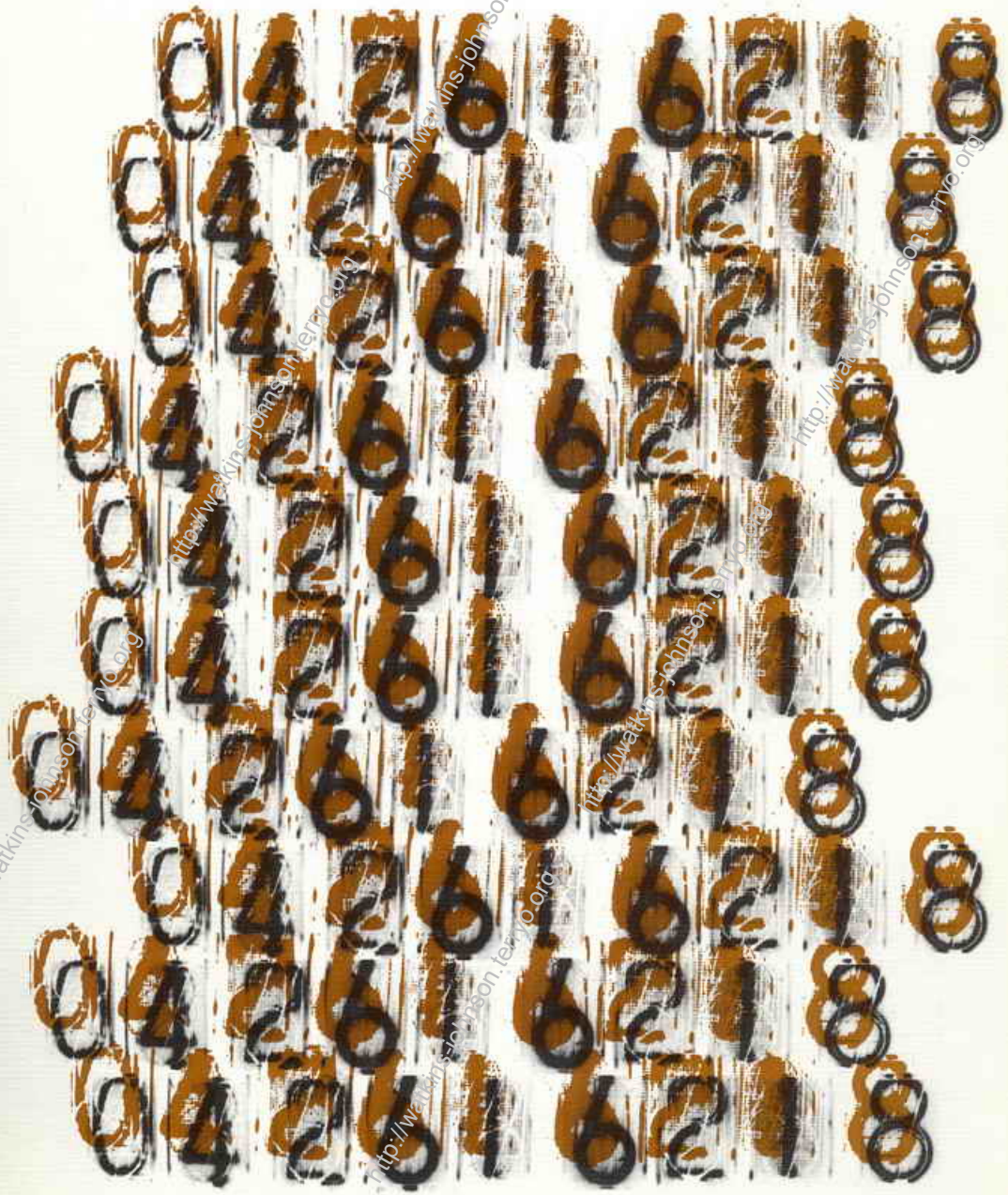

Watkins-Johnson was formed in December, 1957, to engage in research, development and production of advanced electron devices and electronic systems. Now employing more than 1300 people, the Company is a diversified electronics firm with manufacturing facilities in the U.S. and overseas. Corporate offices 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, 20 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 40 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 equipment available, contact our local Representative or W-J Applications Engineering.

Watkins-Johnson - Palo Alto facility

Watkins-Johnson - Rockville facility

Computer-Controlled WJ-1007 Receiver

CATALOG PRODUCTS/QUICK-REACTION CAPABILITY

Watkins-Johnson Company offers over 100 superior catalog products. W-J's wide-ranging communication electronics experience combined with excellent technical staff and exhaustive in-house production facilities, have enabled a quick-reaction capability equal to the needs of virtually any special application. In most cases, customer requirements can be met with W-J's catalog items, all of which are available from stock or on early delivery.

For highly unusual applications, we will either modify existing products or design and fabricate new instruments to match the needs. Utilizing in-house capabilities to the fullest, we can meet tight deadlines even on quantity production runs. Of noteworthy importance in such special projects is the provision for secure areas, which allows us to undertake readily classified assignments of wide scope and complexity.

FREQUENCY ACCURACY

Watkins-Johnson has pioneered in extending the stability of receiving systems. A variety of local oscillator components and techniques permit accuracies as high as 1 part in 10^9 over the entire RF spectrum to be supplied as standard equipment. Analog control receivers provide high stability by use of the most recent components in fully temperature compensated circuits. Digitally controlled receivers utilize either single or double conversion techniques based upon an extensive synthesizer capability. Standard receivers are available that incorporate digital automatic frequency control (DAFC) of many receivers from a single counter, direct local oscillator synthesis, or indirect local oscillator synthesis depending upon customer requirements for accuracy, stability, resettability and spectral purity.

SIGNAL PERFORMANCE

W-J receivers feature state-of-the-art levels in signal performance characteristics. Wide instantaneous dynamic range is insured by careful attention to intermodulation and spurious response characteristics. Modern signal environments produce many closely located signals; effective separation of these signals within the receiver without generating additional signals to cause operator or processing confusion is an absolute necessity. All W-J receivers will effectively stand the test of real signal environment performance and exceed competitive receiver performance levels by a wide margin. For example, a typical receiver manufactured by our competition when supplied with two or more signals of power −60 dBm spaced by 0.5 MHz will generate many times this number of "signals" of roughly this same amplitude and lying within the 20 MHz preselector bandwidth, masking genuine but weak signals. Such intermodulation products are below the low noise level of W-J receivers such as the WJ-560/565 family.

SIGNAL PROCESSING

All W-J receivers are configured to permit addition of automatic signal processing function and many "off-the-shelf" features exist for incorporation. These features include digital or analog AFC, time/frequency/power gating and blanking modules, special detectors, logarithmic or extremely linear demodulation, and digital signal parameter encoding—all implemented to aid the operator in performing his task. Digital signal parameter encoding circuits include amplitude, pulse width, pulse repetition interval, stagger, jitter, intra-pulse FM and similar modulation data. Readout of desired data is normally implemented by direct operator digital display, teletype of other hard copy outputs, and/or to computer file.

A wide variety of operator displays is available to permit operator recognition and detection of signal activity by means of signal activity CRT displays, fading raster storage displays, IF plan displays, and special auxiliary equipment.

DIRECTION FINDING

W-J receivers incorporate a direct interface capability to incorporate DF data for signal environment definition. A full complement of direction finding equipment is available, based upon the most recent developments in antennas and control technology. Standard DF equipment includes the "L" series of rotating antennas to provide low cost installation with high angular accuracy, suitable for ground based or airborne installation. Digital encoding of DF is combined with digital control of the antenna to allow fully automatic operation or to maximize probability of intercept in search operations. Standard products include omnidirectional and shaped beam configurations extending to 40 GHz, amplitude or interferometric processing, eliminating of rotary joints, side-lobe blanking, and similar features.

AUTOMATIC CONTROL

Watkins-Johnson receiving systems provide the ultimate in adaptive control technology. Computer controlled systems are available that permit unattended operation, providing spectrum search, activity comparison, signal encoding and storage, and data readout to flexible format requirements. This capability is enabled by use of a specially developed software program that is adaptable to a variety of readily available computers, permitting the receiving system to be rapidly brought on-line and operational. Special processing requirements may be defined by the customer and inserted simply into the main program as sub-routines as dictated by signal environment characteristics or as the use role is modified with time insuring an ability to cope with future requirements.

SYSTEMS CAPABILITY

Watkins-Johnson Company offers a proven capability for developing or modifying equipment to meet the most critical needs. The close working relationship and intermixing of technical disciplines between the system engineering personnel, the antenna engineers, component engineers and the support staff yields an environment that insures an integrated product with sophisticated capabilities. Typical of military products that have gained rapid acceptance are the QRC-559 (T) Receiving System, the WJ-1140 Modular Receiving System, the WJ-1083 Digital Controlled Panoramic Receiver, the L-Band IF System and similar equipments. A full staff of highly qualified mechanical engineering and technical personnel draw heavily upon past and current programs involved in equipment development, aircraft and van installations, static support, and field engineering to insure complete product capability. This library of experience, both in personnel and past projects, is committed to the perpetuation of this type of effort and can be drawn up to fulfill the needs of all conceivable configurations of equipment for today's and the future's requirements.

COMPONENTS

W-J is able to pioneer in state-of-the-art equipments and systems and produce them in quantity and on schedule because nearly all key components are developed and produced in-house. These components include traveling-wave tubes, cathode-ray tubes, backward-wave oscillator tubes, x-ray tubes, gallium arsenide and yig materials, bulk effect solid-state oscillators, translator amplifiers, transformers and inductors, antennas, mixers and many other items.

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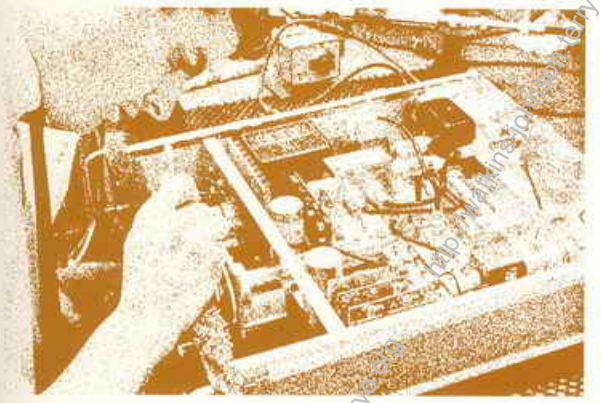
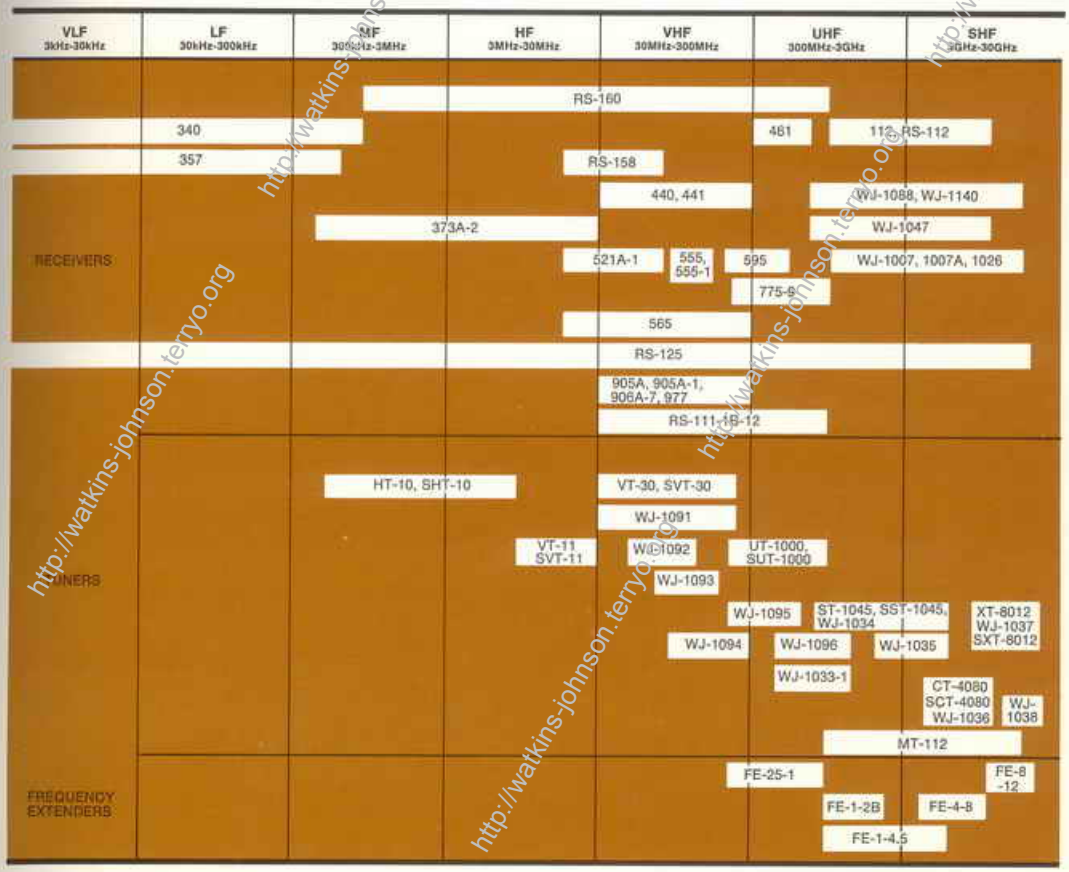


RECEIVER SELECTION GUIDE



NOTE: See page 40 for Antenna Selection Guide

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-120A tuning head covers 1-2 GHz; TH-240A, 2-4 GHz; TH-480A, 4-8 GHz; TH-812A, 8-12 GHz. Five IF bandwidths: 100 kHz and 2, 4, 10, and 20 MHz.

340 RECEIVER

Wideband voltage-tuned receiver with exceptional signal-handling ability designed for RFI and EMI detection. Covers 1 kHz to 900 kHz in one band with AM, FM and CW detection modes. Front panel selectable IF bandwidths of 1, 6, 20 and 50 kHz, are provided. An electronic counter with a five-digit readout is used to display the tuned frequency with an accuracy of ±10 Hz. A digital automatic frequency control (DAFC) circuit permits locking the unit's local oscillator to the counter in 10 Hz increments.

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.

373A-2 HF RECEIVER

Wideband HF receiver covering 500 kHz to 30 MHz in two bands: 500 kHz to 10 MHz and 10 MHz to 30 MHz. Designed for AM, FM or CW reception over entire range. Particularly suitable for RFI detection and predetection recording. Includes IF bandwidths of 6, 20, 100 and 400 kHz. Also includes X-Y outputs for recording signal strength versus frequency.

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.

461 RECEIVER

Compact crystal-controlled AM or FM receiver capable of being fix-tuned to any frequency within the range of 300 to 550 MHz. One of four different IF bandwidths from 20 to 100 kHz may be selected by the customer. Outputs include a dc voltage which is switched on when the squelch circuit operates, an AGC monitor voltage, a 600-ohm balanced audio output and a dc-coupled video output. The receiver is designed for mounting in an EF-506A equipment frame. The EF-506A accommodates six 461 receivers and contains a power supply to operate all receivers.

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 a sweep width of up to 300 kHz and a resolution of 2.5 kHz. DAFC compatible. Includes COR and variable BFO.

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.

565 VHF-UHF RECEIVER

Exceptional signal-handling performance for VHF-UHF receivers, AM, FM, CW and Pulse reception over the frequency range of 20 to 1000 MHz using five plug-in tuning heads. One tuning head can be installed in the receiver at a time. Bandwidths of 10, 50, 200 and 300 kHz, and 1 and 3 MHz are standard. Select any four of the six standard bandwidths or specify any four bandwidths between 10 kHz and 3 MHz. Nonstandard bandwidths are extra-charge option. Built-in spectrum display unit gives a visual display of signal activity over a frequency range of up to 3 MHz.

595 RECEIVER

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

775-9 UHF RECEIVER

Multi-purpose receiver for AM, FM, CW and Pulse signals in the UHF range of 235 to 1000 MHz. Carrier operated relay (COR) and digital automatic frequency control (DAFC) circuits are included. DAFC permits locking the unit's local oscillator in 1-kHz increments to 1000 MHz. IF bandwidths supplied are 100 kHz, 500 kHz and 4 MHz.

905A AND 905A-1 VHF RECEIVERS

General purpose VHF receivers covering 30 to 300 MHz in two bands. Bandwidths supplied in the 905A are 20 and 300 kHz and bandwidths in the 905A-1 are 50 and 300 kHz. Both receivers contain a carrier operated relay (COR).

906A-7 VHF RECEIVER

VHF Receiver is designed for the reception of AM, FM and CW signals. Covers the 30 to 300 MHz range in two bands: 30-90 MHz and 60-300 MHz. Selectable IF bandwidths of 20 and 300 kHz are provided. Features include a crystal marker oscillator for tuning dial calibration, a carrier operated relay and a BFO. A digital automatic frequency control (DAFC) circuit is included which permits locking the unit's local oscillator to a frequency counter.

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 RECEIVING SYSTEM

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 205-2 Receiver, a DRO-308 Frequency Counter, and an SM-7301A Signal Display. There are nine tuning heads (VH-series, UH-series and the HH-11) available which provide coverage from 2 to 1000 MHz. A DRX-308 Counter Frequency 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 the desired tuning head selected by a front panel control. The CSU-160 tuner switching unit also allows the installation of seven tuning heads and additionally provides both front panel and remote selection of a tuning head. The VM-101 marker unit is available and provides markers at the tuned frequency of up to four receivers.

THE TYPE 205-2 RECEIVER is the heart of the system. This voltage-tuned unit has five operating modes: PAN in which the entire frequency range of the installed tuning head is swept and displayed on the SM-7301A Signal Display; SECTOR, in which a selected portion of the band, from zero sweep width to full band, is swept and displayed; PAN/SEC, where the entire frequency range of the installed tuning head and a selected portion are swept and displayed; REMOTE, in which the receiver accepts a tuning voltage from a remote source; and MAN, in which the receiver operates in the conventional manner. The receiver provides AM, FM, and pulse reception with IF bandwidths of 10, 50 and 300 kHz and 1 MHz. Any one of the IF bandwidths can be selected when the receiver is in the MAN or REMOTE modes. In the PAN, SECTOR and PAN/SEC modes the optimum IF bandwidth is automatically selected by the receiver.

THE TYPE SM-7301A SIGNAL DISPLAY functions as an RF Pan Display when the 205-2 Receiver is in the PAN, SECTOR or PAN/SEC mode and as an IF Pan Display when the receiver is in the MAN or REMOTE 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 or REMOTE tuning mode, the SM-7301A 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 logarithmic vertical display may be selected.

THE TYPE DRO-308 FREQUENCY 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 SECTOR and PAN/SEC tuning modes, the readout indicates the center of the selected sector. Thus, when the mode is switched from PAN, SECTOR or PAN/SEC to MAN the exact center of the CRT display on the SM-7301A is the frequency display on the DRO-308. The readout display indicates the nearest 1-kHz increments in the MAN and REMOTE modes and the nearest 10-kHz increment in the PAN, SECTOR and PAN/SEC modes.

With the DRO-308 it is possible to apply digital automatic frequency control (DAFC) to the 205-2 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 COUNTER FREQUENCY EXTENDER is a companion unit to the DRO-308 Frequency 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 205-2 Receiver. It connects to the 205-2 through the EC-160 extender cable which is installed in the 205-2 in place of a tuning head. The TSU-160 can contain from one to seven of the tuning heads normally used with the 205-2 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 CSU-160 TUNER SWITCHING UNIT performs the same as the TSU-160 with the addition of providing a means

of remotely selecting a tuning head. A front-panel switch can be used to select the desired tuning head or the switch can be placed in the REMOTE position enabling remote selection of a tuning head. Remote selection of a tuning head is accomplished by the use of a four bit BCD binary code.

The Type VM-101 MARKER provides a visual indication of the tuned frequency of manual receivers. The VM-101 is for use with manual receivers which have a 21.4 MHz first IF and operate in the 20 to 300-MHz range. The VM-101 provides markers at the tuned frequency of up to four manual receivers. The VM-101 allows 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-7301A 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 205-2 Receiver and the DRO-308 Frequency Counter which mounts in the frame of the SM-7301A. 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-7301A SIGNAL DISPLAY
Display Modes: RF Pan Display for Pan, Sector and Pan/Sec modes; IF
Pan Display for Man and Remote modes
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 COUNTER FREQUENCY EXTENDER
Frequency Range: For use with tuning heads covering 300 MHz to 1000 MHz

VM-101 MARKER:
Number of Manual Receivers: 4
First IF of Manual Receivers: 21.4 MHz

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

CSU-160 TUNER SWITCHING UNIT
Plug in Tuning Heads: Seven, maximum
Selection of Tuning Head: By front panel switch or remote by BCD code

205-2 RECEIVER
Types of Reception: AM, FM, pulse
Frequency Range: 2-1000 MHz in 9 bands
IF Bandwidths: 10, 50, 300 kHz and 1 MHz
Tuning Modes: Panoramic Sector, Pan/Sec, Manual or Remote
Sweep Rate: 0.1 to 25 Hz

TUNING HEADS
Ranges: HH-11, 2-30 MHz; VH-11, 30-60 MHz; VH-12, 60-120 MHz; VH-13, 100-180 MHz; VH-14, 180-300 MHz; VH-15, 20-40 MHz; VH-16, 40-80 MHz; UH-11, 250-500 MHz; UH-12, 500-1000 MHz

DRO-308 FREQUENCY COUNTER
Display: 6-digit readout to nearest 1 kHz in Man and Remote modes and to nearest 10 kHz in Pan, Sector and Pan/Sec modes.
Accuracy: Man or Remote mode, +1, −0 kHz (one count); Pan, Sector or Pan/Sec 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

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 bandwidths 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. Mounted on the front panel of the receivers are a DAFC switch, frequency set, and squelch 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 for an indefinite period.

An RF test signal generator built in the EF-158 Equipment Frame permits a simple "go-no-go" test of each receiver in the system. The EF-158 Equipment Frame also contains a 12-channel active multicoupler to allow all receivers to operate from a single antenna input.

SPECIFICATIONS:

MULTICOUPLER

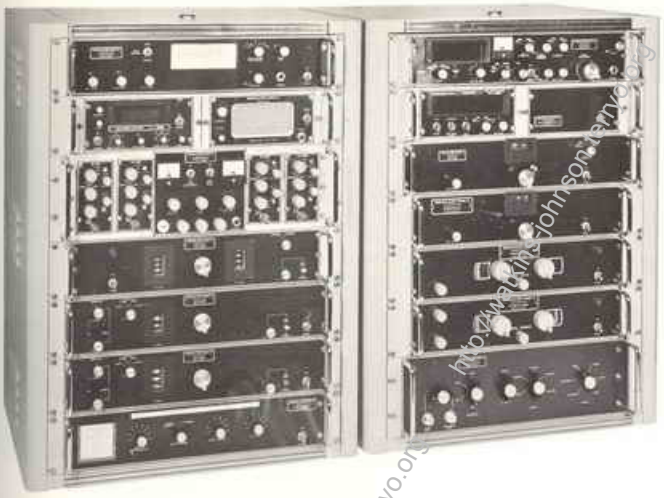
Number of Output Channels	12
Noise Figure	5 dB, maximum
Gain	6 db, nominal
Isolation Between Outputs	38 dB, minimum
Input Impedance	50 ohms, unbalanced
Input VSWR	3:1, maximum

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 types 410-2 or 410-3 Receivers, respectively.
LO Radiation at Antenna Input	−95 dBm, maximum

DRO-270 COUNTER

Display	Five-digit readout for any one of twelve receivers
Accuracy	±1 kHz
DAFC Stability	±1 kHz for indefinite period
Setability	10 kHz increments



TYPE RS-125 RECEIVING SYSTEM

The RS-125 Receiving System is a versatile arrangement of equipment which provides 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 bandwidths available, it is frequently used for RFI monitoring and EMI control. The modular construction of the RS-125 makes it possible for the user to purchase only those components required for the job at hand. It can be easily expanded to meet additional requirements in the future. The frequency coverage is provided in ten bands using seven tuners. By the addition of a 300-series receiver, such as the 357, the frequency coverage can be extended down to 1 kHz. Over the 500 kHz to 12 GHz range the received signals are processed by a demodulator which uses plug-in modules to determine the IF bandwidth, as well as special plug-ins such as a logarithmic IF amplifier, pulse-stretching AGC, box car AGC, and noise limiter. A total of ten standard IF bandwidths are available from 5 kHz to 8 MHz.

The system shown above is typical of many Watkins-Johnson has supplied. It provides continuous coverage from 1 kHz to 12 GHz.

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 covering these frequencies can be locked in 1-kHz increments. The VLF receiver has a built-in counter with DAFC capability covering the 1-kHz to 600-kHz frequency range. Switching panels are provided to connect the antenna to the desired tuner and to connect the demodulator, signal monitor, and frequency counter to the proper tuner.

Tuners can be supplied with internal motor drives for automatic scanning. Three letter models starting with "S" indicate motor drive. The motor-drive units feature sector scan whereby the operator can adjust the upper and lower frequency limits of the sector of interest.

The units listed below have been specially designed for use in an RS-125 Receiving System. Specifications will be found in the sections in this catalog in which these equipments are listed by type. Detailed specifications will be sent upon request.

EQUIPMENTS:

TUNERS

Model	*Range*
HT-10, SHT-10	500 kHz–10 MHz
VT-11, SVT-11	10–30 MHz
VT-10, SVT-10	10–90 MHz
VT-30, SVT-30	30–260 MHz
UT-1000, SUT-1000	235–1090 MHz
LT-1020, SLT-1020	0.95–2.05 GHz
ST-2045, SST-2045	1.95–4.5 GHz
ST-1045, SST-1045	0.95–4.5 GHz
CT-4080, SCT-4080	4–8 GHz
XT-8012, SXT-8012	8–12 GHz

DEMODULATOR

DM-4CA accepts up to four IF Demodulator plug-ins or three IF Demodulators and one special plug-in.

IF DEMODULATOR PLUG-INS

Model	*Bandwidth*
IFD-5C	5 kHz
IFD-15C	15 kHz
IFD-50C	50 kHz
IFD-100C	100 kHz
IFD-200C	200 kHz
IFD-500C	500 kHz
IFD-1000C	1 MHz
IFD-2000C	2 MHz
IFD-4000C	4 MHz
IFD-8000C	8 MHz

SPECIAL DEMODULATOR PLUG-INS

Model	*Function*
NS-101BA	Noise Silencer
IFD-LOG	Logarithmic IF Amplifier
AGC-BC/C	Box Car AGC
AGC-PS/C	Pulse Stretching AGC

SIGNAL MONITORS

Model	*Sweep Width*
SM-9404A	4 MHz, maximum
SM-9804A	8 MHz, maximum

DIGITAL READOUT

DRO-300A (full rack) or DRO-302A-2 (half rack) readouts to 300 MHz. DRX-1000 extends readout range to 1000 MHz.

TYPE RS-112
MICROWAVE PAN-MAN RECEIVING SYSTEM

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 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 RPD-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 separate 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 8 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 could be used with an SM-1622 signal monitor and an RPD-201 remote RF pan display in an EF-201C dual equipment frame for rack mounting. If the MT-112 manual tuner and DM-112 demodulator are used, then the RPD-201 remote pan display could be mounted in an EF-101 single equipment frame for rack mounting. 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 RPD-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 an 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. The RPD-201 indicates 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	100 kΩ
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

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.

COMPUTER CONTROL FOR W-J RECEIVING SYSTEMS

W-J has pioneered the integration of the digitally controlled microwave receiving system with the general purpose (GP) digital computer. With the advent of this development, the tasks for which the microwave receiver can be utilized have been expanded almost to the point where the creativity of the computer programmer is the limiting factor. The computer controlled microwave receiver, shown in block diagram form, can perform functions including, but not limited to:

1. Signal parameter cataloging
2. Signal parameter sorting
3. Automatic frequency scan or dwell
4. Automatic receiver control changing
5. Unattended signal acquisition and analysis

The application of this modern system control and data processing technique has evolved from a thoroughly planned effort. The original development was in the addition of the computer control and data monitoring capabilities to the microwave receiver. After successful completion of the hardware interface, a program was developed to enable the application of the computer capability to be optimized. A Watkins-Johnson Spectrum Surveillance Program has been developed which directs the entire spectrum search and cataloging activity in a planned and pre-determined manner; i.e., that program as entered into the computer. Additional advancement is underway at Watkins-Johnson Company and includes:

1. RF Tuners operating from binary control. Presently the tuners used are under BCD control for ease of operator control. The computer controlled system relieves the requirement for the BCD format and allows the usage of a straight binary code. This code can be handled much faster by the nominal digital computer than can the BCD.

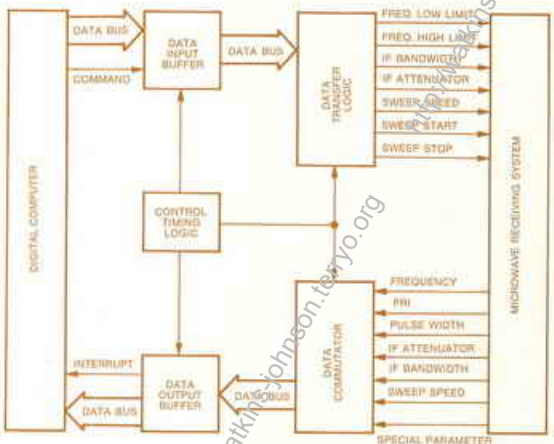
2. Interactive displays which will allow the operator to see and interpret, where necessary, the signal environment from symbolic derivatives of the signal parameters. This display depicts the microwave environment in both graphical and textual formats. The operator can enter data or request pertinent information. The textual information requested appears in an alpha-numeric format for the operator's usage.

3. Further extension of the Spectrum Surveillance Programs to include pattern recognition techniques in addition to the standard parameter qualification criteria. This technique requires the memory and logic capability of a digital computer to be an effective tool.

4. Adaptive programming for computer controlled hardware. This technique will provide for adaptive or "learning" computers that will have the capability of utilizing previously gathered data to make decisions on a real time basis.

5. Computer/Microwave adaptive hardware to increase the real time processing capability by using the receiver as a sensory organ of the computer.

6. A completely operator-independent spectrum surveillance receiver system with the capability of unassisted collection, data reduction, decision making and response to spectrum activity. This system will have lists of recommended responses to the reception of hostile emitters as its output.



WJ-1007 SERIES OF 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 programming 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.

SPECIFICATIONS:

Frequency Range	1–18 GHz
Noise Figure	
1 to 2 GHz	9.5 dB max.
2 to 4 GHz	11.5 dB max.
4 to 8 GHz	13.5 dB max.
8 to 12 GHz	14.5 dB max.
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 10^8
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 20,000 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 10^5. 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 (Opt.)

The DF presentation is supplied by a modified IP-367/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

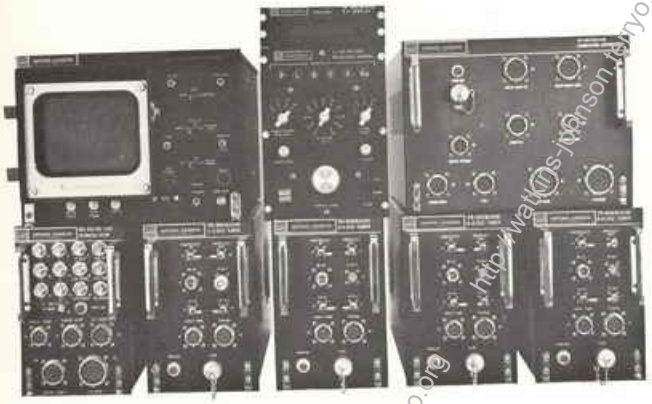
The IF Pan displays the selected IF bandwidth such that its horizontal scale is 2 MHz/cm, 0.5 MHz/cm, or 100 kHz/cm when in the calibrated sweep width positions of 20, 5 and 1 MHz. Sweep width vernier and offset controls permit small sectors of the sweep to be expanded.

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.



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-5400 and MIL-E-16400. Some of the numerous applications for this receiving system include, but are not limited to, ESM 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 equipment to be completely self sufficient. The only required interconnects are those that carry control and/or signal information between equipment. 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[1]	
0.5 to 1 GHz	15 dB max.
1 to 2 GHz	15 dB max.
2 to 4 GHz	15 dB max.
4 to 8 GHz	18 dB max.
8 to 12 GHz	18 dB max.
12 to 18 GHz	18 dB max.
Image Rejection	70 dB minimum
Local Oscillator Radiation	−80 dBm, minimum
Single Signal Spurious Free Dynamic Range	70 dB minimum
Frequency Accuracy[2]	0.1 to 0.4%
Incidental FM[2]	10 kHz to 40 kHz, peak to peak
IF Bandwidth, front panel selectable	1, 5 or 20 MHz
RF Input VSWR[3]	1.5:1.0
Sweep Speed, front panel selectable	1, 5, 10 or 50 GHz/Second
1dB 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
Display Video	0.6 to 6 volts into 1000 ohms
Blanking	0 to 4.0 volts into 24,000 ohms
Horizontal	−5 to +5.0 volts into 1000 ohms
Size[4], tuners and demodulator	A1D cases
Weight	
Tuners, each	25 lbs.
Control Unit	2 lbs.
Demodulator	18 lbs.
Display	2 lbs.
Temperature[5]	0 to +50° Centigrade
Altitude[5]	15,000 ft.
Shock[5]	Bench Handling

NOTES:
1. Specified without low-noise amplifiers.
2. Dependent upon frequency band.
3. Centered in RF passband.
4. A1C case size available if optional external power supply is used.
5. MIL-E-5400, Class II available.

The basic receiver, shown in block diagram form at right, 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.

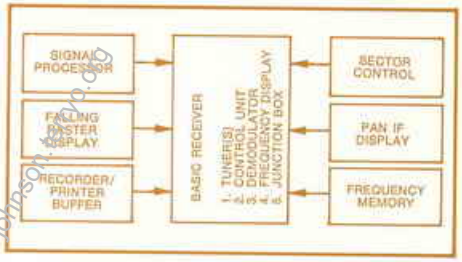
Each RF tuner shown in the block diagram below, is the equivalent of the RF to IF circuitry of a superheterodyne receiver; each consists of an RF preselector, synthesized local oscillator and mixer preamplifier. Tuner RF to IF gain, which is on the order of 20 dB, allows the units to be located remotely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

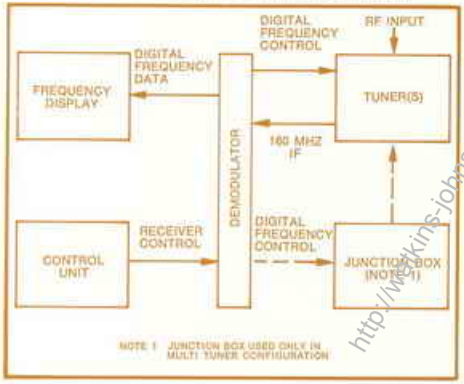
The function of the frequency display is to inform the operator of the receiver of the frequency to which the equipment is tuned. The display is driven by the digital tuning word that is being used to program the tuner in use. This digital tuning word is used to provide a signal for the display.

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.

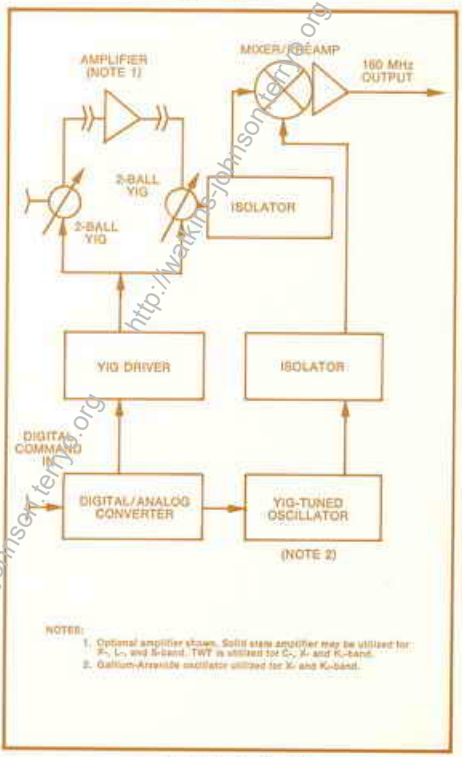
The basic receiver and selected peripheral equipment are shown in block diagram form below. Each piece of equipment is described in the table on pages 22 and 23.



Basic Receiver and Selected Peripheral Equipment



Basic Receiver



Tuner Block Diagram

WJ-1140 MODULAR MICROWAVE RECEIVING SYSTEM

BASIC RECEIVER CONTROL GROUP

PART NUMBER	NOMENCLATURE	FUNCTION
C-100/WJ-1140	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 H. Manual positioning of frequency cursor in scan mode
ID-100/WJ1140	FREQUENCY DISPLAY	Numeric 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. Display video D. Sweep voltage ramp for displays E. Blanking signal for displays F. Switched and filtered 160 MHz IF signal for use with pan IF displays

BASIC RECEIVER TUNERS

PART NUMBER	NOMENCLATURE	FUNCTION
TN-200/WJ1140	TUNER, 0.5–1.0 GHz	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, 1–2 GHz	Same as above
TN-400/WJ1140	TUNER, 2–4 GHz	Same as above
TN-500/WJ1140	TUNER, 4–8 GHz	Same as above
TN-600/WJ1140	TUNER, 8–12 GHz	Same as above
TN-700/WJ1140	TUNER, 12–18 GHz	Same as above

PERIPHERAL OPTIONS

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.
MU100/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.
JT-100/WJ1140	JUNCTION BOXES	Provide hard wired interfaces for connecting various modules together.
NONE	CABLING	Provides interconnecting cabling for various configurations of receiver.

WJ-1154 SERIES OF FREQUENCY SYNTHESIZERS

The WJ-1154 series of frequency synthesizers offers state-of-the-art performance in the 1 to 18 GHz frequency range. Ideal for use in microwave receivers, as a swept signal source in automatic test equipment or in general lab testing, these units feature local and remote digital programming (BCD) to simplify operation.

High power output (1 watt) in the 1 to 2 GHz frequency range is provided by some of the units. Leveled power of 1 mW ±0.5 dB is available across the entire 0.5 to 18 GHz range. Frequency steps of 1 MHz are standard; some units offer frequency steps of 1 or 100 kHz. Frequency accuracy and stability is excellent at 1 part in 10^9. Fast programming response times are an important part of the specifications for this rugged, reliable instrument family. High spectral purity and low phase noise are featured by some of the units.

All local controls are located on the front panel of these units and are easily accessible and clearly labeled. The desired frequency is controlled by thumbwheel switches that indicate frequency directly as they are dialed. The other functions of the synthesizers (SWEEP, FM, and FM SWEEP) are enabled through lighted pushbutton switches. In addition, a LOCK lamp on the front panel monitors equipment operation, allowing continuous assessment of synthesizer status. Remote control is accomplished by programming the proper digital command signal through a connector located on the rear panel of the equipment. Auxiliary outputs and different frequency steps are available as options.

SPECIFICATIONS:

	WJ-1154	*WJ-1154-3*	*WJ-1154-5*	*WJ-1183*
Frequency Range	1-12.4 GHz	1-2 GHz	1-18 GHz	8-12.4 GHz
Frequency Steps	1 MHz	1 MHz	100 kHz	1 kHz
Frequency Accuracy	1 part in 10^9 per day, or as determined by an external frequency standard.			
Power Output	1 mW	1 watt	1 mW	10 mW
Harmonic Suppression	−15 dB (1-2 GHz) −40 dB (2-12.4 GHz)	−15 dB	−45 dB (1-2 GHz) −55 dB (2-18 GHz)	−60 dB
Fundamental Suppression	−33 dB	———	−50 dB	———
Non-Harmonic Spurious	−60 dB (1-2 GHz) −40 dB (2-12.4 GHz)	−60 dB	−60 dB (1-2 GHz) −40 dB (2-18 GHz)	−70 dB
Phase Noise	———	———	———	−70 dB/Hz at 100 Hz −90 dB/Hz at 1 kHz −108 dB/Hz at 100 kHz −105 dB/Hz at 100 kHz
Programming Response Time (measured from receipt of 'Initiate' command to phase lock at the programmed frequency)	100 msec	10 msec	100 msec	10 msec
Program Input	Local input is BCD thumbwheel switch for all units; remote input is by means of external BCD commands.			

WJ-1165 SERIES SIGNAL SOURCES

The WJ-1165 series of compact, lightweight signal sources covers the 0.5 to 18 GHz frequency range in six bands. Designed for applications where size and weight are primary considerations, the WJ-1165 micro-sources feature all solid state construction for trouble-free performance, instant RF power of greater than 6 mW (up to 50 mW in some bands), low residual FM, excellent linearity and high frequency accuracy.

The micro-sources may be programmed manually in 1 MHz increments to any discrete frequency in the band. A standard external sweep mode is available to accommodate sawtooth and triangular waveforms.

High "Q" YIG spheres are utilized for frequency control, thus ensuring an extremely clean output spectrum and providing excellent linearity over the entire frequency range. The oscillators are driven by extremely well-regulated power supplies that provide power with low ripple content for maximum performance.

Options include remote BCD control for discrete frequency selection, internal sweep over the entire frequency band, and error voltage input for phase locking.

SPECIFICATIONS:

RF PERFORMANCE	*WJ-1165-1*	*WJ-1165-2*	*WJ-1165-3*	*WJ1165-5*	*WJ-1165-6*
Nominal Frequency Band	0.5-1.0 GHz	1.0-2.0 GHz	2.0-4.0 GHz	8.0-12.4 GHz	12.4-18.0 GHz
Power Output into Load VSWR 1.25:1 Min.	25 mW	25 mW	18 mW	8 mW	5 mW
Power Output Variation (Matched Load) Max.	6 dB	6 dB	6 dB	8 dB	8 dB
Spurious Oscillation					
Ratio of Signal to 2nd Harmonic Output	13 dB	13 dB	13 dB	20 dB	20 dB
Ratio of Signal to all other Spurious Output	50 dB	50 dB	50 dB	50 dB	50 dB
Frequency Drift, 10-60°C, Max.	15 MHz	15 MHz	20 MHz	200 MHz	250 MHz
Pulling Figure, Any Phase	2 MHz @ 1.5:1 VSWR	4 MHz @ 1.5:1 VSWR	1 MHz @ 1.5:1 VSWR	10 MHz @ 1.5:1 VSWR	10 MHz @ 1.5:1 VSWR
Residual FM, Peak to Peak	50 KHz	50 KHz	70 KHz	100 KHz	100 KHz
TUNING CHARACTERISTICS					
Sweep Rate (Saw Tooth)	100 Hz	100 Hz	100 Hz	100 Hz	100 Hz
Tuning Linearity dc @ 30°C Max.	±5 MHz	±6 MHz	±8 MHz	±25 MHz	±25 MHz
Frequency Accuracy	±0.6%	±0.6%	±0.4%	±0.4%	±0.4%
Output Impedance	50 ohms	50 ohms	50 ohms	50 ohms	50 ohms
Incremental Frequency Steps	1 MHz	1 MHz	1 MHz	1 MHz	1 MHz
PRIMARY ELECTRICAL REQUIREMENTS					
Primary Voltage	115 VAC ±10% 60 Hz				
Primary Power	60 watts max.				

TUNERS

The tuners listed in the chart below 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.

WJ-1033, 34, 35, 36, 37 AND 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 AND 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.

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
WJ-1091	1	30-50 MHz	6dB	21.4 MHz	300 kHz
VT-30, SVT-30	2	30-60 MHz 54-260 MHz	6.5dB 6.5dB	21.4 MHz 21.4 MHz	3 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-1000C, SUT-1000C	2	235-500 MHz 490-1000 MHz	10dB 12dB	21.4 MHz 21.4 MHz	6 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
ST-1045, SST-1045	2	0.95-2.05 GHz 1.95-4.5 GHz	18dB 18dB	21.4 MHz 21.4 MHz	8 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 2-4 GHz 4-8 GHz 8-12 GHz	10dB 18dB 18dB 18dB	160 MHz 160 MHz 160 MHz 160 MHz	20 MHz 20 MHz 20 MHz 20 MHz
WJ-1038	1	12-18 GHz	20dB	160 MHz	30 MHz

MICROWAVE TUNER AND DEMODULATOR

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 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.

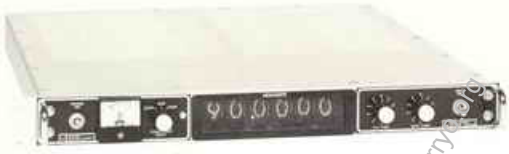
For other equipment in this range, please refer to the earlier description on the 112 Receiver.

FREQUENCY EXTENDERS

The frequency coverage of VHF receivers such as the 905A or 977 may be extended to include HF, UHF and SHF regions through the use of frequency extenders. Types FE-1-4.5A, FE-4-8, FE-8-12 have a tunable four-section YIG preselector for each band.

SPECIFICATIONS:

Model	*Bands*	*Range*	*Maximum Noise Figure*	*IF Output*
FE-25-1	2	235-500 MHz 490-1000 MHz	10 dB 12 dB	60 MHz
FE-1-4.5A	2	0.95-2.05 GHz 1.95-4.5 GHz	18 dB 18 dB	160 MHz 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 FREQUENCY COUNTER

Companion unit for 521A-1 Receiver. Provides 6-digit display of received frequency. Provides a readout range of 20 MHz to 90 MHz with a 30 MHz offset. Features dual DAFC (digital automatic frequency control) when used with 521A-1 receiver. Has a ± 100 Hz resolution. Compact unit occupies only 1.75 inches of vertical space.

DRO-300A FREQUENCY COUNTER

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 Counter Frequency Extender, can indicate frequencies up to 1000 MHz. Includes DAFC to lock VHF receivers to desired frequencies in 1-kHz increments.

DRO-302A-2 FREQUENCY COUNTER

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 FREQUENCY COUNTER

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.

DRO 309A FREQUENCY COUNTER

State-of-the-art Frequency Counter to indicate the tuned frequency in the range of 0.1 to 1,000 MHz of receivers having IF's of 8, 10, 21.4 and 60 MHz and one of customer selection. Features include 6 Digit LED Display, Direct Count, extremely rugged construction, low power consumption. Resolution of ± 100 Hz from 0.1 to 50 MHz and ± 1 kHz from 20 to 1,000 MHz. Automatic last 2 digit DAFC to lock receivers to desired frequency. BCD output.

DRX-1000 COUNTER FREQUENCY EXTENDER

Extends range of DRO-300A or DRO-302A-2 frequency counter 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-2 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-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.

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.

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-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.

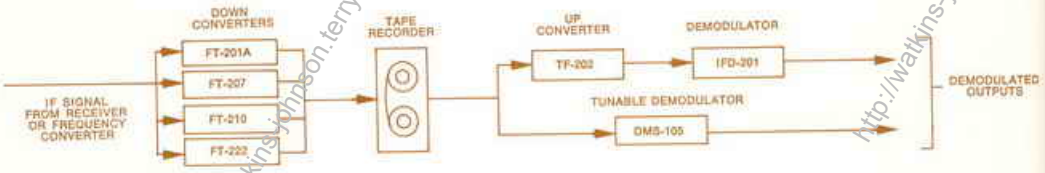
Model	*Center Frequency/ Tuning Range*	*Capability*	*IF Bandwidths*
DM-160	160 MHz	AM, FM, pulse	350 kHz, 1.5 MHz, 4 MHz
DM-212	160 MHz	AM, FM, pulse	10, 20 MHz

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 converters are designed to accept a 21.4 MHz input. Where the IF output of a receiver is other than 21.4 MHz a frequency converter such as the IFC-162 is required to translate the receiver IF to 21.4 MHz. 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 four different bandwidths.

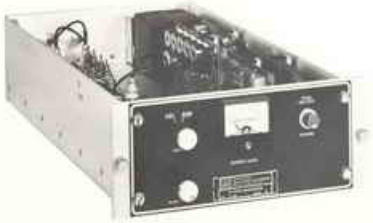


FT-201A IF-TAPE CONVERTER

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.

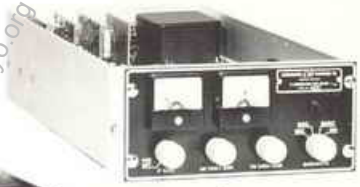
FT-207 IF-TAPE CONVERTER

Wideband down converter accepts input spectrum centered at 21.4 MHz and translates it to one centered at 2.15 MHz 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-210 IF-TAPE CONVERTER

Accepts the 21.4-MHz IF output from receivers and translates this signal to one which can be recorded on a wideband tape recorder having an upper frequency limit of 2 MHz. The converter has a data bandwidth of 150 kHz to 2 MHz. The FT-210 is a half-rack size which mounts in an EF-101 or EF-201C frame.



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.

IFD-201 IF DEMODULATOR

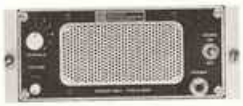
Accepts the 21.4-MHz output from an up converter. Provides bandwidth selection and AM and FM demodulation. Has IF bandwidths of 10, 50, 300, and 1000 kHz. Provides separate AM and FM video outputs.

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. The unit is 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.

IFC-162 FREQUENCY CONVERTER

Designed to translate a low-level 160-MHz signal from a tuner to a 21.4-MHz output signal at a level sufficient to provide the input for an IF-tape converter such as the FT-201A, FT-207, FT-210 and FT-222. Overall bandwidth of the IFC-162 is 6 MHz. Both AGC and manual gain modes are provided in the IFC-162. The unit is constructed in a half-rack size which mounts in an EF-101 or EF-201C frame.



MP-101 METER PANEL

Operates 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. The unit consists of an IF amplifier/driver, an AM detector, and provisions for metering a carrier level at the AM detector output. Variable slide-back-gate is included to display pulse signals with a minimum amount of baseline noise.

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.

EQUIPMENT FRAMES

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-506 is used to mount 440 or 441 receivers.

Model	*Openings*	*Dimensions*
EF-101	1	3¼" x 8"
EF-201C	2	3¼" x 8"
EF-506A	6	2½" x 4¼"

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 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 equipment:

- 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 (Five Outputs)
- Type BSC-5 Basic Supergroup Converter (One Output)
- Type TDM-101 Basic Group Demodulator (One Input; Twelve Outputs)
- Type TDM-110 Basic Group Demodulator (Ten Inputs; Ten Outputs)
- Type GDM-1 Basic Group Demodulator (One Input; One Output)
- 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.

A TDM-110 could be used in place of the TDM-101 in a TDS-100 system. 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.

Another option available is the use of a GDM-1 in place of a TDM-101 or TDM-110. The GDM-1 is designed to demodulate one voice channel at a time. The channel to be demodulated is determined by a plug-in crystal. The unit is designed for mounting in the EF-511 Equipment Frame. An EF-511 can house as many as ten GDM-1's. Operating power is provided by the EF-511.

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.

The BSC-5 Basic Supergroup Converter is also available for converting a 60-channel basic supergroup to the 12-channel basic group format. The BSC-5 accepts a 60-channel basic supergroup input and provides as its output one of the five 12-channel basic groups. A front-panel switch is used to select the desired basic group.. The unit is designed for mounting in the EF-511 Equipment Frame which can house as many as ten BSC-5's at one time. Operating power is provided by the EF-511.

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 the 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 10 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 TDM-102 Demodulator for the CCITT Base Group "A" is also available. 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.

Detailed specification sheets are available for all the units discussed. Technical assistance is also available to advise on telephone system demultiplexing problems.

SPECIFICATIONS:

ANT-101 ANTENNA

Power Gain	12 dB, minimum
3 dB 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
Sweep Rate	5 Hz to 25 Hz
Resolution	200 kHz

IFD-210 IF DEMODULATOR

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

BSC-5 CONVERTER

Input Frequency Range	312 to 552 kHz
Output Frequency Range	60 to 108 kHz
Number of Outputs	One, selected 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

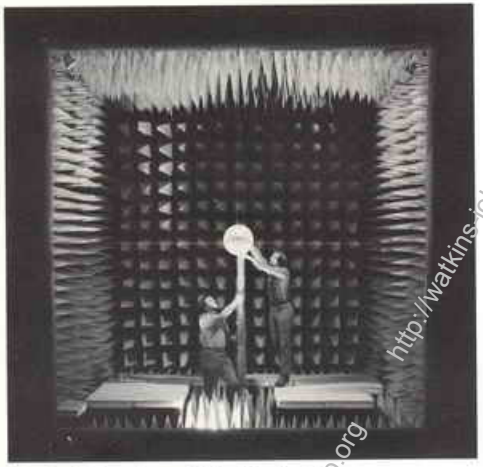
Number of Inputs	Ten
Input Frequency Range	60 to 108 kHz
Type of Demodulation	SSB
Number of Outputs	Ten
Output Frequency Range	300 Hz to 3.5 kHz
Output Channel Selection	Any one of twelve channels on all ten outputs may be selected by front-panel switches

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

GDM-5 DEMODULATOR

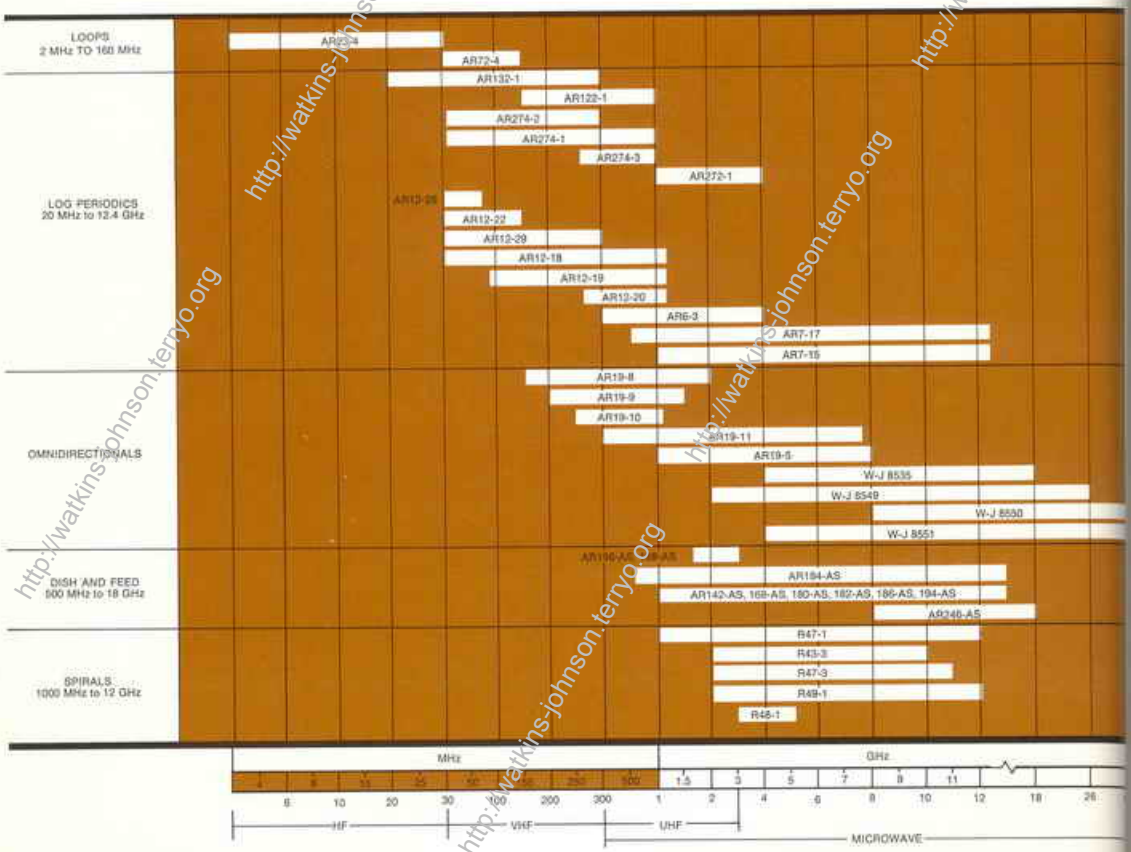
Input Frequency Range	4 to 108 kHz
Type of Demodulation	SSB
Number of Outputs	One
Output Frequency Range	300 Hz to 3.15 kHz
Output Channel Selection	Determined by plug-in crystal installed



Anechoic Chamber — Palo Alto Facility

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.

SURVEILLANCE ANTENNA GUIDE



BALANCED LOOP ANTENNAS

The AR23-4 and the AR72-4 are lightweight, precision-balanced loops that offer the outstanding combination of broad frequency range, minimum size, and high sensitivity. The AR23-4 features a simple step tuning system which is an integral part of the antenna; the broadband characteristics of the AR72-4 are such that no antenna tuning is required.

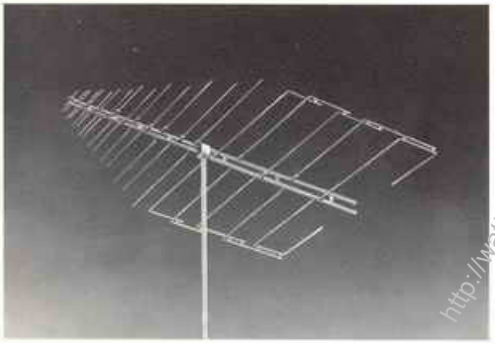
Antenna Model Number	Frequency Range	How Polarized	Radiation Patterns
AR 23-4	2–30 MHz	In Plane of Loop	Bi-directive Figure Eight
AR 72-4	30–160 MHz	In Plane of Loop	Bi-directive Figure Eight

STANDARD LOG PERIODIC ANTENNAS

The AR7-Series consists of two linear polarized antennas that maintain near-constant radiation patterns all the way up to 12.4 GHz. The AR7-15 has a frequency range of from 1 to 12.4 GHz and the AR7-17 from 0.5 to 12.4 GHz. Both antennas are specifically designed for dish reflectors; they are fabricated by high-precision techniques and are completely enclosed by foam-filled outer fiberglass housings.

The AR12-Series of standard log periodic antennas provides six models to cover the frequency range from as low as 30 MHz up to 1100 MHz. All models are linear polarized and operate with an average VSWR of 2:1. They are designed with a power handling capacity of 25 Watts average power and 1 kw peak power, making them suitable for a wide range of transmitting and receiving applications.

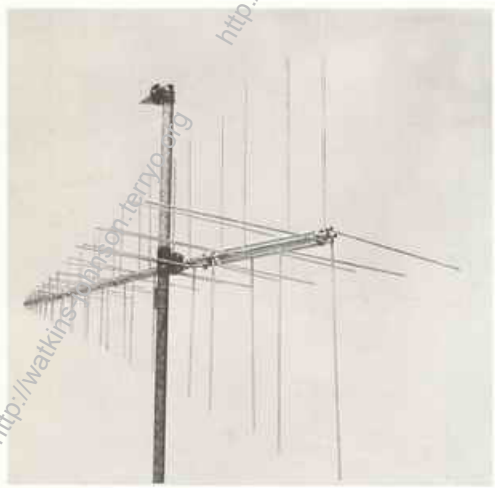
Antenna Model Number	Frequency Range	VSWR (Max)	Gain (Nominal)	How Polarized	Front-to-Back Ratio (Minimum)	Cross Polarization (Minimum)	Side Lobes (Nominal)	Power Handling Capacity	
								Peak	Avg.
AR7-15	1 to 12.4 GHz	2.25:1	7 db	Linear	18 db	15 db(1-8 GHz) 10 db(8-12 GHz)	15 db	25 W	5 W
AR7-17	0.5 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

Compacted log periodics are especially useful for applications where weight or space are critical factors in selecting an LP with frequency requirements between 20 MHz and 1 GHz. The design techniques employed in the AR122-1 and the AR132-1 have made possible a drastic reduction in size of these antennas without a compromise in their performance specifications.

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)



DUAL-POLARIZED LOG PERIODIC ANTENNAS

Dual-polarized log periodic antennas provide the broadband, linear performance characteristics of the standard LP and at the same time feature a polarization versatility which makes them particularly suited for many communications monitoring links, and ECM surveillance applications. This series offers a radome-protected model, the AR272-1, which covers the frequency range between 1 and 4 GHz and is ideal for parabolic reflector installations. Three models of the AR274 version that operate between 30 MHz and 1 GHz are also offered: the AR274-1 which provides excellent coverage over the entire range of 30 MHz to 1 GHz; the AR274-2 which covers the 30 to 300 MHz portion of this band; and the AR274-3 which covers the band from 250 MHz to 1 GHz.

Antenna Model Number	Frequency Range	VSWR (max.)	Gain (nom.)	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	7 db	Orthogonal Linear	300 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

DISH AND FEED ANTENNAS

Watkins-Johnson dish and feed antennas are available with circular, dual or linear polarization. All three types feature broadband operation, an average VSWR of well below 2:1, and squint of less than 1°. The feeds are radome-protected on all models.

Antenna Model Number	Frequency Range GHz	VSWR	Gain db	Gain (GHz)	How Polarized	Power Handling Capacity	Front-to-Back Ratio	Squint	Side Lobes	3 db Beamwidths
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	16.0 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 ** SIDE LOBES AR168AS

	1.0 GHz	10.0 GHz
E PLANE	10.5 db	17.7 db
H PLANE	8.5 db	14.1 db

	1.0 GHz	10.0 GHz
E PLANE	4.9 db	19 db
H PLANE	4.7 db	14 db

OMNIDIRECTIONAL CONICAL SPIRAL ANTENNAS

The conical spiral antennas have been designed to provide ultra-broadband reception with special emphasis on maintaining a low VSWR and high efficiency. Covering the frequency range from 150 MHz to 40 GHz, this series offers a superior performance antenna to meet any specific omnidirectional surveillance requirement within the band.

Antenna Model Number	Frequency Range	VSWR	Gain	How Polarized	Deviation From Omni	Power Handling Capacity	
						Peak	Avg
AR 19-5	1 to 8 GHz	2:1 max over 90% of band	0 db over isotropic	Circular	±3 db on horizon	1 kw	5W
AR 19-8	150 MHz to 2 GHz	2:1	same	same	same	same	same
AR 19-9	200 MHz to 1.4 GHz	same	same	same	same	same	same
AR 19-10	250 MHz to 1.1 GHz	same	same	same	same	same	same
AR 19-11	300 MHz to 7.3 GHz	same	same	same	same	same	same
WJ—8535	4.0–26.0 GHz	3.0:1 max	same	Slant Linear	same	same	same
WJ—8549	2.0–26.0 GHz	2.0:1 max	same	Vertical	±1 db on horizon	same	same
WJ—8550	8.0–40.0 GHz	3.0:1 max	same	Slant Linear	±3 db on horizon	same	same
WJ—8551	4.0–40.0 GHz	2.5:1 max	same	Vertical	±1 db on horizon	same	same

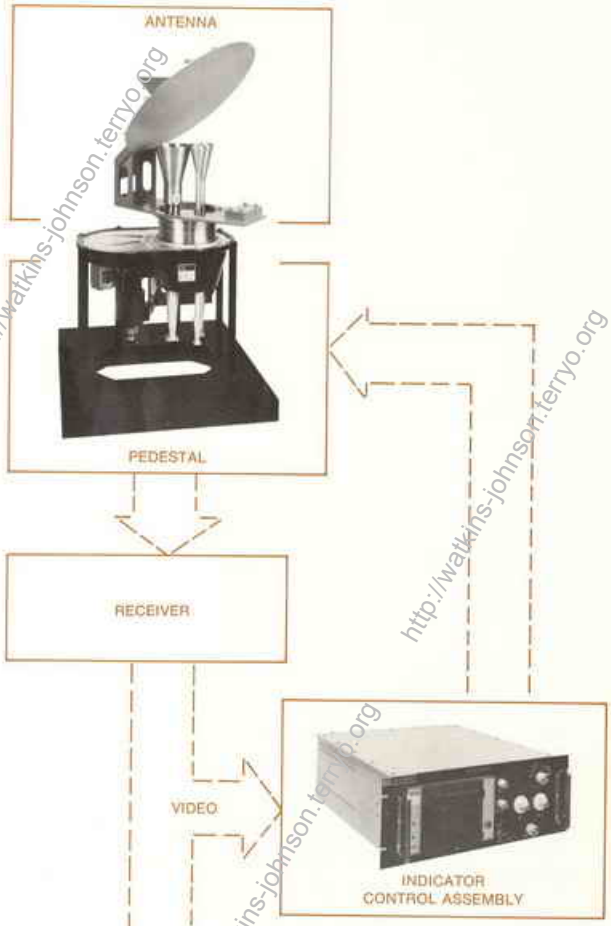
PLANAR SPIRAL ANTENNAS

Designers of airborne ECM receiving systems are provided with outstanding spiral antenna performance, both for unit to unit uniformity and independence of frequency, in the planar spiral antenna series. Meticulous design and precise assembly of ferrites and other absorbers of superior properties, in conjunction with a broadband balun, make these important characteristics possible.

Antenna Model Number	Frequency Range	How Polarized	VSWR	Gain	Axial Ratio	3 dB Beam-width	10 dB Beam-width	Squint	Surface Operating Temperature
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 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

40 MHz to 40 GHz DIRECTION FINDING ANTENNA SYSTEMS

Watkins-Johnson offers a family of direction-finding systems that provide a visual display of the direction of arrival of an incoming RF signal in the 40 MHz to 40 GHz frequency range. These lightweight, easily installed, low-maintenance systems are ideal for airborne, shipboard, fixed-station or mobile van applications. They may be rotated in azimuth up to 600 rpm or slewed manually by the operator to any desired position. Variations to the basic system are available to meet specific frequency ranges, beamwidths, gain, polarization, and number of individual antenna outputs. A control system which permits synchronization of antenna spin rate and receiver sweep rate is also available, as well as complete installation and maintenance manuals.



SPECIFICATIONS:

	L4/A	*L6/A*	*L3/A*	*L5/A*
Frequency Range:	40-500 MHz	0.5-18 GHz	0.5-12.4 GHz	12-40 GHz
Band 1	(40-190)	(0.5-4.0)	(0.5-1.0)	(12-18)
Band 2	(190-500)	(4-18)	(1-2)	(18-26)
Band 3	———	———	(2-4)	(26-40)
Band 4	———	———	(4-12.4)	———
Polarization:	Vertical/ Horizontal	V/H for antenna 1, Circular for antenna 2	Circular	Circular
Gain:				
Antenna 1	−15 dB avg.	0 dB @ 0.5 GHz	−6 to 0 dB	+16 dB Min
Antenna 2	−8 dB avg.	+5 dB per octave to 18 GHz	−2 to +6 dB	+16 dB Min
Antenna 3	———	———	0 to +8 dB	+16 dB Min
Antenna 4	———	———	+2 to +12 dB	———
Horizontal Beamwidth:	60 to 100°	5 to 50°	25 to 90°	12 to 20°
Rotary Joint/Output:	Single-Channel	Two-Channel	2 Two-Channel	———
Connector:	Type N	3 mm	3 mm	Standard Waveguide
Antenna Rotation:	0-200 rpm	0-600 rpm	0-600 rpm	0-600 rpm

RECEIVERS CROSS REFERENCE INDEX

RECEIVER/TUNER (IF REQUIRED)	FREQUENCY RANGE	SM-	COUNTER DRO/DRX	TYPE OF RECEIVER	EQUIPMENT FRAMES	IF BANDWIDTHS	TYPES OF RECEPTION
1. 340	1–900 kHz	8421	Internal	Man/Remote		1, 6, 20, 50 kHz	AM, FM, CW
2. 357	1–600 kHz	8421	Internal	Man		.15, 1, 3, 6 kHz	AM, SSB, CW, MCW, FSK
3. 373A-2/7	.5–30 MHz	9404A	300A-1/ 302A-7	Man		6, 20, 100, 400 kHz	AM, FM, CW
4. 521A-1	20–80 MHz	Internal	290A	Man		4, 10, 50 kHz	AM, FM, CW
5. 905A	30–300 MHz	9304A	None	Man		20, 300 kHz	AM, FM, CW
6. 905A-1	30–300 MHz	9304A	None	Man		50, 300 kHz	AM, FM, CW
7. 906A-7	30–300 MHz	9304A	300A	Man		20, 300 kHz	AM, FM, CW
8. 977	30–300 MHz	9304A	302A 309A	Man		60, 300, 3,000 kHz	AM, FM, CW, Pulse
9. 565/VH-101	20–90 MHz	Internal	309A/315	Man		Any Four Of	AM, FM, CW, Pulse
565/VH-103	90–260 MHz	Internal	309A/315			10, 50, 200, 300 kHz	
565/VH-105	200–425 MHz	Internal	309A/315			1 and 3 MHz	
565/UH-101	250–500 MHz	Internal	309A/315				
565/UH-102	500–1,000 MHz	Internal	309A				
10. 555	90–180 MHz	Internal	300A	Man		10, 20, 50 kHz	AM, FM, CW
11. 595	220–440 MHz	Internal	309A	Man		10, 20, 50 kHz	AM, FM, CW
12. 775-3	235–1,000 MHz	9404A	None	Man		100, 500, 4,000 kHz	AM, FM, CW, Pulse
13. 775-9	235–1,000 MHz	9404A	309A	Man		100, 500, 4,000 kHz	AM, FM, CW, Pulse
14. RS-111-1B-12	30–1,000 MHz	Internal	309A	Man		20, 75, 300, 2,000 kHz	AM, FM, CW
15. RS-111-1B-35	30–1,000 MHz	Internal	309A	Man		20, 75, 300, 2,000 kHz	AM, FM, CW
16. 440/441	30–300 MHz	9304A		Fixed	EF506	5, 20, 50, 75 or 100 kHz	AM/FM
17. 461	300–550 MHz	9304A		Fixed	EF506A	20, 50, 75 or 100 kHz	AM/FM
18. 112 TH-120 TH-240 TH-480 TH-812	1–12 GHz	1622/1622-1		Man		100 kHz, 10 and 20 MHz, Plus 500 kHz and 1 MHz or 284 MHz	AM, FM, Pulse

RECEIVING SYSTEMS	FREQUENCY RANGE	SM-	COUNTER DRO/DRX	TYPE OF RECEIVER	EQUIPMENT FRAMES	IF BANDWIDTHS	TYPES OF RECEPTION
1. RS-158/410-( )	20–80 MHz		270	Man	EF-158	10, 20 or 50 kHz	AM, FM
2. RS-180/481	30–60 MHz		280	Man	EF-180	10, 20 or 50 kHz	AM, FM
RS-180/482	60–120 MHz		280	Man	or		
RS-180/483	100–180 MHz		280	Man	EF-182		
RS-180/484	180–300 MHz		280	Man			
3. RS-160/HH-11	2–30 MHz	SM-7301A	308	Pan/Man	TSU-160	10, 50, 300 kHz	AM, FM, Pulse
RS-160/VH-15	20–40 MHz	SM-7301A	308	Pan/Man	TSU-160	1 MHz	
RS-160/VH-11	30–60 MHz	SM-7301A	308	Pan/Man	TSU-160		
RS-160/VH-16	40–80 MHz	SM-7301A	308	Pan/Man	TSU-160		
RS-160/VH-17	50–100 MHz	SM-7301A	308	Pan/Man	TSU-160		
RS-160/VH-12	60–120 MHz	SM-7301A	308	Pan/Man	TSU-160		
RS-160/VH-13	100–180 MHz	SM-7301A	308	Pan/Man	TSU-160		
RS-160/VH-14	180–300 MHz	SM-7301A	308	Pan/Man	TSU-160		
RS-160/UH-13	220–440 MHz	SM-7301A	308	Pan/Man	TSU-160		
RS-160/UH-11	250–500 MHz	SM-7301A	308	Pan/Man	TSU-160		
RS-160/UH-12	500–1,000 MHz	SM-7301A	308	Pan/Man	TSU-160		

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

ARIZONA
Bennewitz Associates, Inc.
4311 N. Brown Avenue
Scottsdale 85251
Telephone: (602) 947-7375

CALIFORNIA
L & M Engineering, Inc.
3242 McKinley Drive
Santa Clara, 95051
Telephone: (408) 243-2691

L & M Engineering, Inc.
3511 Inglewood Ave.
Inglewood 90301
Telephone: (213) 674-6850

COLORADO
Bennewitz Associates, Inc.
2801 E. Colfax Ave.
Denver 80206
Telephone: (303) 399-1132

DISTRICT OF COLUMBIA
Watkins-Johnson
6006 Executive Blvd.
Rockville, Md. 20852
Telephone: (301) 881-3300

FLORIDA
Gentry Associates, Inc.
500 N. Bumby Ave.
Orlando 32803
Telephone: (305) [illegible]-7748

ILLINOIS
RF Specialists
119 West Higgins Road
Park Ridge 60068
Telephone: (312) 698-2044

INDIANA
RF Specialists
[illegible] Woodwind Drive
Indianapolis 46217
Telephone: (317) 783-7530

MARYLAND
Watkins-Johnson
6006 Executive Blvd.
Rockville 20852
Telephone: (301) 881-3300

MASSACHUSETTS
Lancer Associates, Inc.
18 Adams Street
Burlington 01803
Telephone: (617) 272-5445

MICHIGAN
S. Sterling Company
17500 W. McNichols Road
Detroit 48235
Telephone: (313) 255-1970

MISSOURI
Kemco, Inc., Strather Bldg.
Room 15, 8050 Brown Road
St. Louis 63134
Telephone: (314) 524-0800

NEW MEXICO
(White Sands Missile
Range only)
John W. Casey III
16778 San Pedro
San Antonio, Texas 78216
Telephone: (512) 494-2911

Bennewitz Associates, Inc.
527 Wyoming, S.E.
Albuquerque 87108
Telephone: (505) 255-8723

NEW YORK
Eastern Instrumentation
Incorporated
300 Northern Blvd.
Great Neck, L. I. 11021
Telephone: (516) 466-5500

Ossmann Instruments, Inc.
6666 Old Collamer Road
E. Syracuse 13057
Telephone: (315) 437-6666

Ossmann Instruments, Inc.
474 Thurston Road
Rochester 14619
Telephone: (716) 328-2230

Ossmann Instruments, Inc.
1801 Vestal Parkway East
Vestal 13850
Telephone: (607) 785-9947

Ossmann Instruments, Inc.
P.O. Box 203
Wappingers Falls 12590
Telephone: (914) 297-7777

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

OHIO
S. Sterling Company
5827 Mayfield Road
Cleveland 44124
Telephone: (216) 442-8080

S. Sterling Company
2673 Culver Avenue
Dayton 45429
Telephone: (513) 298-7573

PENNSYLVANIA
Eastern Instrumentation
Incorporated
613 Cheltenham Avenue
Philadelphia 19126
Telephone: (215) 927-7777

S. Sterling Company
No. 2 Parkway Center
Pittsburgh 15220
Telephone: (412) 922-5720

TEXAS
Kemco, Inc.
13135 West Carpenter Frwy
Irving 75060
Telephone: (214) 255-4506

Kemco, Inc.
8405 Leawood Blvd.
Houston 77022
Telephone: (713) 438-1788

(Bexar County Only)
John W. Casey III
16778 San Pedro
San Antonio 78216
Telephone: (512) 494-2911

WASHINGTON
Ruth S. Drake Associates
Incorporated
6132 Mennard Ave. South
Seattle 98108
Telephone: (206) 763-2[illegible]

EXPORT

AUSTRALIA
Rama Electronics Pty. Ltd.
47 Talavera Road
North Ryde, N.S.W.
Telephone: 885444
Telex: AA20361
Cable:
RAMELAUST-NORTH RYDE

Rama Electronics Pty. Ltd.
55 Wellington Street
Windsor, Victoria 3181

Rama Electronics Pty. Ltd.
6 Oakes Street
Torrens, A.C.T. 2600

Rama Electronics Pty. Ltd.
5 Rosella Avenue
Linden Park, S.A. 5065

BELGIUM
S. A. Telindus
76, Rue Stanley
1180 Brussels
Telephone: 44.66.96/97
Telex: 22700
Cable: INKOMA-BRUSSELS

CANADA
Allan Crawford Assoc., Ltd.
6427 Northam Drive
Mississauga, Ontario
Telephone: (416) 678-1500
TWX: 610-492-2119

Allan Crawford Assoc., Ltd.
157 St. Charles Street W.
Longueuil, P.Q.
Telephone: (514) 670-1212
TWX: 610-422-3875

Allan Crawford Assoc., Ltd.
376 Churchill Avenue
Ottawa, Ontario
Telephone: (613) 725-3354
TWX: 610-562-1530

Allan Crawford Assoc., Ltd.
1820 Pandora Street
Vancouver, B.C.
Telephone: (604) 253-7136
TWX: 610-929-3059

DENMARK
Danavia A. S.
Strandgade, 48
DK-1401 Copenhagen K
Telephone: AS94.2221
Telex: 5749
Cable:
AIRTRADE-COPENHAGEN

FINLAND
OY Hedengren AB
Lauttasaarentie 50
00200 Helsinki 20
(P.O. Box 20130
00100 Helsinki 10)
Telephone: 670271
Telex: 121110
Cable: HEDOY-HELSINKI

FRANCE
Bureau de Liaison
113, Rue de Courcelles
75 Paris 17
Telephone: 622.38.30
Telex: 2[illegible] Code 226 BOL
Cable:
BUREAULIAISON-PARIS 007

GREECE
American Technical
Enterprises
P.O. Box 156
Athens 9
Telephone: 659470
Cable:
AMERITECHNI-ATHENS

HOLLAND
Rimi[illegible] en Hartman
Electrotechniek N.V.
Koppelweg 30
The Hague
Telephone: 070-678380
Telex: 31528
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INDIA
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Cable: OCKAP-NEW DELHI

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Tel-Aviv
Telephone: 53459
Telex: 033-299
Cable: STGTUG-TEL-AVIV

ITALY
Watkins-Johnson Italiana
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Piazza G. Marconi, 25
00144 Roma-EUR
Telephone: 59 45 54
Cable: WJROM-ROMA

JAPAN
Kanematsu Gosho Kaisha, Ltd.
7th Floor
New Otemachi Bldg.
2-1, 2-chome, Otemachi
Chiyoda-ku, Tokyo 100-91
Telephone: 03-270-7711
Telex: TK2540, TK2564
Cable: MERCANTILE-TOKYO

KOREA
Seine Trading Corporation
I. P. O. Box 2447
Seoul
Telephone: 73-0336, [illegible]6630
Cable: INNSANGATI-SEOUL

NORWAY
J. M. Feiring A/S
Nils Hansensvei 7
Box 101 Bryn
Oslo 6
Telephone: 68 63 60
Telex: [illegible]
Cable: FEIRING-OSLO

PORTUGAL
Eltec Electronica, Comercio
e Industria Limitada
Avenida Almirante Reis
No. 30, 2nd Floor
Lisbon 1
Telephone: 822677, 848856
Cable: TRANSISTOR-LISBON

SOUTH AFRICA
Specialized Electronics
(Pty.) Ltd.
42 Jones Crescent
P.O. Box 35
Halfway House
Transvaal
Telephone: 956-2013
Telex: 43-0568SA
Cable: ANTIGUAMBRON-
TRANSVAAL

SPAIN
Pymsa S. L.
Enrique Larreta, 9
Madrid-16
Telephone: 235-43-75
235-53-11
Cable: PARMO-MADRID

SWEDEN
Johan Lagercrantz KB
Cardsvagen 100
Box 314
S-17103 Solna 3
Telephone: 08/83 07 90
Telex: 10363
Cable: LAGCRANTZ-SOLNA

SWITZERLAND
Megex Zurich, GmbH
8048 Zurich
Badenerstrasse 582
Telephone: (051) 52 76 00
Telex: 54303
Cable:
MEGEXIMPORT-ZURICH

UNITED KINGDOM
Watkins-Johnson
Shirley Avenue
Windsor, Berkshire
Telephone: Windsor 69241
Telex: 84578
Cable: WJUKW-WINDSOR

WEST GERMANY
Watkins-Johnson
8 München 2
Maximilianstrasse 18A
Telephone: (0811) 29 33 30
Telex: 529401
Cable: WJINT-MÜNCHEN

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6006 Executive Blvd., Washington Science Center, Rockville, Md. 20852
(301) 881-3300 TWX: 710-824-9603 TELEX: 89-2558 CABLE: WJCEI

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

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