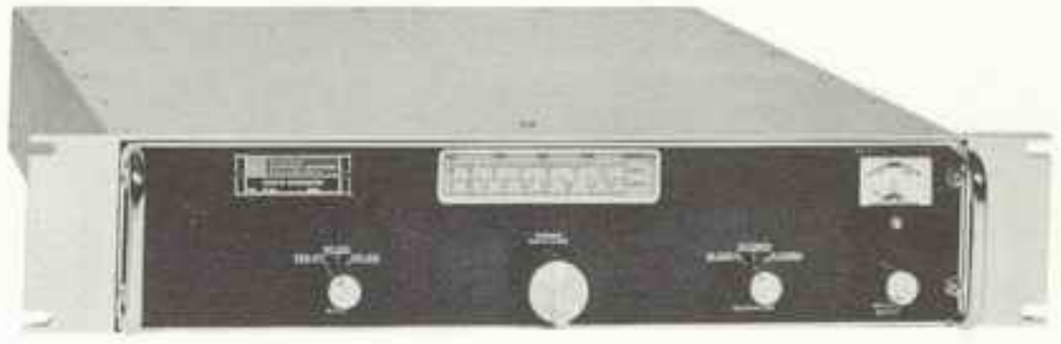
Wideband down converter accepts input spectrum centered at 21.4 MHz and translates it to one centered at 2.15 MHz for recording on a tape recorder which has a 4-MHz bandwidth. Either manual or automatic gain control may be selected. Output data bandwidth from 300 kHz to 4 MHz. Half rack size.

FT-222 IF-TAPE CONVERTER

Narrowband predetection converter provides output center frequency between 20 kHz and 200 kHz from an input signal at 21.4 MHz. For use with tape recorders having a bandwidth of less than 500 kHz. Output center frequency is customer selected by changing a crystal. Data bandwidth is equal to center frequency. Mounts in EF-101 or EF-201C frame.

TF-103 TAPE-IF CONVERTER

Provides a 21.4-MHz center frequency IF output from input video signals in the 40 kHz to 4 MHz frequency range. Input range covered in three bands: 40-250 kHz, 150 kHz-1.5 MHz, and 400 kHz-4 MHz. Tuning provided to convert any frequency within a band to the 21.4-MHz center frequency. Manual gain control and output level meter provided. Four use with wideband tape recorders. Companion demodulator is the IFD-103.



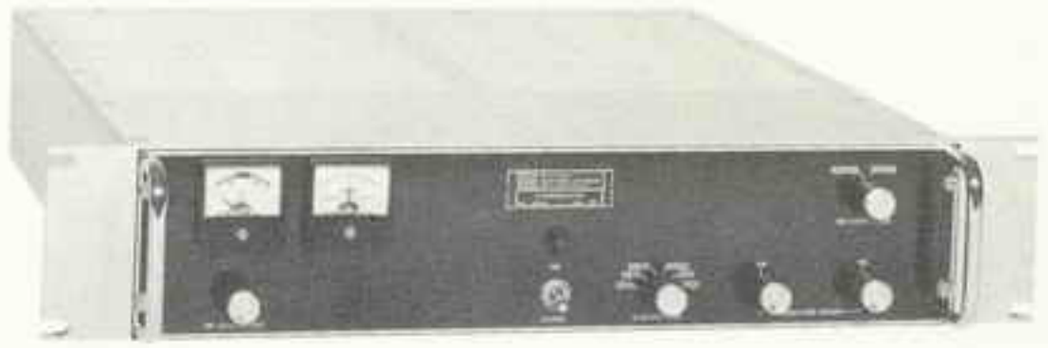
TF-201, TF-202 PREDETECTION CONVERTER

Translate output signal from a tape recorder having a 1.5 MHz bandwidth up to 21.4 MHz for demodulation. Data bandwidth is 1.3 MHz when input center frequency is 750 kHz. Units are half-rack size for mounting in an EF-101 or EF-201C equipment frame. The TF-202 includes tuning controls to maintain output frequency at 21.4 MHz for an input center frequency between 100 kHz and 1.4 MHz. This permits separation of a narrow-band signal from the complete band.

TF-202 Shown

IFD-103 IF DEMODULATOR

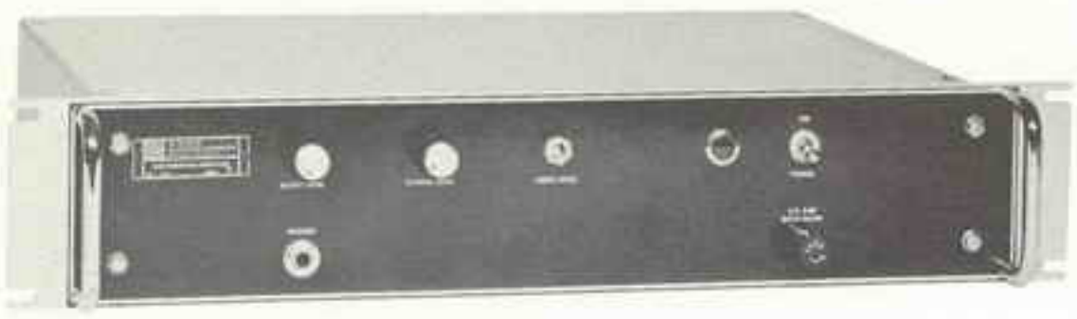
Accepts the 21.4-MHz output from an up converter. Provides bandwidth selection and AM and FM demodulation. Has IF bandwidths of 10, 50, 100, and 300 kHz, 1 and 3 MHz. Provides a predetection IF output in addition to AM and FM video outputs.



IFD-201 IF DEMODULATOR

Accepts the 21.4-MHz output from an up converter. Provides bandwidth selection and AM and FM demodulation. Has IF bandwidths of 10, 50, 300, and 1000 kHz. Provides separate AM and FM video outputs.

DA-1 VIDEO DISTRIBUTION AMPLIFIER



Provides nine separate outputs from a common video input. Six data outputs are identical. They will deliver 1.5V rms, into a 91-ohm load with a frequency response of 30 Hz to 2 MHz. The seventh output is for oscilloscope display and is similar to the six data outputs except gain is unity with respect to input. The eight and ninth outputs provide 600-ohm loudspeaker and 1000-ohm headset audio over a frequency range of 200 Hz to 15 kHz at levels of 100 mW and 10 mW, respectively.

DA-5 AUDIO DISTRIBUTION AMPLIFIER

Provides five isolated audio outputs from a common input. Each output will deliver 100 mW into a 600-ohm or 150-ohm load with a frequency response of 150 Hz to 10 kHz. Internally adjusted gain controls set amplitude of each output signal.

EF-201C

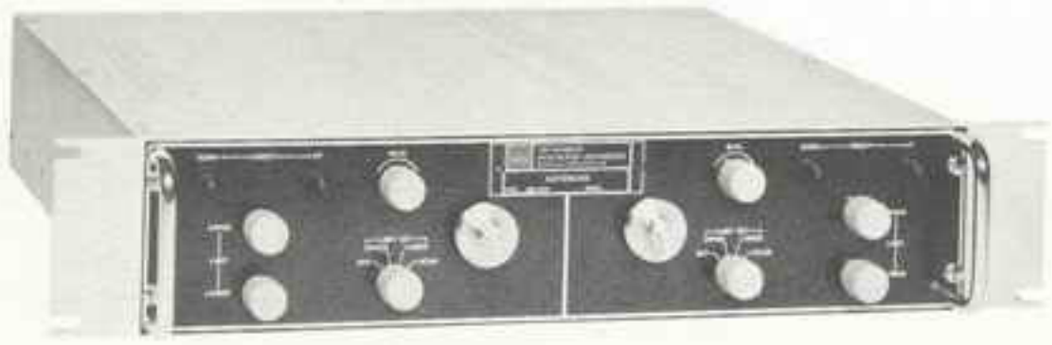
EF-402

EF-506

EQUIPMENT FRAMES

Model	*Openings*	*Dimensions*
EF-101	1	3¼" x 8"
EF-201C	2	3¼" x 8"
EF-401	1	6¾" x 3¾"
EF-402	2	6¾" x 3¾"
EF-403	3	6¾" x 3¾"
EF-404	4	6¾" x 3¾"
EF-506	6	2½" x 4½"

Various equipment frames are available. Some representative types are listed to the left. The EF-101 and EF-201C are used to mount half-rack units such as the S-9203 shown on the next page. The EF-401 through EF-404 are used to mount 415 or 416 receivers or an SM-4301B signal monitor. The EF-506 is used to mount 440 or 441 receivers which could also be mounted in the PEC-401 portable equipment case.

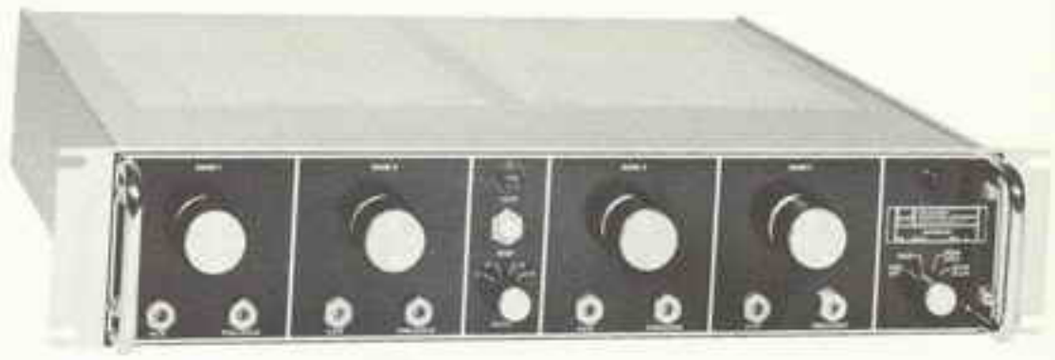


MD-50, MD-100 AUTOSCANS

Motor drive units used to adapt manual receivers for mechanical scanning. The MD-50 is single channel for use with receivers having a single tuning knob. The MD-100 has two channels for use with receivers having two tuning knobs. We invite inquiries concerning the use of these devices.

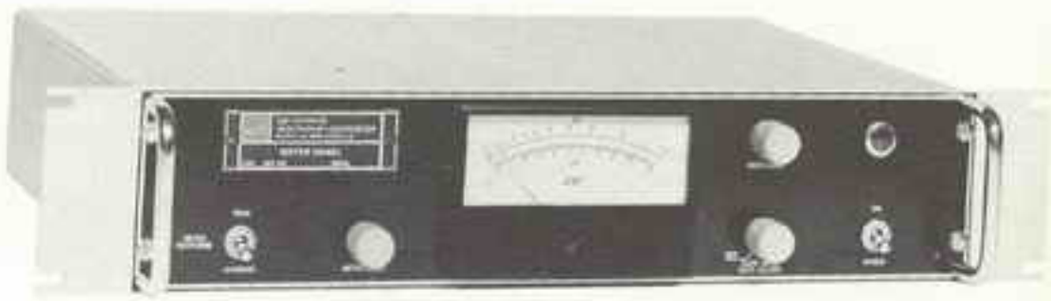
MD-104 AUTOSCAN

For operation with RS-111-1B-17 Receiving System. Scans signals without an operator. Externally drives tuning knobs on the receiver and provides electrical "command" to auxiliary equipment such as printer, recorder, etc. Four channels, each channel controlling one drive pulley. Variable scan speed and variable threshold level adjustments; manual, auto-scan and scan-lock operation. Standard rack mount, 3.5 inches high.



MP-101, MP-102 METER PANELS

Operate from the 21.4-MHz IF output from a receiver. The MP-101 converts a tunable receiver to a selective comparison voltmeter. Either peak or average response can be selected. Variable slide-back-gate included. The MP-102 converts a tunable receiver into a frequency deviation meter. Provides FM deviation ranges from 3 kHz to 300 kHz in three bands. Accurate indications provided of the peak deviation of sine-wave modulation.



MP-101 Shown

S-9902A SPEAKER PANEL

Selects one of six inputs for monitoring. Input transformer matches speaker to 600-ohm line. Unselected inputs are terminated in 600-ohm resistors. Will accept up to a 4 watt input for high-level monitoring.

S-9203, S-9903D SPEAKER PANELS

Integral solid-state amplifier and power supply. Provide high-level audio monitoring through front-panel speakers from five-watt amplifiers. Have seven selectable inputs. Input impedance is 10,000 ohms for bridging audio lines. The S-9203 is half-rack size for mounting in EF-201C equipment frame. The S-9903D mounts in a standard 19-inch rack.

SOR-1A SIGNAL OPERATED RELAY

Solid-state device operates a relay when activated by any one of three selectable inputs: voice frequency, positive-going dc, or negative-going dc. Designed to activate tape recorders or other remote devices in response to audio or AGC signals from a receiver.

TDS-100 Carrier Demultiplexing System

The TDS-100 Carrier Demultiplexing System is designed to monitor and evaluate the electromagnetic integrity of microwave telephone signals in the 3.7 to 4.2 GHz frequency band. Recommendations of the CCITT have been followed for frequency allocations, so the equipment can be used world wide. The actual frequency allocations can be found in the "Reference Data for Radio Engineers", MIL-STD-188B, and numerous other publications. A building block scheme has been used for system development which permits the user to assemble a system to meet his particular requirement at minimum cost. Units presently available will simultaneously demodulate all 960 channels of CCITT supergroups 1 through 16. Push-button switches on the system's frequency converters and demodulators make it possible to apply any desired channel to a monitor speaker or headphones. For the user who is interested in only selected channels, or can accommodate only a small number of channels simultaneously, the flexibility offered by the push-button approach plus the building block approach makes tailoring a system to do the job a simple matter, requiring a minimum of hardware.

Complete systems from antenna to speaker can be assembled from the following equipments:

Type FE-3442 Tuner
Type IFD-210 IF Demodulator
Type SM-1622 Signal Monitor
Type TFC-101 Supergroup Converter
(Supergroups 1 through 10)
Type TFC-105 Supergroup Converter
(Supergroups 11 through 16)
Type TFC-212 Basic Supergroup Converter
Type TDM-101 Basic Group Demodulator
Type TDM-110 Basic Group Demodulator
(Ten inputs)
Type PR-101 Low Noise Preamplifier
Type ANT-101 Antenna
Type APR-101 Antenna-Preamplifier

With the exception of a ceramic triode local oscillator in the RF tuner and the CRT display in the signal monitor, all active elements are solid state. The resulting low power consumption and light weight make TDS-100 systems ideally suited for mobile applications or for applications in which the system must be transported frequently.

The basic CCITT multiplexing scheme consists of allotting 4 kHz to each voice channel. Twelve such channels are multiplexed in the 60 to 108 kHz band. Each channel is single sideband with suppressed carrier. This constitutes the basic group 12-channel building block. The TDM-101 accepts the 60-108 kHz input and simultaneously demodulates the twelve voice channels. Each of the twelve outputs from the demodulator are suitable for driving audio power amplifiers, tape recorders, or other devices.

Another demodulator option available in the TDS-100 system is the TDM-110. This unit contains ten independent base group demodulators, each of which can select one of the twelve channels by means of front-panel thumb-wheel switches. Thus, the TDM-110 can provide ten outputs; one selected voice channel from each of ten 12-channel basic group inputs.

Demultiplexing of video signals down to the 12-channel basic group level is accomplished by the TFC-101 and TFC-105 Supergroup Converters and the TFC-212 Basic Supergroup Converter. The TFC-101 accepts CCITT supergroups 1 through 10 containing up to 600 voice channels and converts each supergroup to a standard 60-channel basic supergroup covering the frequency range of 312 to 552 kHz. For a 960-channel system the TFC-105 is required for converting supergroups 11 through 16 to the 312 to 552 kHz range. Once the signals are available in the 60-channel basic supergroup format, the TFC-212 then further demultiplexes each basic supergroup into five 12-channel basic groups which are then ready for demodulation by the TDM-101 or TDM-110.

For the simultaneous demodulation of all channels of a 600-channel system, a TFC-101, ten TFC-212's, and fifty TDM-101's would be required. For a 960-channel system, the TFC-105, six additional TFC-212's and thirty additional TDM-101's are required. To select any basic group out of a 600-channel system requires only a single TFC-101, TFC-212, and TDM-101. By use of the push-button switches on the units any one channel of the 600 can be routed to a monitor speaker or recorder. With the TFC-105

added, any one of 960 channels can be selected. In many applications system flexibility can be increased by using the TDM-110 rather than the TDM-101. For example, five TDM-110's can replace fifty TDM-101's in a 600-channel system, making it possible to simultaneously monitor any fifty selected channels. A single TDM-110 fed by two TFC-212's permits monitoring ten channels out of two selected supergroups provided by a TFC-101 or a TFC-105.

The FE-3442 provides continuous tuning of the 3.4 to 4.2 GHz frequency band allocated to telephone signal transmission. Its output center frequency is 160 MHz with an overall bandwidth of 20 MHz. A visual display of signal activity about the tuned frequency is provided by a SM-1622 Signal Monitor. The 160-MHz output from the RF tuner is fed to the IFD-210 which provides FM demodulation of the input signal. Two IF bandwidths are provided in the IFD-210, 10 MHz and 22 MHz. Its video bandwidth extends to 8.5 MHz, making the IFD-210 suitable for use in demultiplexing systems of up to 1800 channels. An AGC voltage is generated in the IFD-210 to control the gain of its own IF amplifier stages, as well as provide gain control of the FE-3442.

A number of antenna and preamplifier options are available in the TDS-100. For installations where the RF signal level is relatively high and the antenna lead-in relatively short, the FE-3442 can be connected directly to an ANT-101 Antenna. The ANT-101 is a linear microwave horn with a minimum power gain of 12 dB and a beamwidth of 25°. It is designed for tripod mounting, but the tripod is not included with the ANT-101.

Where weak signals are encountered or appreciable cable runs are required, the APR-101 is recommended. This unit consists of an ANT-101 with a tunnel diode preamplifier built on to the antenna. The amplifier provides a minimum gain of 22 dB over the 3.7 to 4.2 GHz frequency range and has a noise figure of 4.5 dB. Like the ANT-101, the APR-101 is also designed for tripod mounting, but the tripod is not supplied.

For installations in which the cable losses exceed approximately 18 dB from the APR-101 to the tuner, the PR-101 Preamplifier is available to provide the necessary gain to preserve the system noise figure. The PR-101 incorporates the same tunnel diode amplifier used in the APR-101, but is packaged in a standard 19-inch rack mounting housing which occupies 3.5 inches of vertical rack space.

Although not a part of the TDS-100 system, the CEI Division has in production the TDM-102 Demodulator for the CCITT Base Group "A". This base group consists of twelve voice channels covering the frequency range of 12 to 60 kHz. The TDM-102 functions identically to the TDM-101; it differs only in the frequency of the input band.

The SM-6108 Signal Monitor is also available to display the entire 60-108 kHz base group band and provide an indication of activity in any of the twelve channels.

Detailed specification sheets are available for all the units discussed; contact the Sales Department of the CEI Division or your CEI representative. Technical assistance is also available to advise on telephone system demultiplexing problems.

SPECIFICATIONS

ANT-101 ANTENNA

Power Gain	12 dB, minimum
3dB Beamwidth	25° approximately

APR-101 ANTENNA/PREAMPLIFIER

Antenna Power Gain	12 dB, minimum
Antenna 3-dB Beamwidth	25°, approximately
Preamplifier Gain	23 dB, nominal
Noise Figure	4.5 dB, maximum
Bandwidth	500 MHz
Center Frequency	3.95 GHz

PR-101 PREAMPLIFIER

Center Frequency	3.95 GHz
Bandwidth	500 MHz
Noise Figure	4.5 dB, maximum
Gain	23 dB, nominal

FE-3442 TUNER

Tuning Range	3.4 to 4.2 GHz
Noise Figure	15 dB, typical
RF Bandwidth	20 MHz
Output Frequency	160 MHz
Gain	20 dB, nominal

SM-1622 SIGNAL MONITOR

Input Center Frequency	160 MHz
Sweepwidth	20 MHz, maximum
Sweep Rate	5 Hz to 25 Hz
Resolution	200 kHz, maximum

IFD-210 IF DEMODULATOR

Input Center Frequency	160 MHz
Type of Demodulation	FM
IF Bandwidths	10 MHz and 22 MHz
Video Bandwith	8.5 MHz

TFC-101 CONVERTER

Input Frequency Range	60 kHz to 4 MHz
Number of Outputs	Twelve: for supergroups 1 through 10 and 2 optional supergroups
Output Frequency Range	312 to 552 kHz
Monitor Output	Any one of twelve outputs can be selected for monitoring by front-panel switch

TFC-105 CONVERTER

Input Frequency Range	2548 to 4028 kHz
Number of Outputs	Six: for supergroups 11 through 16
Output Frequency Range	312 to 552 kHz
Monitor Output	Any one of six outputs can be selected for monitoring by front-panel switch

TFC-212 CONVERTER

Input Frequency Range	312 to 552 kHz
Output Frequency Range	60 to 108 kHz
Number of Outputs	Five
Monitor Output	Any one of five outputs can be selected for monitoring by front-panel switch

TDM-101 DEMODULATOR

Input Frequency Range	60 to 108 kHz
Type of Demodulation	SSB
Number of Outputs	Twelve
Output Frequency Range	300 Hz to 3.5 kHz
Monitor Output	Any one of twelve outputs can be selected for monitoring by front-panel switch

TDM-110 DEMODULATOR

Number of Inputs	Ten
Input Frequency Range	60 to 108 kHz
Type of Demodulation	SSB
Number of Outputs	Ten
Output Frequency Range	300 Hz to 3.5 kHz
Output Channel Selection	Any one of twelve channels on all ten outputs may be selected by front-panel switches

TDM-102 DEMODULATOR

Input Frequency Range	12 to 60 kHz
Type of Demodulation	SSB
Number of Outputs	Twelve
Output Frequency Range	300 Hz to 3.5 kHz
Monitor Output	Any one of twelve outputs can be selected for monitoring by front-panel switch

Surveillance Antennas

Watkins-Johnson offers a wide selection of VHF/UHF/Microwave antennas for use with the receivers and receiving systems described in this brochure. A summary of these antennas appears on the following pages. Complete performance data for each antenna is presented in a separate brochure entitled "Surveillance Antennas," which is available from W-J Applications Engineering, Palo Alto, California.

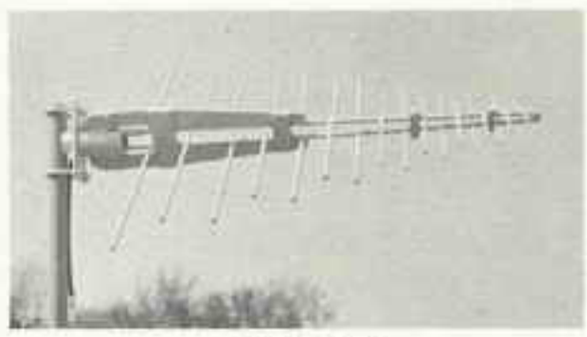
BALANCED LOOP ANTENNAS

AR72-4

Antenna Model Number	Frequency Range	Gain	How Polarized	Radiation Patterns
AR23-4	2–30 MHz	See curve	In plane of loop	Bi-directive figure eight
AR72-4	30–160 MHz	See curve	In plane of loop	Bi-directive figure eight

STANDARD LOG PERIODIC ANTENNAS

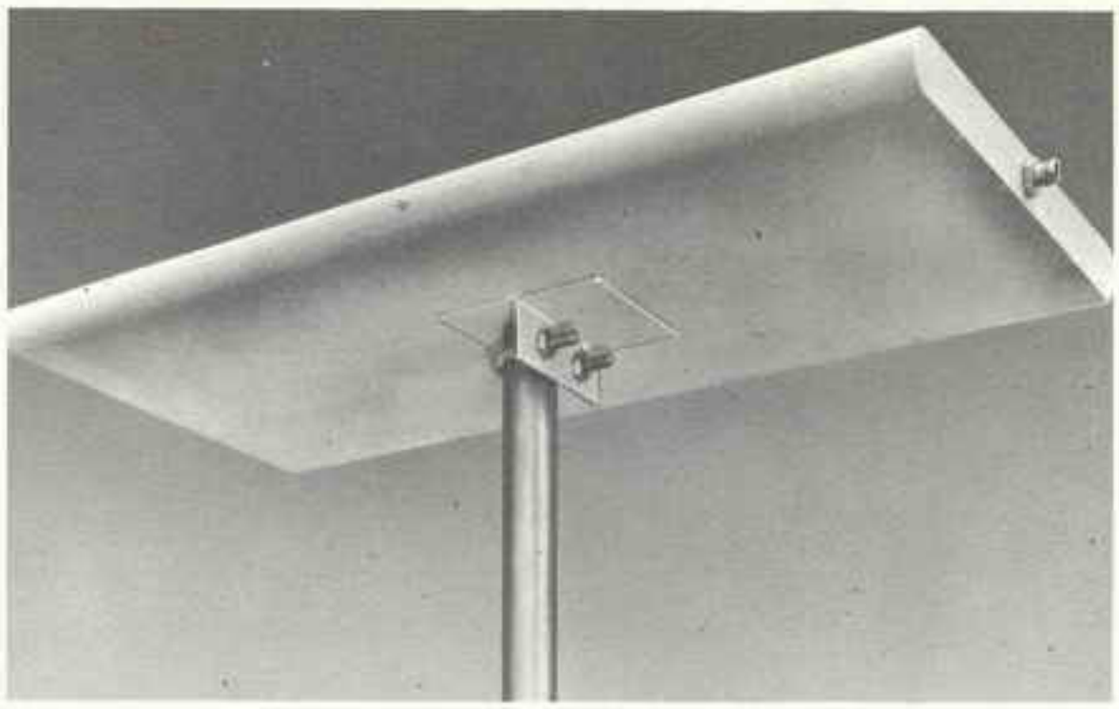
AR7-15



AR12-20

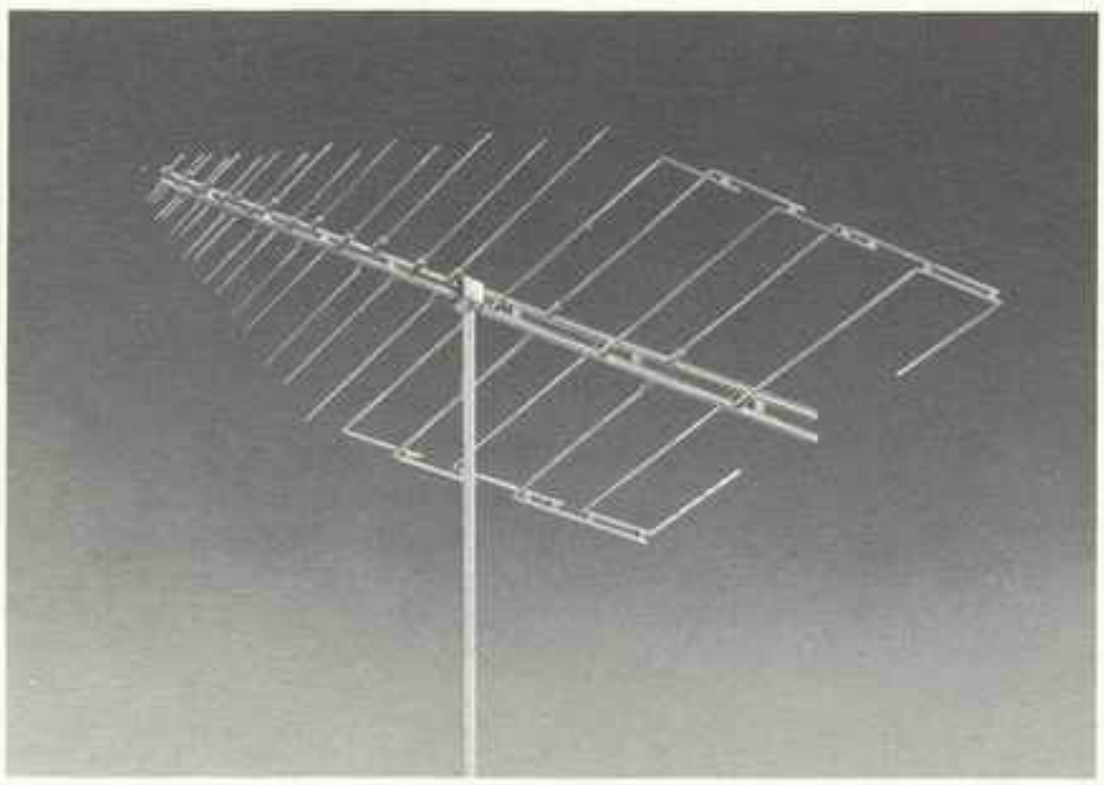
Antenna Model Number	Frequency Range	VSWR (Max)	Gain (Nominal)	How Polarized	Front-to-Back Ratio (Minimum)	Cross Polarization (Minimum)	Side Lobes (Nominal)	Power Handling Capacity	
								Peak	Avg
AR7-15	1 to 12.4 GHz	2.25:1	8 db	Linear	18 db	15 db(1-8 GHz) 10 db(8-12 GHz)	15 db	25 W	5 W
AR7-17	0.5 to 12.4 GHz	2.25:1	same	same	18 db	15 db(.5-8 GHz) 10 db(8-12 GHz)	18 db	25 W	5 W
AR12-18	30 to 1100 MHz	2.25:1	same	same	20 db	15 db	18 db	1 kw	25 W
AR12-19	90 to 1100 MHz	2.25:1	same	same	20 db	same	18 db	1 kw	25 W
AR12-20	250 to 1100 MHz	2:1	same	same	20 db	same	18 db	1 kw	25 W
AR12-22	30 to 160 MHz	2.25:1	same	same	20 db	same	18 db	1 kw	25 W
AR12-25	30 to 76 MHz	2:1	same	same	20 db	same	18 db	1 kw	25 W
AR12-29	30 to 300 MHz	2.25:1	same	same	20 db	same	18 db	1 kw	25 W

COMPACTED LOG PERIODIC ANTENNAS



AR122-1

Antenna Model Number	Frequency Range	VSWR	Gain	How Polarized	Power Handling Capacity	Front-to-Back Ratio
AR122-1	150 MHz to 1 GHz	1.8:1 over 95% of band	4.3 db minimum	Linear	10 W Avg	10 db (150-200 MHz) 15 db (200-1000 MHz)
AR132-1	20 MHz to 300 MHz	2:1 Avg	5 db minimum	Linear	1 kw Avg	10 db (20-30 MHz) 15 db (30-300 MHz)



AR274-1 with AR272-1 mounted on top

DUAL-POLARIZED LOG PERIODIC ANTENNAS

Antenna Model Number	Frequency Range	VSWR	Gain	How Polarized	Power Handling Capacity		Front-to-Back Ratio	3 db Beamwidth		Inter-Channel Isolation
					Peak	Avg		E Plane	H Plane	
AR272-1	1 to 4 GHz	2:1	8db	Orthogonal Linear	200 W	10 W	20 db	65°	110°	20 db
AR274-1	30 MHz to 1 GHz	2.25:1	same	same	1 kw	25 W	same	same	same	same
AR274-2	30 to 300 MHz	2.25:1	same	same	1 kw	25 W	same	same	same	same
AR274-3	250 MHz to 1 GHz	2:1	same	same	1 kw	25 W	same	same	same	same

Note: Above antennas may be ordered with a 90° hybrid for circular polarization by specifying an "H" suffix to the basic model number
EX:AR272-1H

OMNIDIRECTIONAL CONICAL SPIRAL ANTENNAS

AR19-5

PERFORMANCE SPECIFICATIONS

Antenna Model Number	Frequency Range	VSWR	Gain	How Polarized	Deviation From Omni	Power Handling Capacity	
						Peak	Avg
AR19-5	1 to 11 GHz	2:1	0 db over isotropic	Circularly	±3 db on horizon	1 kw	5W
AR19-6L AR19-6R	7 to 11 GHz	same	same	same	same	same	same
AR19-8	150 MHz to 2 GHz	same	same	same	same	same	same
AR19-9	200 MHz to 1.4 GHz	same	same	same	same	same	same
AR19-10	250 MHz to 1.1 GHz	same	same	same	same	same	same
AR19-11	300 MHz to 7.3 GHz	same	same	same	same	same	same

DISH AND FEED ANTENNAS – PERFORMANCE SPECIFICATIONS

Antenna Model Number	Frequency Range	VSWR	Gain		How Polarized	Power Handling Capacity	Front-to-Back Ratio	Squint	Side Lobes	3 db Beamwidths
	GHz		db	(GHz)						
AR142-AS	1 to 12.4	<2.5:1	14.5 35.0	1 12.4	Circular	5 W Avg	>30 db	<1°	>15 db	22°(1.0 GHz) 2°(12.4 GHz)
AR168-AS	1 to 12.4	2.5:1 Avg	11.5 29.0	1 12.4	Linear	same	*	same	**	30°(1.0 GHz) 4°(12.4 GHz)
AR180-AS	1 to 12.4	<2.5:1	14.5 35.0	1 12.4	Linear	same	>15 db	same	>15 db	22°(1.0 GHz) 2°(12.4 GHz)
AR182-AS	1 to 12.4	<2.5:1	18.0 38.0	1 12.4	Linear	same	>15 db	same	>15 db	18°(1.0 GHz) 1.5°(12.4 GHz)
AR184-AS	.5 to 12.4	<2.5:1	14.0 40.0	.5 12.4	Linear	same	>17 db	same	>18 db	22°(1.0 GHz) 1°(12.4 GHz)
AR186-AS	1 to 12.4	<2.5:1	20.0 40.0	1 12.4	Linear	same	>17 db	same	>15 db	11°(1.0 GHz) 1°(12.4 GHz)
AR194-AS	1 to 12.4	<2.5:1	20.0 40.0	1 12.4	Circular	same	>30 db	same	>17 db	11°(1.0 GHz) 1°(12.4 GHz)
AR196-AS	1.4 to 2.3	<2:1	24.0 28.0	1.4 2.3	Dual Circular L & R Hand Simultaneous	same	>30 db	same	>18 db	18°(1.4 GHz) 5°(2.3 GHz)
AR198-AS	1.4 to 2.3	<2:1	18.0 22.0	1.4 2.3		same	>20 db	same	>15 db	16°(1.4 GHz) 10°(2.3 GHz)
AR246-AS	8 to 18	<2:1	>30.0	12-18	Linear	same	>15 db	same	>12 db	1° to 4°

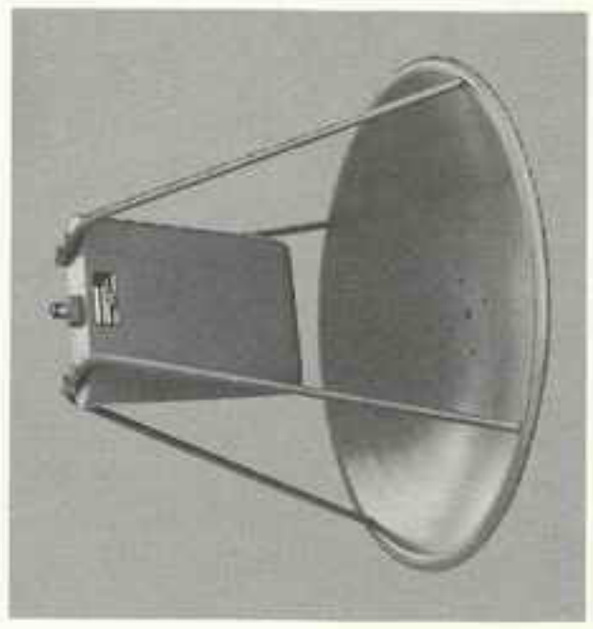
*F/B RATIO AR168AS

	1.0 GHz	6.0 GHz	10.0 GHz
E PLANE	10.5 db	33.0 db	17.7 db
H PLANE	8.5 db	15.4 db	14.1 db

**SIDE LOBES AR168AS

	1.0 GHz	6.0 GHz	10.0 GHz
E PLANE	4.9 db	>20 db	19 db
H PLANE	4.7 db	15 db	14 db

AR168AS



DISH AND FEED ANTENNAS

PLANAR SPIRAL ANTENNAS

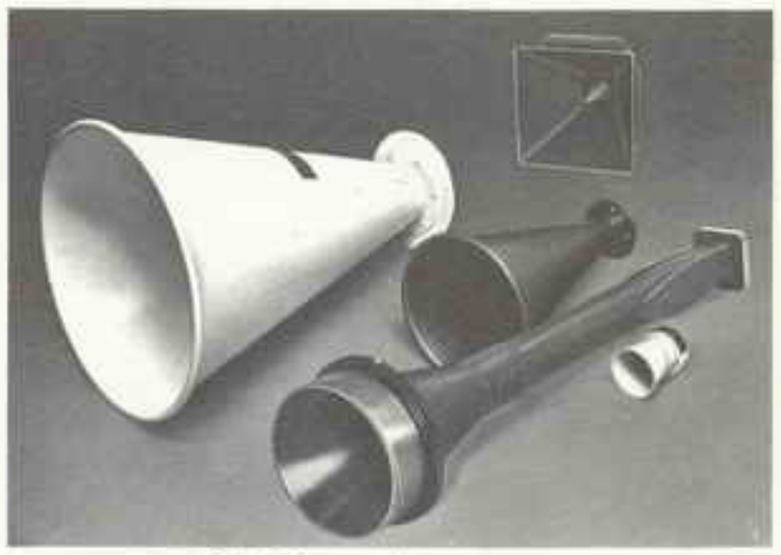
R35-1

Antenna Model Number	Frequency Range	How Polarized	VSWR	Gain	Axial Ratio	3 dB Beam-width	10 dB Beam-width	Squint	Surface Operating Temperature
R 35-1	2.6–5.2 GHz	R.H. or L.H. Circular	<2.5:1 (2.6 to 2.8 GHz) <2.0:1 (2.8 to 5.2 GHz)	>3 dB over 80% of the band	<1 dB	70°±8°	130°±15°	<5°	225°F
R 43-3	2.0–10.0 GHz	R.H. or L.H. Circular	1.75:1	>3 dB over 80% of the band; 0 dB over isotropic	1 dB	75°±8°	135°±15°	<5°	225°F
R 47-1	1.0–12.0 GHz	R.H. or L.H. Circular	2.0:1	>3 dB over 80% of the band; 0 dB over isotropic	1 dB	74°±8°	135°±15°	5°	225°F
R 47-3	2.0–11.0 GHz	R.H. or L.H. Circular	1.75:1	0 dB over 80% of the band	1 dB	73°±8°	130°±15°	5°	225°F
R 48-1	2.6–5.2 GHz or 8.0–9.5 GHz	R.H. or L.H. Circular	1.8:1	0 dB over isotropic (2.6–5.2 GHz); +2 dB (8.0–9.5 GHz)	1 dB	70°±8°	130°±15°	<5°	225°F
R 49-1	2.0–12.0 GHz	R.H. or L.H. Circular	2.0:1	>3 dB over 80% of the band; 0 dB over isotropic	1 dB	73°±8°	130°±15°	5°	225°F

CIRCULARLY POLARIZED HORN ANTENNAS

TYPE	FREQUENCY RANGE GHz	VSWR (max)	VSWR (typ)	ELLIP (VOLTAGE RATIO) (max)	ELLIP (VOLTAGE RATIO) (typ)	GAIN (mid band)	HPBW (mid band)
P9-A	7.5–10.8	2.6	2.3	1.65	1.29	13	22°
P9-B	7.5–10.8	2.6	2.0	1.70	1.30	6	46°
P9-1B	8.05–12.6	2.6	2.0	1.55	1.26	2.5	33°
P9-1C	8.05–12.6	2.6	2.0	1.70	1.26	12	25°
P9-2A*	8.05–12.6	2.6	2.0	1.70	1.26	10	25°
P17-1	4.0–8.0	2.6	2.0	1.60	1.26	13	18°
P23-1	8.0–18.0	1.7	1.3	1.60	1.45	18	20°

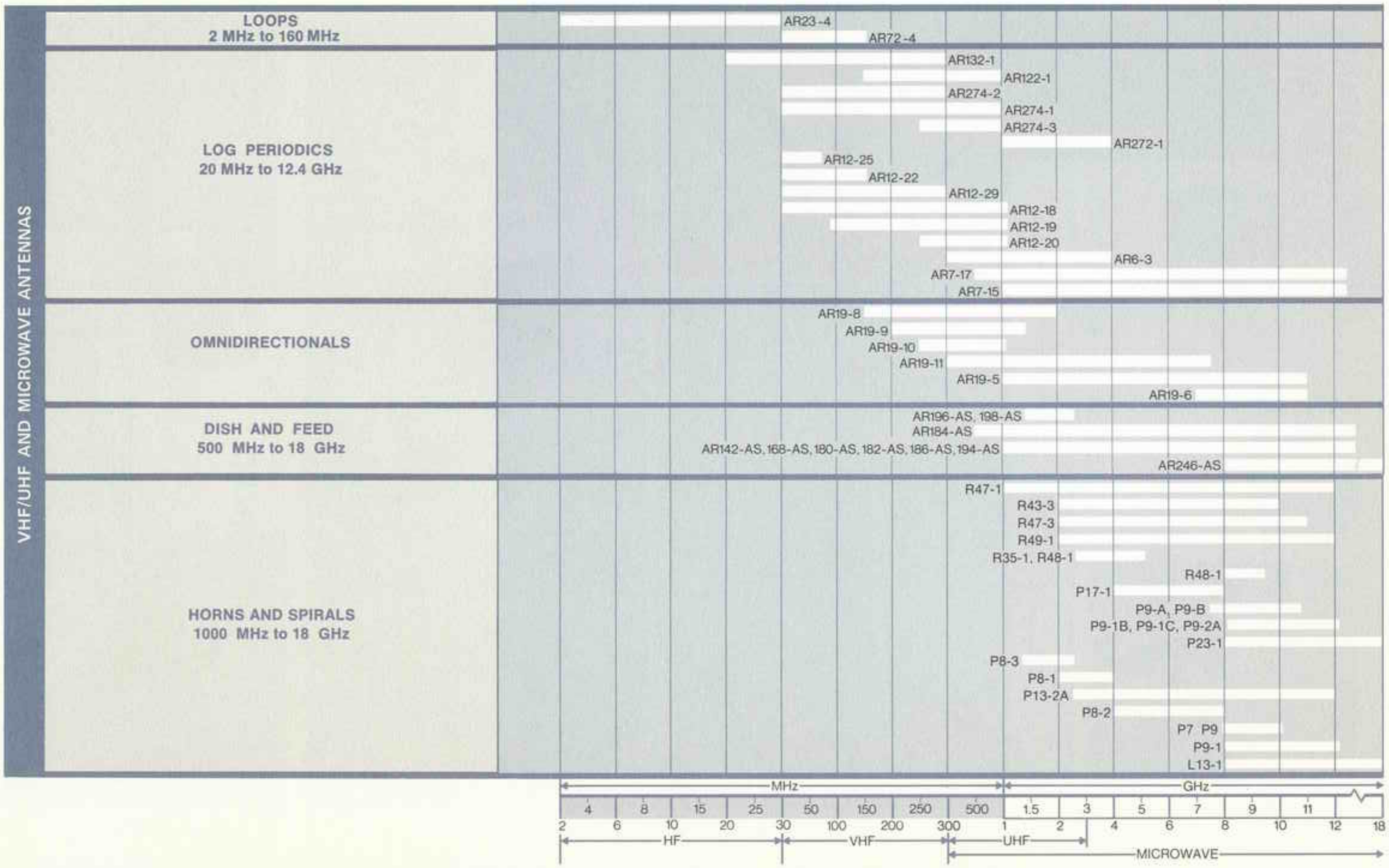
*Adjusted for Constant HPBW



C-P Horn Antennas

CIRCULARLY POLARIZED SPIRAL ANTENNAS

TYPE	FREQUENCY RANGE GHz	VSWR (max)	VSWR (typ)	ELLIP (VOLTAGE RATIO) (max)	ELLIP (VOLTAGE RATIO) (typ)	GAIN (db) (max)	GAIN (db) (typ)
P7	7.9–10.1	2.0	1.4	1.33	1.22	+1.5	−2.0
P8-1	2.0–4.0	2.0	1.6	1.33	1.16	+4.5	+1.5
P8-2	4.0–8.0	2.4	1.7	1.44	1.22	+3.5	0
P8-3	1.3–2.6	2.0	1.5	1.33	1.22	+4.5	+1.5
P9	7.9–10.1	2.0	1.4	1.33	1.22	+1.5	−2.0
P9-1	8.0–12.5	2.7	1.5	1.23	1.20	+1.5	−2.0
P13-2A	2.5–12.0	3.0	1.7	1.33	1.21	+4	−4

C-P Spiral Antennas

Surveillance Antenna Guide