

COMMUNICATION ELECTRONICS TECHNOLOGY DIVISION



CONDENSED PRODUCT CATALOG



WATKINS-JOHNSON



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California

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Introduction

For over three decades, Watkins-Johnson Company (W-J), headquartered in Palo Alto, California, has taken an active part in tactical and strategic surveillance, reconnaissance and signal analysis missions throughout the world. The company has a well-deserved reputation as a leading supplier of innovative, state-of-the-art, high-quality and reliable products. Keeping abreast of the rapid technological advances and increasing performance requirements of the military and intelligence communities, W-J maintains a key role in satisfying these rigid requirements — now and for the future. ◀



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CET Division

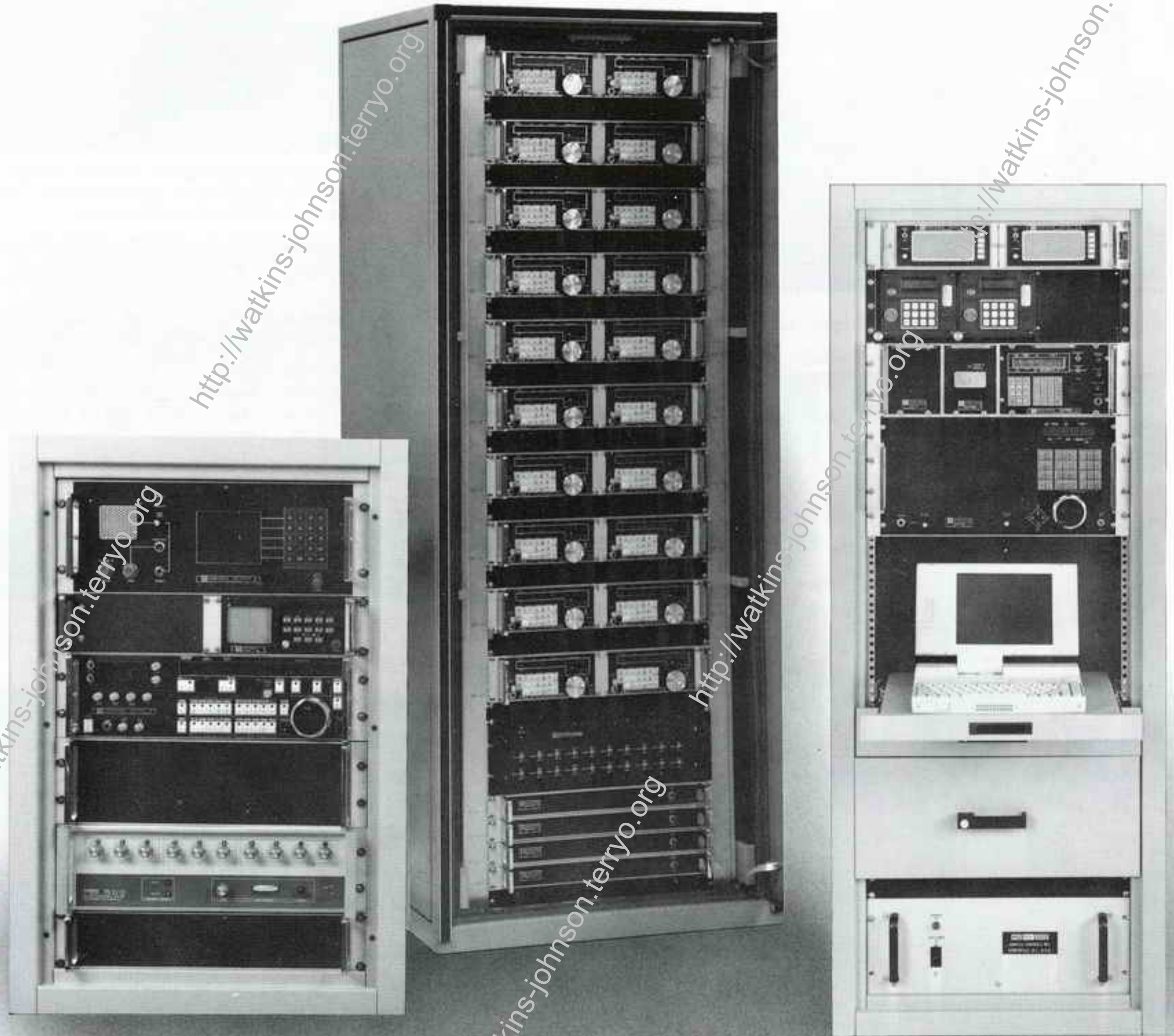
A vital part of the W-J Defense Group, the Communication Electronics Technology Division (CET) develops and manufactures high-performance intercept and analysis equipment for military, intelligence, space and industrial applications worldwide. Located in Gaithersburg, Maryland,

CET offers a full line of electronic equipment for communication, direction finding and signal processing, covering the radio frequency spectrum from ELF to SHF. A large selection of equipment is available from full-size rack-mountable units to miniature receivers.



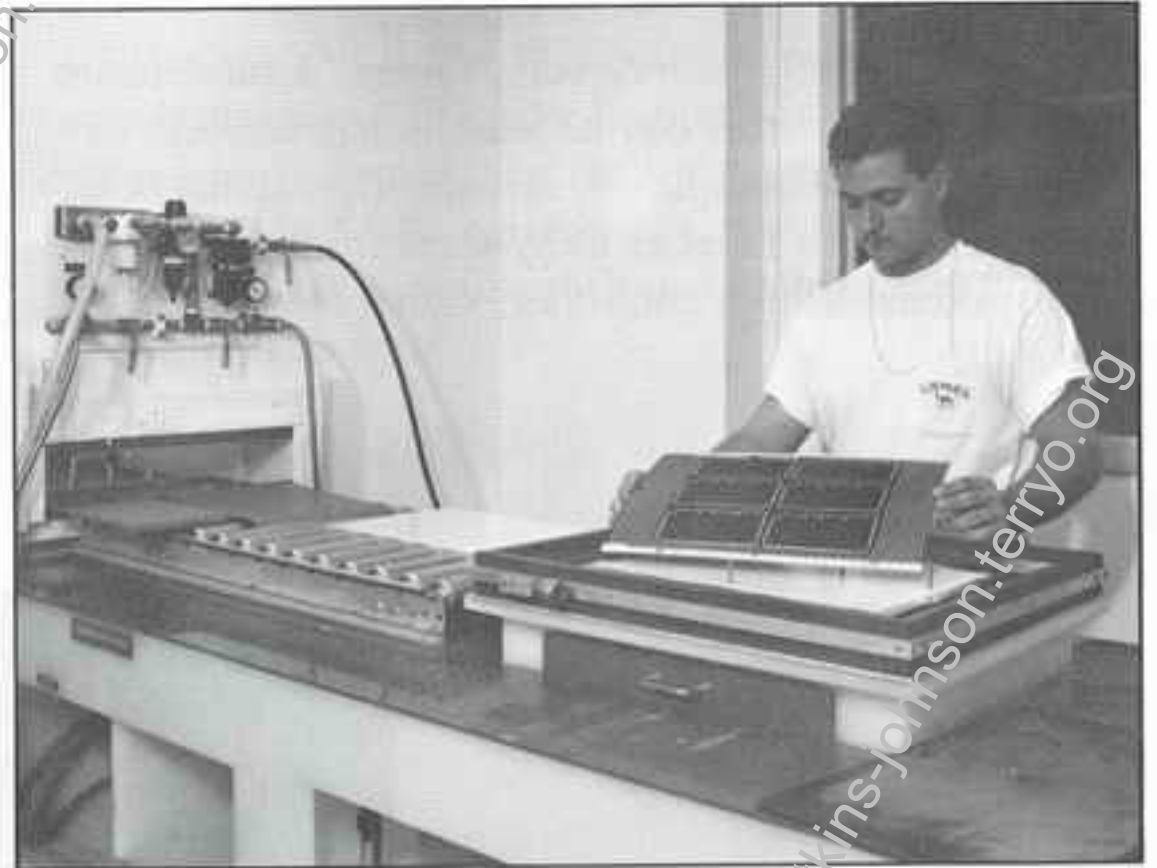
Nearly all of CET's receivers, tuners, demodulators and signal monitors can be used independently, or integrated into complex system configurations. CET has packaged a number of systems from simple subsystems using a controller, signal monitor and

several receivers, to complete programs. Many CET stand-alone units show great versatility when incorporated into these systems. CET systems currently operate in fixed-ground, mobile, airborne and ship-board installations throughout the world.



Facilities

The CET plant is a full service facility from design to delivery, through continued customer service after equipment is in the field. Decades of management and engineering experience have been combined with the latest automated machinery to smoothly and efficiently produce quality products in a timely and cost-effective manner.

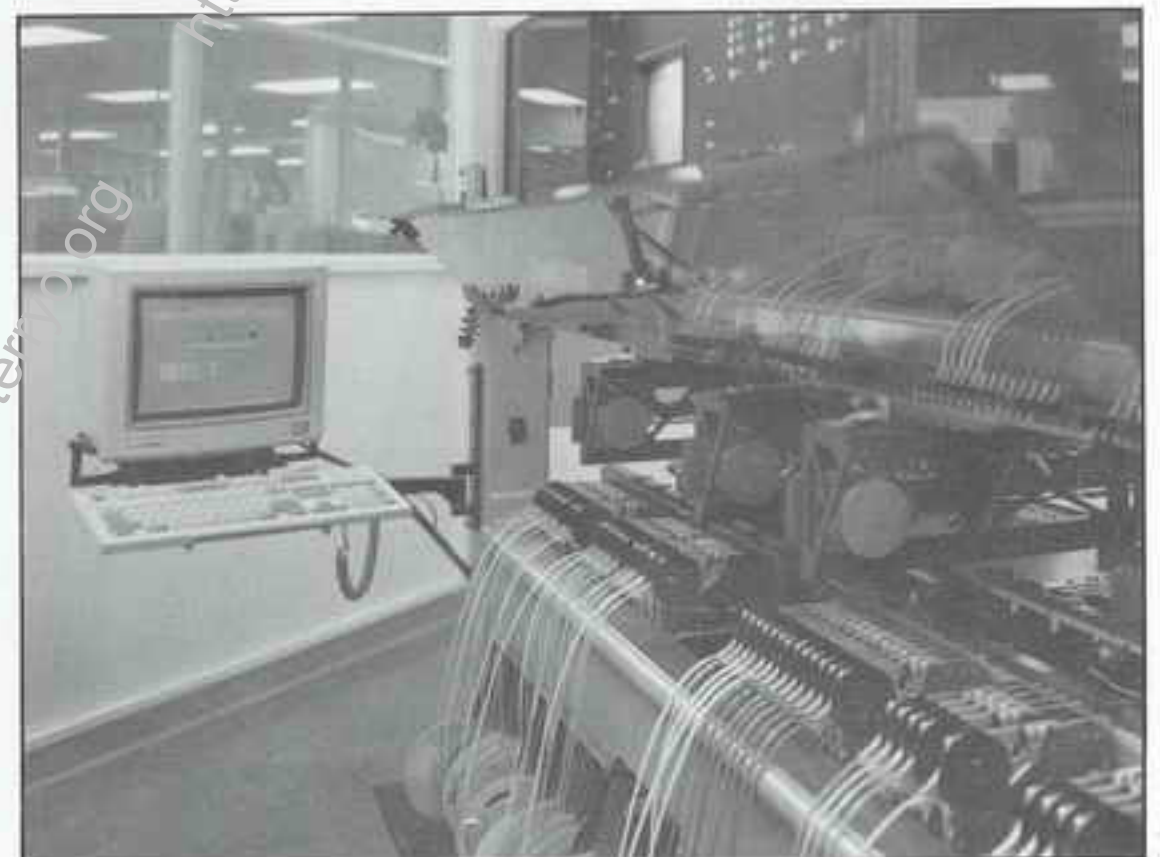


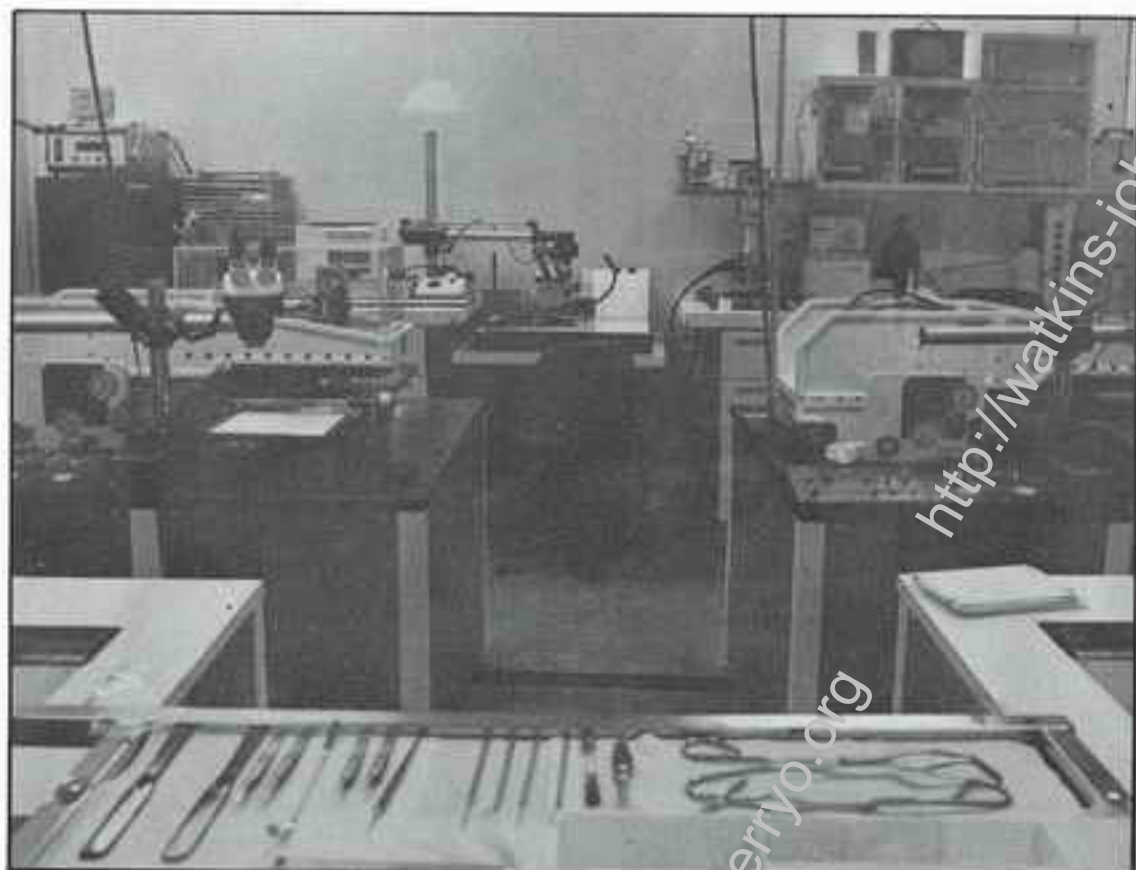
Fully equipped assembly shops and laboratories use both manual and automated fabrication techniques to etch, drill, cut to size and assemble single- and multi-layered printed circuit boards.



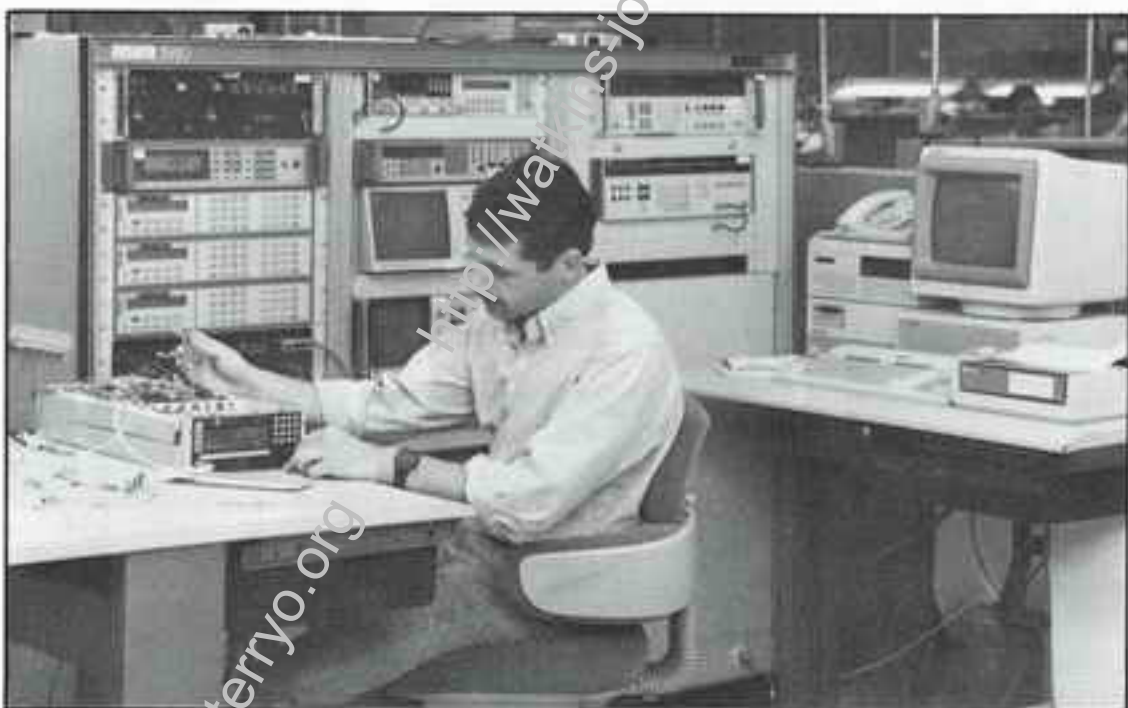
Executable CAD/CAM programs control precision cutting, bending, punching and milling processes to transform raw material into rugged, high-performance products.

To produce smaller, lower-cost packages, CET has added high-speed automated surface-mount production facilities.





In the thick-film laboratory, W-J produces complex high-density multi-layered circuit boards with an increased number of components and circuit interconnections.



Automated time-intensive testing provides operational data for full performance evaluations.

Product Assurance

CET has successfully integrated a broad spectrum of quality assurance and reliability functions to assure that all products are in compliance with both customer and internal quality standards:

- ▶ MIL-2000 facility
- ▶ MIL-I-45208A
- ▶ MIL-Q-9858A
- ▶ MTBF/MTTR predictions
- ▶ Environmental stress screening
- ▶ Resident DCAS audit
- ▶ Statistical process control.

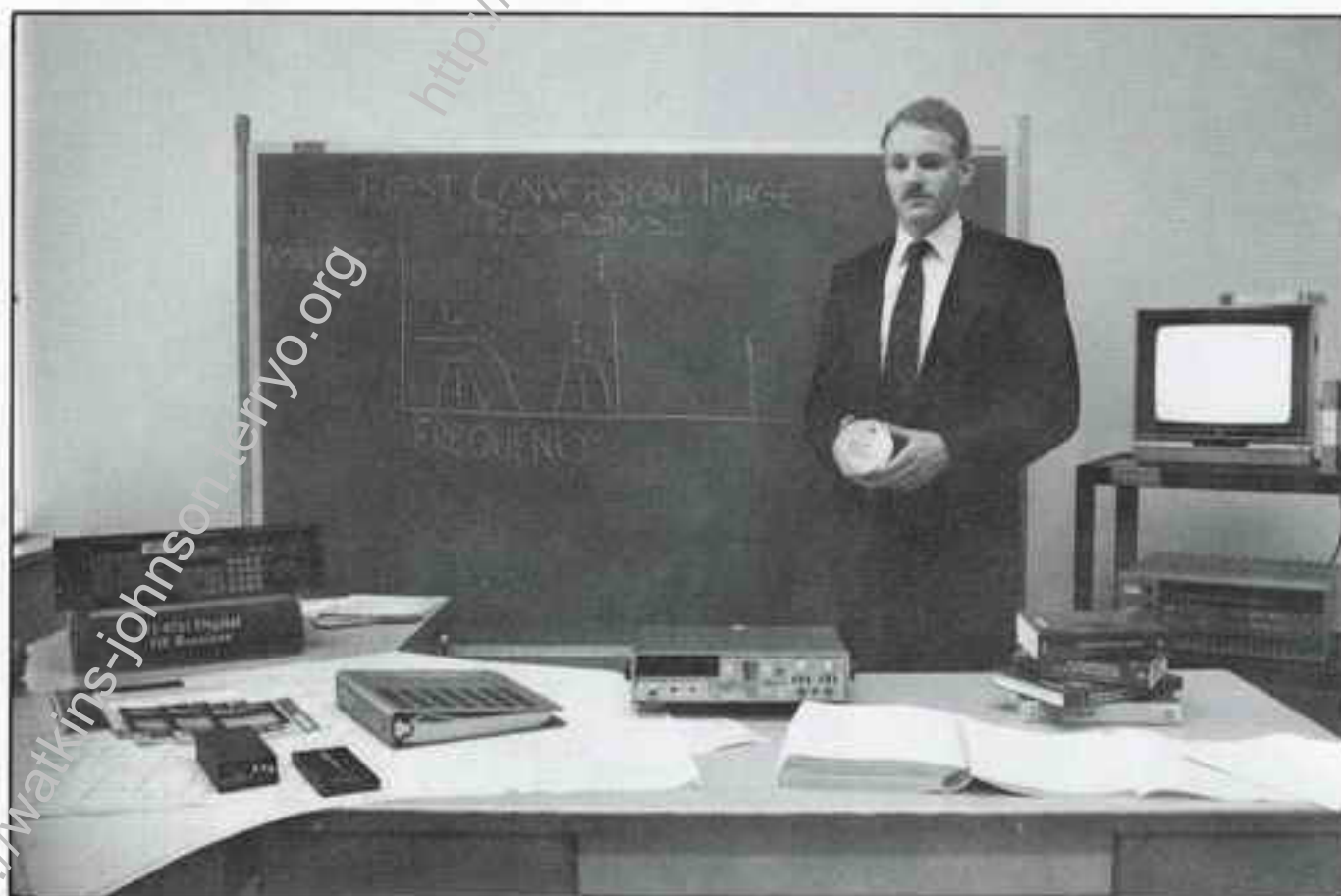
Integrated Logistics Support (ILS)

Experienced W-J training specialists provide courses in the operation and maintenance of all equipment manufactured by CET. Classes can be conducted in a formal or informal setting. Training is geared to typical applications of W-J equipment, but can be tailored to the specific mission of the customer. The lectures and laboratory training emphasize hands-on experience in operating, troubleshooting and repairing equipment. Training services include:

- ▶ sessions accommodating up to ten students knowledgeable in digital and analog electronics
- ▶ sessions at W-J or the customer's facility
- ▶ written course materials
- ▶ training videos in NTSC or PAL formats

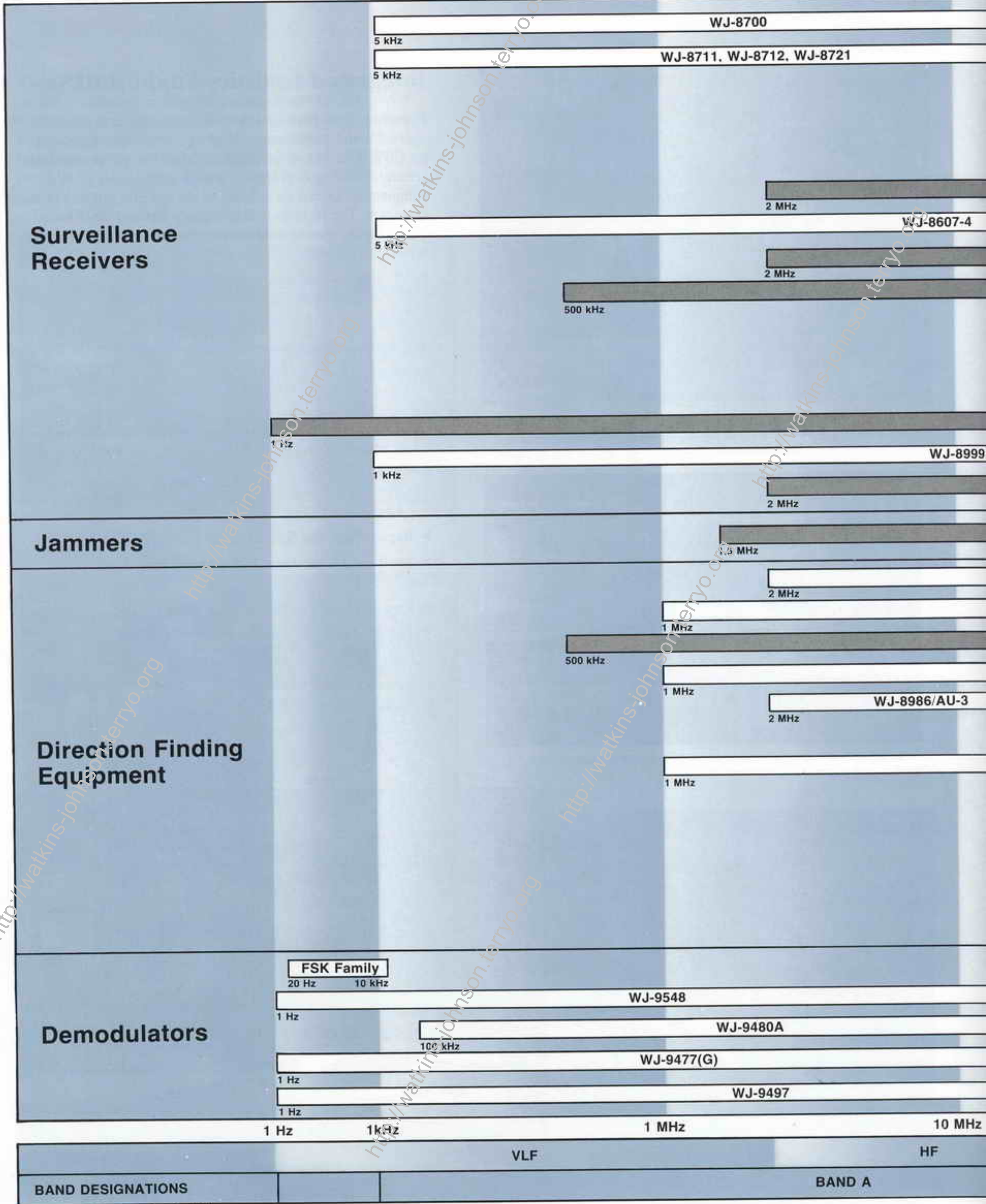
CET Division has also developed special lesson plans and training materials so customers can conduct their own in-house training programs on CET equipment. Additional ILS includes:

- ▶ MIL-Spec and commercial technical manuals (-10 through -34)
- ▶ Repair Parts and Special Tools Lists (RPSTL)
- ▶ Short- and Long-Form Provisioning Parts Lists (SFPPL & LFPPL)
- ▶ Logistics Support and Analysis (LSA)
- ▶ Logistics Support Analysis Records (LSAR)
- ▶ Level of Repair Analysis (LRA)
- ▶ Interim Support Items Lists (ISIL) and Recommended Spares Listings (RSL)
- ▶ Ground Support Equipment Selection Data (GSESD)



Frequency Range Chart

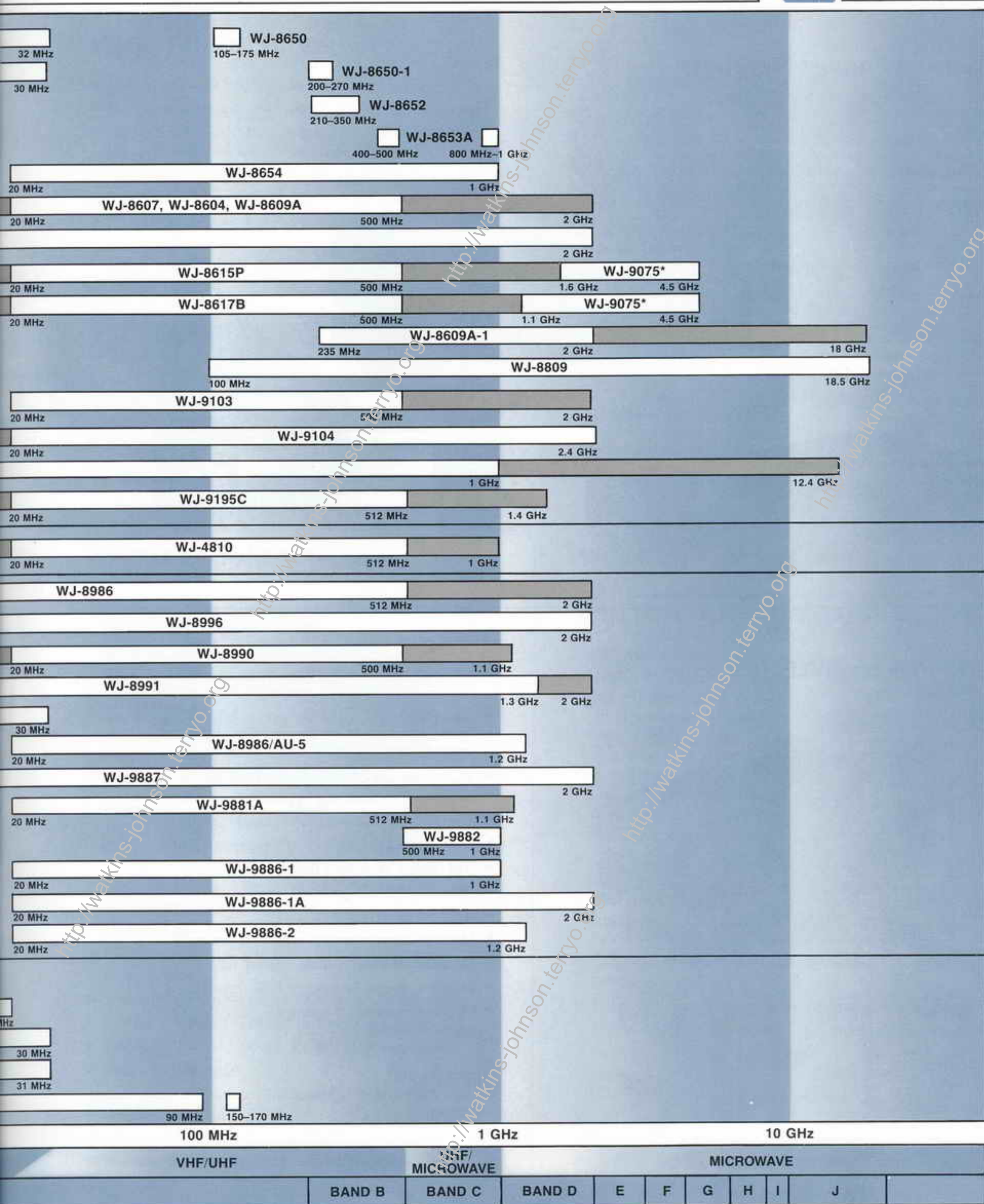
Watkins-Johnson Company ▶ Communication Electronics Tec



BAND DESIGNATIONS

BAND A

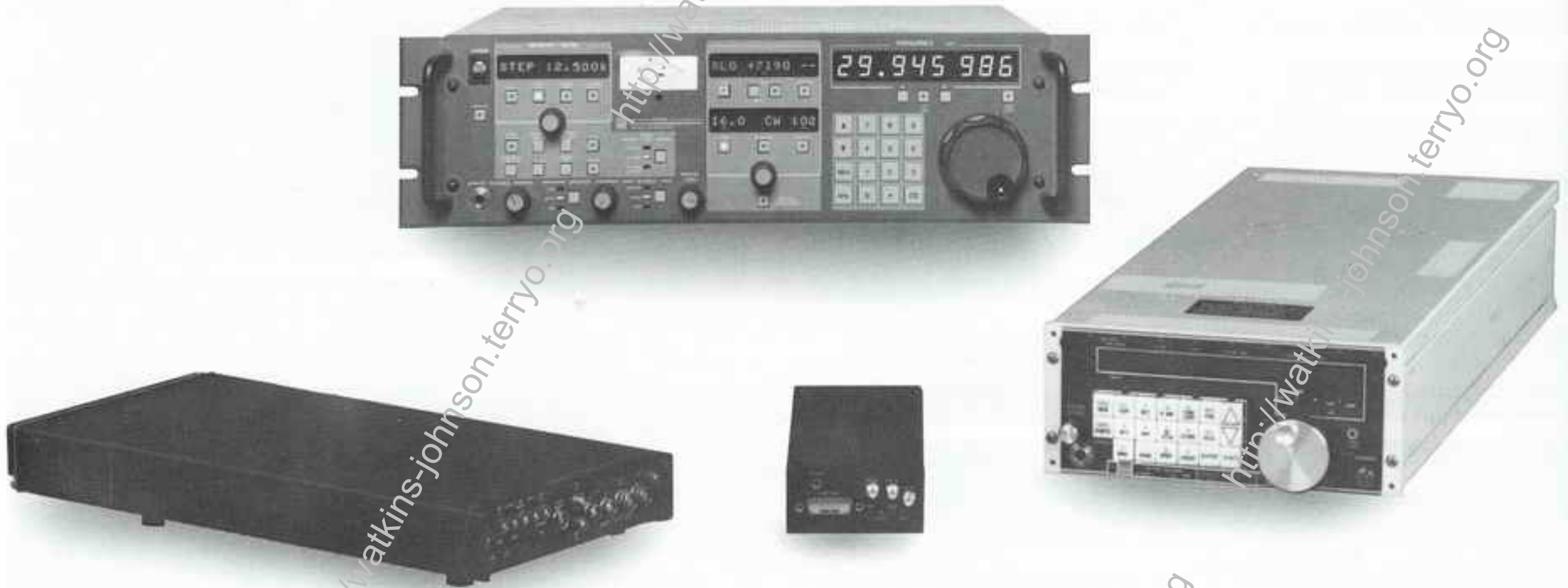
*Contact factory for details.



Surveillance Receivers & Accessories

General Purpose Receivers

CET offers a wide variety of surveillance receivers covering VLF, HF, VHF/UHF and microwave frequencies. The most recent advances in technology are employed to meet the ever-changing requirements for smaller and more specialized equipment.



WJ-8700 Dual VLF/HF Receiver



Height	Width	Depth	Weight
3.5 in. (8.89 cm)	8.25 in. (20.95 cm)	20 in. (50.80 cm)	18 lbs. (8.14 kg)

- ▶ 5-kHz to 32-MHz frequency range with 10-Hz tuning resolution
- ▶ Two fully independent receivers contained in a 3.5 in. (8.89 cm) half rack [up to 4 receivers in a standard 19 in. (48.26 cm) rack]
- ▶ Microprocessor-controlled with 8-line by 40-character display for menu-driven operation
- ▶ 5 standard IF bandwidths (expandable to 6)
- ▶ Scan, Step, Lockout with 100 memory channels
- ▶ AM, FM, CW & SSB demodulation modes
- ▶ Suboctave preselector
- ▶ RF input overvoltage protection
- ▶ Multiple receiver control capability (up to 29)
- ▶ Optional 21.4-MHz signal monitor output
- ▶ Optional special data buses, FSK demodulator
- ▶ Optional independent sideband, baseband converter output & control NET

Applications:

Designed for systems applications requiring versatile control capability.



WJ-8711 Digital HF Receiver

- ▶ Fully synthesized 5 kHz to 30 MHz (1-Hz steps)
- ▶ High dynamic range: +30 dBm 3rd-order intercept typical
- ▶ Digital filtering provides 5 or more Selectable IF bandwidths (up to 16 kHz with exceptional shape factors)
- ▶ AM, FM, USB, LSB, ISB & CW standard detection modes
- ▶ Fast, flexible scanning with 100 memory channels
- ▶ 3 available scan modes: channel scan; F1-F2 scan; & F1-F2 scan with lockout
- ▶ Large, readable LED displays & user-friendly controls
- ▶ Internal switchable preamplifier & attenuator
- ▶ Operator-selectable RS-232 or CSMA remote control
- ▶ Built-in self test
- ▶ Optional suboctave preselector
- ▶ Available as tabletop receiver or mounted in a standard 19 in. (48.26 cm) equipment rack
- ▶ Internal power supply accepts 97 to 253 VAC, 47 to 440 Hz line power, automatically adjusts to input line voltage
- ▶ Optional digitized IF & audio data outputs



Height	Width	Depth	Weight
5.25 in. (13.33 cm)	19 in. (48.26 cm)	20 in. (50.80 cm)	15 lbs. (6.78 kg)

- ▶ Power consumption less than 35 W
- ▶ IF filtering, AGC, demodulation, BFO & passband tuning functions accomplished via digital signal processing (DSP) techniques

Applications:

Wherever HF performance is needed at a low cost.

WJ-8712 Digital HF Receiver



Height	Width	Depth	Weight
3.5 in. (8.89 cm)	8.25 in. (20.95 cm)	20 in. (50.80 cm)	15 lbs. (6.78 kg)

- ▶ Same performance characteristics & functional equivalent of the larger WJ-8711
- ▶ Half-rack with blank front panel
- ▶ Fully synthesized 5 kHz to 30 MHz (1-Hz steps)
- ▶ Noise blanking
- ▶ Internally switchable preamplifier & attenuator
- ▶ Internally selectable RS-232 or CSMA remote control
- ▶ Optional suboctave preselector & digital data output
- ▶ Optional front panel

Applications:

Due to the modularity of the design and the inherent flexibility of the DSP techniques employed, many customer-specific requirements can be supported.

WJ-8721 VXI HF Receiver

- ▶ Full HF receiver in a single 6U C size VXI card slot
- ▶ Frequency coverage from 5 kHz to 30 MHz in 1-Hz steps
- ▶ High dynamic range: +30 dBm 3rd-order intercept typical
- ▶ Digital filtering provides 5 or more IF bandwidths up to 16 kHz with exceptional shape factors
- ▶ AM, FM, CW, USB, LSB & ISB detection modes standard
- ▶ VXI message-based control available
- ▶ High-density packaging: up to 12 HF receivers in a single VXI chassis
- ▶ Master/slave phase-locked local oscillators when used in multichannel applications, such as HFDF
- ▶ Digital IF & optional FFT data available over the VXIbus
- ▶ Built-in self test
- ▶ Receiver with optional suboctave preselector available in single-slot solution



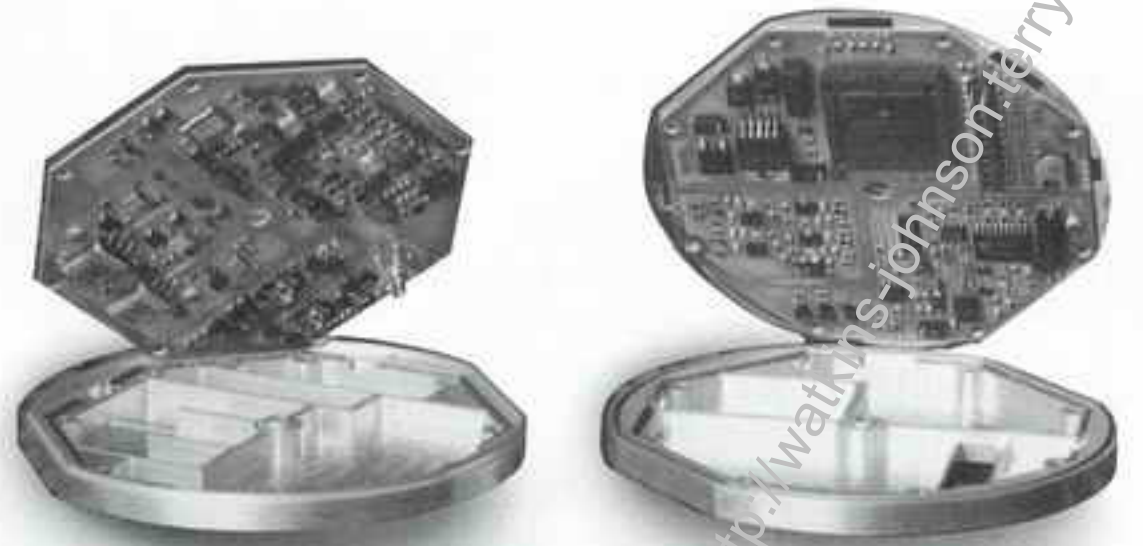
Height	Width	Depth	Weight
9.2 in. (23.37 cm)	1.2 in. (3.05 cm)	13.4 in. (33.53 cm)	5 lbs. (2.26 kg)

Applications:

WJ-8721 is ideal for applications where high density and the highest degree of integration is required.

Specialized Miniature Receiver Family

CET capabilities in MMIC, SMT, thick- and thin-films, and integrated techniques are used to design and manufacture equipment for standard products, and customer-specific applications. Emphasis is on small size, light weight and low-power consumption, combined with unique circuit architectures. CET miniature receivers offer excellent noise figure specifications, as well as excellent selectivity and sensitivity.



WJ-8650 Miniature Receiver
105 to 175 MHz Frequency Range



WJ-8652 Miniature Receiver
210 to 350 MHz Frequency Range



WJ-8653A Miniature Receiver
400 to 500 & 800 to 1000 MHz Frequency Ranges



WJ-8654 Microceptor
20 to 1000 MHz Frequency Range



Examples of Special Application Miniature Receivers

Features	WJ-8650	WJ-8650-1	WJ-8652	WJ-8653A	WJ-8654*
Frequency Range	105 to 175 MHz	200 to 270 MHz	210 to 350 MHz	400 to 500; 800 to 1000 MHz	20 to 1000 MHz
Number of Channels	10	10	5	N/A	100
Detection Modes	Narrowband AM/FM	Narrowband AM/FM	AM/FM	FM	AM, FM, SSB & CW
IF Bandwidths	5 & 15 kHz	15 KHz	100 kHz, 1 MHz, 2 MHz	25 kHz	64 to 100 kHz (plus 3.2-kHz SSB Filter)
Tracking Preselector	yes	yes	yes	no	yes
Scan, Step Capable	yes	yes	yes	yes	yes
Typical Scanning Speed	25 mSec	5 mSec	25 mSec	4 mSec	2 mSec
2nd-Order Intercept	+ 30 dBm, min	+ 30 dBm, min	+ 30 dBm, min	+ 30 dBm	+ 30 dBm
3rd-Order Intercept	- 15 dBm, min	- 15 dBm, min	TBD	- 5 dBm	- 10 dBm, min
Power Requirement	10 to 14 Vdc 4 W max	10 to 14 Vdc 4 W max	10 to 14 Vdc 2.5 W max	10 to 14 Vdc 5 W max	9 to 16 Vdc 5 W max
Size/Shape	4.25 in. (10.80 cm) diameter	4.25 in. (10.80 cm) square			
Height	0.6 in. (1.52 cm)	0.8 in. (2.03 cm)	0.75 in. (1.9 cm)	0.8 in. (2.03 cm)	1.65 in. (4.19 cm)
Width			3.25 in. (8.25 cm)	3.5 in. (8.8 cm)	3.0 in. (7.62 cm)
Depth			7.12 in. (18.08 cm)	8.75 in. (22.23 cm)	7.75 in. (19.68 cm)
Weight	10 oz. (0.37 kg)	10 oz. (0.37 kg)	1 lb. (0.45 kg)	1 lb. (0.45 kg)	2.5 lbs. (1.13 kg)

* Control format and interface operations are the same as the WJ-8607 Miniceptor

Miniceptor Receivers

The W-J Miniceptors are miniature intercept VHF/UHF receivers for use in limited space applications. Their compact size and flexible capabilities, with both remote and handoff interfaces, make the Miniceptors perfect for numerous independent and systems applications.

W-J Miniceptors have maintained the high dynamic range, low phase noise, large signal handling, and selectivity of larger units but use advanced technologies in construction and design to produce a very cost-effective miniature receiver. Various subsystem and system configurations can be created incorporating Miniceptors into specialized W-J equipment frames, or into customer-specific equipment racks.

WJ-8607 Miniceptor Receiver



Height	Width	Depth	Weight
1.5 in. (3.81 cm)	6.5 in. (16.51 cm)	10.5 in. (26.67 cm)	5 lbs. (2.26 kg)

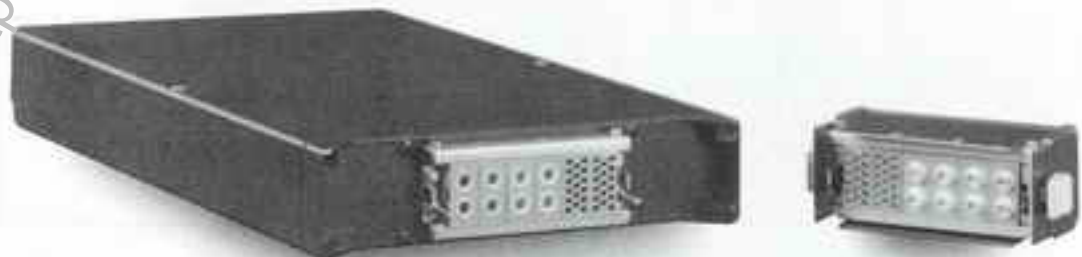
- ▶ 20 to 512 MHz frequency range (2 to 2000 MHz optional)
- ▶ 100-Hz resolution
- ▶ AM, FM, CW & Pulse detection modes (SSB optional)
- ▶ RF preselection
- ▶ +45 dBm 2nd order intermodulation

- ▶ +6 dBm 3rd-order intermodulation
- ▶ 12 mSec tuning speed
- ▶ AGC & MGC gain control modes
- ▶ 5 IF bandwidths (6.4 kHz to 8 MHz optional)
- ▶ 16 W power consumption
- ▶ HPIL & RS-232 remote interfaces
- ▶ Scan, step capable
- ▶ Compatible with WJ-9902 & 9908 equipment frames

WJ-8604 Miniceptor Receiver

Same specifications as the WJ-8607 with the exception of the following:

- ▶ Provides a quick-disconnect multipin connector for all I/Os



Height	Width	Depth	Weight
1.5 in. (3.81 cm)	6.5 in. (16.51 cm)	12 in. (30.48 cm)	6 lbs. (71 kg)

WJ-8609A Miniceptor Receiver

Same specifications as the WJ-8607 with the exception of the following:

- ▶ AM, FM & Pulse detection modes only
- ▶ +2 dBm 3rd-order intermodulation
- ▶ 5 IF bandwidths (0.25 to 40 MHz)
- ▶ 18 W power consumption



WJ-9902 Equipment Frame

- ▶ Houses 1 or 2 Miniceptors in half-rack chassis
- ▶ Integral AC power supply
- ▶ Optional host interface (IEEE-488, RS-232C or RS-422A)
- ▶ Optional integral front panel for operator control
- ▶ Mounting-compatible with other CET half-rack equipment

Height	Width	Depth	Weight
3.5 in. (8.89 cm)	8.5 in. (21.59 cm)	20 in. (50.80 cm)	10 lbs. (4.52 kg)



WJ-9605 Front Panel

- ▶ Provides operator-control for 1 or 2 WJ-8607 Miniceptors, or remote front panel W-J receiver NET controller
- ▶ Powered by external 10 to 14 Vdc user-supplied source or equipment frame

Height	Width	Depth	Weight
3.5 in. (8.89 cm)	8.3 in. (21.08 cm)	3.1 in. (7.87 cm)	2.2 lbs. (1.0 kg)

Applications:

- ▶ Additional "controller" on the W-J Receiver Net
- ▶ Remote front panel unit for the WJ-8700
- ▶ Remote front panel for the WJ-9902 with or without host interface
- ▶ Remote front panel for the WJ-9908 with a host interface



WJ-9908 Equipment Frame

- ▶ Houses up to 8 Miniceptors in full-rack chassis
- ▶ Integral AC power supply
- ▶ Optional host interface (IEEE-488, RS-232C or RS-422A)

Height	Width	Depth	Weight
8.75 in. (22.23 cm)	19 in. (48.26 cm)	21 in. (53.34 cm)	20 lbs. (9.04 kg)



WJ-9607 Multi-Receiver Front Panel

- ▶ Provides operator control for up to 29 HPIL-equipped WJ-8607s, WJ-8609As or WJ-8809s
- ▶ Powered by external 10 to 14 Vdc user-supplied source

Height	Width	Depth	Weight
3.5 in. (8.89 cm)	8.3 in. (21.08 cm)	4.4 in. (11.17 cm)	3.0 lbs. (1.35 kg)

Applications:

- ▶ Controls other receivers via W-J Receiver Net (WJ-8700)
- ▶ Host interface to Miniceptors via IEEE-488, RS-232C or RS-422A

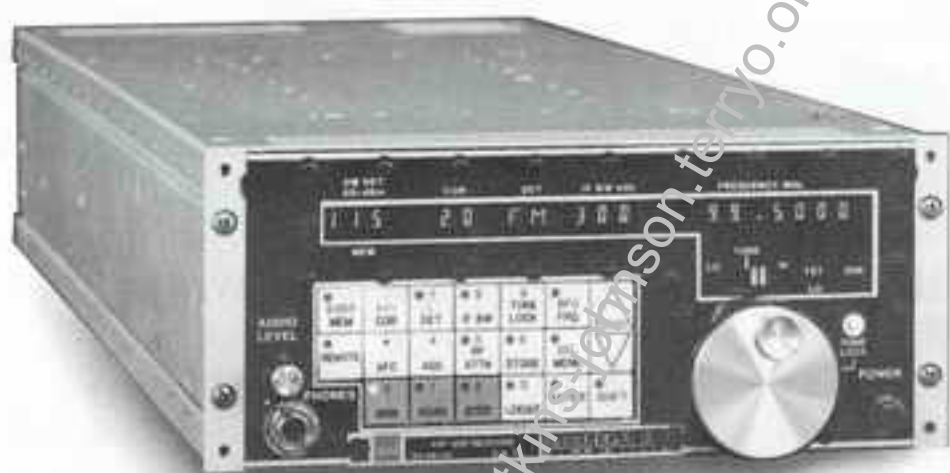
**See page 32 for Miniceptor control software.*

WJ-861X Receiver Family

The WJ-861X Receivers are designed for applications ranging from stand-alone receiver installations to complex multiple receiver systems. Each receiver uses microprocessor control circuitry to provide flexible control that satisfies a broad array of requirements for local or remote control

operations. IEEE-488 compatibility and a common command structure permits multiple receiver systems, using any combination of WJ-8515P or WJ-8617B Receivers. Each receiver responds to the same remote commands, permitting control over a group of receivers from one central controller.

WJ-8615P Compact VHF/UHF Receiver



Height	Width	Depth	Weight
3.5 in. (8.89 cm)	8.25 in. (20.95 cm)	20 in. (50 cm)	25 lbs. (11.31 kg)

- ▶ Standard frequency range of 20 to 500 MHz, 2 to 1600 MHz with frequency extender option
- ▶ High dynamic range
- ▶ 3 standard IF bandwidths (3.2 kHz to 8 MHz) with 2 optional accepted
- ▶ AM, FM, CW & pulse detection modes, with SSB optional
- ▶ Battery backed-up memory, clock & calendar
- ▶ Low close-in phase noise
- ▶ Optional tracking preselector, selected audio- & wideband-output
- ▶ Front panel & remote control of step, scan & lockout
- ▶ Log of signal acquisition with date & time to RS-232 printer or audio tape
- ▶ Simultaneous output of demodulated audio & log data formatted for 2-channel audio recorder
- ▶ Handoff of front panel setup to other receivers
- ▶ Low in-band intermodulation products (-60 dBc typical)

WJ-8617B VHF/UHF Receiver



Height	Width	Depth	Weight
5.25 in. (13.33 cm)	19 in. (48.26 cm)	18 in. (45.72 cm)	50 lbs. (22.62 kg)

- ▶ Frequency range of 20 to 500 MHz tuning (expandable from 0.5 to 1100 MHz, down to 10 kHz on special request)
- ▶ Fully synthesized tuning
 - 100-Hz resolution
 - 10 mSec typically between any 2 frequencies
 - low phase noise
- ▶ Up to 10 selectable IF bandwidths
- ▶ 96-channel programmable memory
- ▶ AM, FM, CW & pulse detection modes (optional log video SSB & variable BFO)
- ▶ Optional LOG/LIN signal monitor
- ▶ Step, scan & lockout capability
- ▶ 2 RF inputs permit 2 signal sources



Microwave Collection Receivers

W-J Microwave Receivers are smaller, use less power, are more flexible, and match or exceed performance parameters of many sophisticated commercial receivers in today's market. The WJ-8609A-1 Miniceptor uses a block downconverter to

extend its frequency range into the microwave spectrum. The WJ-8809 is a complete microwave receiving system in a miniaturized package consisting of a microwave converter, a receiver and a 2-GHz frequency extender.

WJ-8609A-1 Wideband Receiver



Height	Width	Depth	Weight
1.5 in. (3.81 cm)	6.5 in. (16.51 cm)	13.7 in. (34.79 cm)	6.5 lbs. (16.51 kg)

- ▶ Uses WJ-9290 block downconverter to extend frequency range to microwave spectrum (235 MHz to 18 GHz)
- ▶ 100-Hz resolution
- ▶ AM, FM & Pulse detection modes
- ▶ RF preselection
- ▶ +45 dBm 2nd-order intermodulation
- ▶ +6 dBm 3rd-order intermodulation
- ▶ 12 mSec tuning speed
- ▶ AGC & MGC gain control modes
- ▶ 5 IF bandwidths (0.25 to 40 MHz SAW filters)
- ▶ 18 W power consumption
- ▶ HPIL & RS-232 remote interfaces
- ▶ Scan, step capable
- ▶ Compatible with WJ-9902 & 9908 Equipment Frames

WJ-8809 Microwave Receiver System



Height	Width	Depth	Weight
3.2 in. (8.13 cm)	6.5 in. (16.51 cm)	11.25 in. (28.57 cm)	13.5 lbs. (6.15 kg)

- ▶ Continuous tuning from 0.1 to 18.5 GHz
- ▶ 100-Hz resolution
- ▶ AM, FM & Pulse detection modes
- ▶ RF preselection
- ▶ +30 dBm 2nd-order intermodulation
- ▶ -5 dBm 3rd-order intermodulation
- ▶ 10 mSec tuning speed
- ▶ AGC & MGC gain control modes
- ▶ 5 selectable IF bandwidths (0.5 to 40 MHz)
- ▶ Low group delay filters
- ▶ Low phase noise (88 dBc/Hz @ 10 kHz)
- ▶ 35 W power consumption
- ▶ Remote control (HPIL, RS-232 or RS-422)
- ▶ Scan, step capable
- ▶ Remote microwave converter

WJ-9290 Series Block Downconverter



- ▶ Extends WJ-8609A-1 Miniceptor to microwave spectrum
- ▶ Tailored to specific communication bands
- ▶ Matched in frequency range to desired antenna
- ▶ 4 W power consumption (10 to 14 Vdc)
- ▶ Mounts near antenna equipped with appropriate low noise amplifier

Height	Width	Depth	Weight
0.75 in. (1.90 cm)	3.5 in. (8.89 cm)	6.0 in. (15.24 cm)	15 oz. (0.42 kg)

Multichannel Wideband Digital Tuners

W-J's growing family of digital tuners are designed expressly for use as RF front-ends for customer-designed signal processing systems. Multiple phase-coherent and/or independently tuned channels, integrated analog-to-digital converters (ADCs), fast tuning, broad frequency coverage and high signal fidelity are provided in compact, highly reliable packages. A variety of remote control interfaces, data output interfaces, bandwidths and sample rates can be provided as options.

WJ-9103 Multichannel Digital Tuner



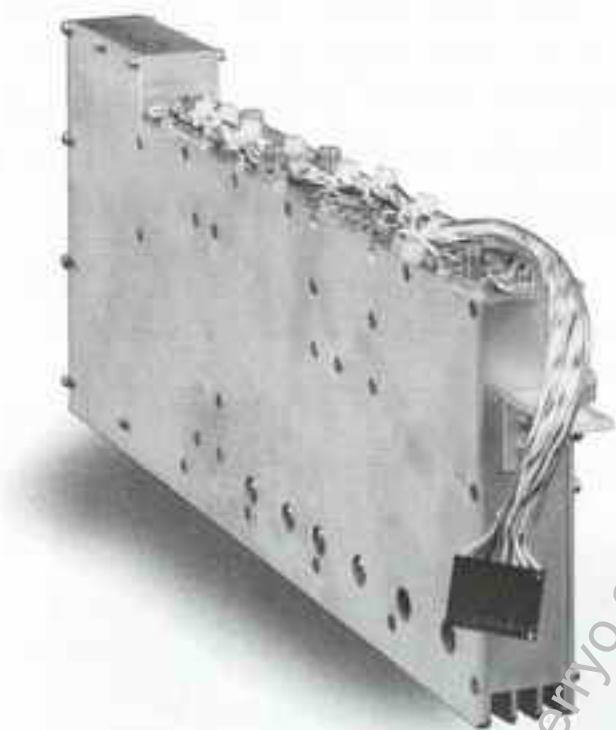
Height	Width	Depth	Weight
5.25 in. (13.33 cm)	19 in. (48.26 cm)	22 in. (55.88 cm)	55 lbs. (24.88 kg) fully loaded

Applications:

- ▶ precision direction finding
- ▶ spectral analysis
- ▶ antenna beamforming

- ▶ Consists of:
 - up to 8 tuner modules
 - tunable local oscillators
 - equalization signal source
 - digital controller
 - support circuits
- ▶ Up to 8 channels, tunable in parallel from 20 to 500 MHz (20 to 2000 MHz with optional frequency extender)
- ▶ 2-MHz instantaneous bandwidth standard (4-MHz bandwidth optional)
- ▶ Digital IF outputs from each channel at 12-bits of precision with a sample rate of 5.12 MHz (10.24 MHz for optional 4-MHz bandwidth)
- ▶ Internal equalization source supports external calibration
- ▶ Minimal phase & amplitude distortion within each channel
- ▶ Low phase & amplitude mismatch between channels
- ▶ Remote control via IEEE-488 interface
- ▶ Power requirements of 115/230 VAC (50 to 400 Hz)
- ▶ Power consumption less than 500 W

WJ-9103/DTM (Digital Tuner Module)



Height	Width	Depth	Weight
4.75 in. (12.06 cm)	1.25 in. (3.17 cm)	11.25 in. (28.57 cm)	3.25 lbs (1.47 kg)

- ▶ 3-stage superhetrodyne receiver followed by a 12-bit ADC
- ▶ 3-band preselector integrated within the tuner
- ▶ 62-dB gain control range
- ▶ Digital IF output at 12-bits of precision
- ▶ 2-MHz instantaneous bandwidth (4-MHz bandwidth optional)
- ▶ Minimal phase & amplitude distortion
- ▶ Low phase & amplitude mismatch between modules
- ▶ Required from external sources:
 - 3 local oscillators
 - ADC sample clock
 - bit-serial control data
- ▶ Power consumption of 31 W

Applications:

- ▶ Precision direction finding
- ▶ Spectral analysis
- ▶ Antenna beamforming

WJ-9104 Multichannel Digital Tuner



Height	Width	Depth	Weight
5.25 in. (13.33 cm)	19 in. (48.26 cm)	18 in. (45.72 cm)	55 lbs. (27.14 kg)

- ▶ Up to 8 channels tunable in parallel, or independently, from 20 to 2400 MHz
- ▶ 10-MHz instantaneous bandwidths
- ▶ Digital IF outputs from each channel at 12-bits of precision with a sample rate of 25.6 MHz
- ▶ Minimal phase & amplitude distortion within each channel
- ▶ Low phase & amplitude mismatch between channels
- ▶ Fast tuning (50 microseconds)
- ▶ Remote control via high-speed parallel interface
- ▶ Options:
 - LF/HF capability (0 to 33 MHz)
 - Programmable IF bandwidths (4 kHz to 10 MHz)
 - Serial/Fiber-optic data output
 - Ethernet or high-speed serial remote control interfaces
 - 20-MHz instantaneous bandwidth with 10-bit ADC operating at 50 MHz

Applications:

- ▶ Precision direction finding
- ▶ Signal analysis
- ▶ Antenna beamforming
- ▶ Fast acquisition

SURVEILLANCE RECEIVERS & ACCESSORIES

Specialized Acquisition Receivers

To meet the requirements of an ever-changing communication environment, CET has designed specialized acquisition receivers including the WJ-9195C Rapid Acquisition Spectrum Processor (RASP) and the WJ-8999 Portable EMC/Tempest Test Receiver. The WJ-9195C RASP is a broadband receiver, digital IF processor and a spectrum

display — all housed in a single rack-mountable enclosure. The WJ-8999 is a multi-purpose receiving system designed to meet the requirements for electromagnetic compatibility (EMC) investigations, wideband ambient signal surveys and analysis of narrowband and broadband signals.

WJ-8999 Portable EMC/TEMPEST Test Receiver

- ▶ 1-kHz to 1-GHz frequency coverage (1 to 12.4 GHz optional)
- ▶ Receiver sensitivity & dynamic range: optimized EMC testing
- ▶ Semi-automatic operating modes
- ▶ 18 IF bandwidths: 100 Hz to 50 MHz (100 & 200 MHz optional)
18 video bandwidths: 50 Hz to 20 MHz plus bypass (50 & 100 MHz optional)
- ▶ Fixed frequency, scan/plot, scan/monitor & remote control modes
- ▶ Audio, video, IF, signal monitor & printer outputs available
- ▶ Optional built-in signal monitor
- ▶ AM, AM/AGC, FM, CW & EOG detection modes
- ▶ A Tuner Synthesizer Unit remotely controls a microprocessor-based Digital Control Unit that allows 4 operating modes
- ▶ Furnished with 2 carrying cases & rack-mounting hardware

Applications:

- ▶ EMC investigations
- ▶ Wideband RF ambient signal surveys
- ▶ Narrowband & broadband signal analysis



Height	Width	Depth	Weight
7 in. (17.78 cm)	16.87 in. (42.85 cm)	15 in. (38.10 cm)	42 lbs. (19 kg)
excluding options & case			

WJ-9195C Rapid Acquisition Spectrum Processor (RASP)



Height	Width	Depth	Weight
8.75 in. (22.22 cm)	19 in. (48.26 cm)	17 in. (43.18 cm)	60 lbs. (27.14 kg)

- ▶ Control & handoff of up to 15 external receivers
- ▶ Fast scan rate — 1 GHz/second
- ▶ 20 to 512 MHz frequency range (expandable from 2 to 1400 MHz)
- ▶ Resolution of 5 or 25 kHz
- ▶ High dynamic range — 60 dB (typical)
- ▶ Interactive RF spectrum display

Applications:

- ▶ Spectral search & display
- ▶ Fast scan/handoff for push-to-talk signals

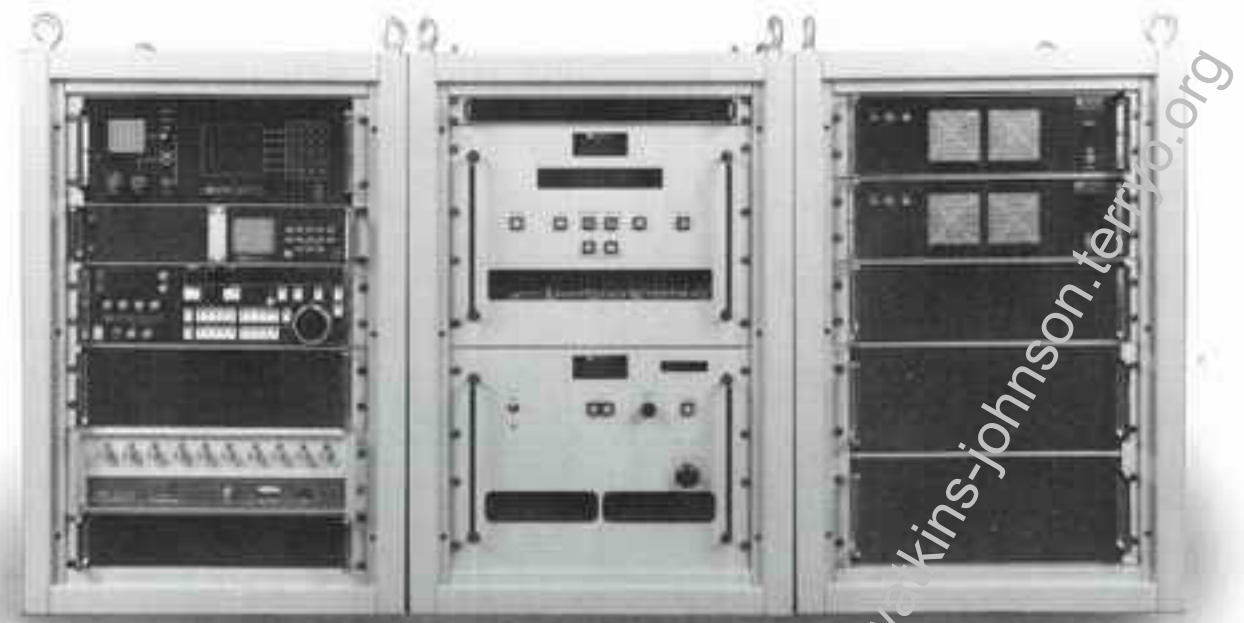
Communications Jammers

Customer requirements are always the main considerations for CET components and systems; our engineering technology enables us to adapt or design equipment to meet

specific needs. The WJ-4810 system provides user-tailored communications jamming in the HF, VHF and UHF bands either in one band alone, or in any combination.

WJ-4810 Communications Jamming System [AN/TLQ-504(.)V]

- ▶ Modular design with flexible architecture
- ▶ Integrated microprocessor-control for ease-of-operation
- ▶ AM, FM, CW or SSB modulation
- ▶ Variable jamming bandwidth
- ▶ 100 non-volatile memory channels with priority & lockout
- ▶ Selectable pseudo-random lookthrough
- ▶ Pseudo-simultaneous jamming of up to 6 targets
- ▶ IEEE-488 & RS-232 ports
- ▶ Built-in RF & TR switching
- ▶ Real-time clock
- ▶ Automatic or manual threat acquisition
- ▶ Programmable "softkey," menu-driven controller
- ▶ Built-in speaker
- ▶ Linear or pseudo-random syllabic rate on/off keying
- ▶ Optional built-in harmonic suppression
- ▶ RS-232 data output with time-of-day for printer or CRT



- ▶ Output mismatch protection
- ▶ Built-in digital meter for measuring forward & reverse power
- ▶ 19 in. (48.26 cm) system rack height ranges from 3.5 to 6.4 ft. (1.06 to 1.94 m)
- ▶ System weights range from 305 to 646 lbs. (138 to 291.86 kg)

WJ-4810 Jammer Control Unit (JCUA) (C-5486/TLQ-504)



- ▶ 20 to 500 MHz range (optional extension down to 1.5 MHz & up to 1 GHz)
- ▶ AM, FM or CW modulation with variable jamming bandwidth
- ▶ Noise, fixed-tone, two-tone & swept-tone modulation sources
- ▶ Provision of external microphone or recorder input
- ▶ Pseudo-simultaneous jamming of up to six targets
- ▶ Programmable "softkey," menu-driven front panel control
- ▶ 100 non-volatile memory channels with priority & lockout
- ▶ Selectable lockthrough capability, fixed or pseudo-random
- ▶ Built-in speaker for monitoring receiver or jammer audio
- ▶ Remote interface

Height	Width	Depth	Weight
6.97 in. (17.70 cm)	19 in. (48.26 cm)	23.44 in. (59.53 cm)	45 lbs. (20.36 kg)

Applications:

- ▶ Complete system control for HF, VHF or UHF communications jamming.

Direction Finding Equipment

CET's Direction Finding (DF) equipment is designed for use in large surveillance receiver systems and smaller tactical systems, and covers a wide range of frequencies and requirements. Standard antennas can also be adapted to meet the special needs of users. CET's broad

experience in digitally controlled, high-performance receivers, coupled with a strong background in the design and production of small, lightweight, ruggedized equipment, has resulted in a complete line of manpack receiving and DF equipment.

WJ-8986 Correlative Vector N-Channel DF System



- ▶ Correlative vector DF technique for high-accuracy & antenna versatility
- ▶ 3- to 5-channel simultaneous signal processing
- ▶ 2 to 512 MHz frequency range (expandable to 2000 MHz)
- ▶ 50 MHz/second scan & DF rate
- ▶ DSP technology for high processing & gain/DF sensitivity
- ▶ Effective against frequency agile & PTT-type signals
- ▶ DFs on 10 microsecond pulses (monopulse-type design)
- ▶ PC/AT-based design with 3.5 in. floppy & 32-MB hard disks
- ▶ Graphical front panel displays (including spectrum FTT)
- ▶ Front panel with keypad & EL display (optional keyboard & headset)
- ▶ Full remote control
- ▶ Power less than 200 W
- ▶ Single rack-mountable unit

Height	Width	Depth	Weight
8.75 in. (22.22 cm)	19 in. (48.26 cm)	20 in. (50.80 cm)	66 lbs. (29.86 kg)

Applications:

- ▶ Resolving co-channel signals
- ▶ Direction finding of low-power & short-duration signals
- ▶ Vehicular mounting

WJ-8995 Correlative Vector DF

- ▶ Correlative vector DF technique for high-accuracy/antenna versatility
- ▶ 24-channel simultaneous signal processing
- ▶ 1.0 to 2000 MHz frequency range
- ▶ Low-power unit (10 W)
- ▶ Ruggedized to MIL-STD-810C
- ▶ Rack-mountable or field-deployable
- ▶ Full remote capability
- ▶ Optional RS-232 or Ethernet interface
- ▶ Optional quick-reaction analysis scan (100 MHz/second)
- ▶ Allows sleep modes for all functions of the unit to reduce power



Height	Width	Depth	Weight
3.5 in. (8.89 cm)	8.5 in. (21.59 cm)	10 in. (25.40 cm)	10 lbs. (4.52 kg)

Applications:

- ▶ Manportable & covert missions where small size & low power are primary concerns.

WJ-8990B Manpack Tactical Intelligence System (MANTIS)



- ▶ 20 to 500 MHz intercept & DF, (expandable to 0.5 to 1100 MHz intercept & 20 to 1000 MHz DF)
- ▶ HF, VHF & UHF intercept & DF in a 2-man load
- ▶ Stand-alone or optional netted operation
- ▶ RS-232 interface for use with a variety of terminals
- ▶ Ruggedized to MIL-STD-810C
- ▶ Built-in test

Applications:

For fast-moving, forward deployed operations where weight, size and capability are essential.

Height	Width	Depth	Weight
6 in. (15.24 cm)	11 in. (27.94 cm)	16 in. (40.64 cm)	60 lbs. (27.14 kg), including DF antenna

WJ-8991 Manportable Correlative Vector DF System

- ▶ HF/VHF/UHF intercept & DF system consists of:
 - WJ-8996 DF Processor
 - WJ-9887 Covert/Portable DF Antenna for fixed-site operation
 - Handheld controller
 - Optional handheld antenna for on-the-move operation
- ▶ 1.0 to 1300 MHz frequency range with WJ-9887 DF antenna (2000 MHz optional)
- ▶ Utilizes multichannel correlative technique to allow interfacing to a variety of antennas
- ▶ Uses hardware & DSP algorithms to provide state-of-the-art performance while maintaining small size, light weight & low power
- ▶ Applies sophisticated power management & built-in test capabilities



Applications:

For fast-moving, forward deployed operations where weight, size and capability are essential.

Entire system fits into an ALICE pack

Height	Width	Depth	Weight
19 in. (48.26 cm)	22 in. (55.88 cm)	12 in. (30.48 cm)	50 lbs. (22.62 kg)

DIRECTION FINDING EQUIPMENT

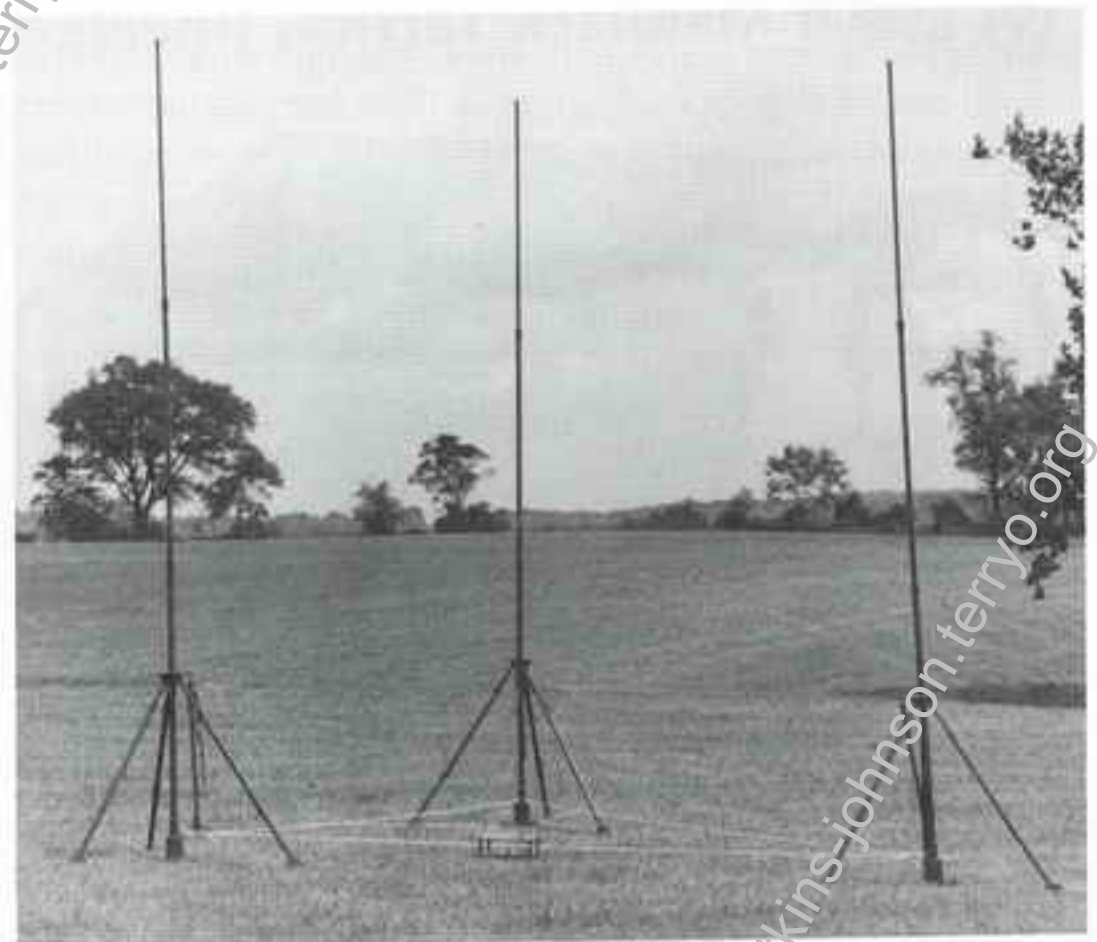
WJ-8986/AU-3 Antenna

- ▶ Consists of 3, 4 or 5 vertically polarized monopole elements arranged to form a triangular ground-mounted array
- ▶ Lightweight, portable
- ▶ 2 to 30 MHz frequency range
- ▶ Provides optimum sensitivity & accuracy in HF region
- ▶ Monopole height: 15 ft. (4.57 m); baseline: 14 ft. (4.26 m)
- ▶ Case Size:

Height	Width	Depth	Weight
8 ft. (2.43 m)	2 ft. (0.6 m)	2 ft. (0.6 m)	126 lbs. (56.3 kg)

Applications:

Recommend deployment in clear area at least 75 to 100 meters from other obstructions, including buildings or shelters. (Note that the use of these antennas with the WJ-8986 DF system requires inclusion of the WJ-8986/AAU-1 option.)



WJ-8986/AU-5 Antenna

- ▶ Consists of 3 interferometer DF antenna bays; each bay made up of 3 vertical resistively loaded, dipole elements with each array arranged in an equilateral triangle
- ▶ Frequency range of 20 to 1200 MHz
- ▶ Ruggedized
- ▶ 2.7 ft. (3.8 m) high; 75 lbs. (34 kg)

Applications:

- ▶ Fixed-site
- ▶ Shipboard



WJ-9887 Low Profile DF Antenna

- ▶ 1.0 to 2000 MHz frequency range
- ▶ Hybrid loop from 1 to 100 MHz
- ▶ TEM horn from 100 to 2000 MHz
- ▶ Vertical polarization
- ▶ -30 to +60 degrees C operating range

Height	Diameter	Weight
8 in. (20.32 cm)	19 in. (48.26 cm)	15 lbs. (6.78 kg)

Applications:

- ▶ Vehicle top-mounting
- ▶ Mast-mounting
- ▶ Covert ground-mounting



WJ-9881A DF Antenna

- ▶ 20 to 512 frequency coverage
- ▶ Push-up mast extends length up to 35 ft. (10.66 m)
- ▶ High sensitivity
- ▶ Low physical profile
- ▶ Ruggedized



Height	Width	Depth	Weight
46 in. (1.16 m)	14 in. (35.56 cm)	14 in. (35.56 cm)	35 lbs. (15.83 kg)

Applications:

Designed for use with several manportable W-J DF systems, in particular the WJ-8990B MANTIS.

WJ-9882 UHF Antenna

- ▶ Consists of four dipoles symmetrically placed in a square array
- ▶ Uses W-J pseudo-doppler technique
- ▶ 500 to 1000 MHz frequency range
- ▶ 50-ohms impedance
- ▶ Vertical polarization
- ▶ 3:1 typical VSWR
- ▶ -20 to +60 degrees C operating temperature range (-40 to +70 degrees C non-operating range)
- ▶ 35,000 ft. (10,668 m) operating altitude
50,000 ft. (15,240 m) non-operating altitude
- ▶ Mounts on WJ-9898 telescoping mast



Element length	Array Baseline	Weight
5 in. (12.70 cm)	4.3 in. (10.92 cm)	10 lbs. (4.52 kg)

Applications:

- ▶ Companion to the WJ-8990B MANTIS

WJ-9886 DF Antenna Series

The WJ-9886 Antenna Systems, which can interface directly with the WJ-8986 N-Channel DF Receiver/Processor, have been designed to fulfill a variety of needs and applications, which could be mounted on various fixed or mobile platforms. Each system is comprised of several array types:

- ▶ external top hats
- ▶ internal top hats
- ▶ internal traveling-wave dipoles, or
- ▶ monocones

Different combination of these arrays create the three antenna systems in this series. Each antenna covers a wide range of frequencies while providing maximum gain along with light weight, durability and low cost. All three versions can be configured with three, four or five elements per array, allowing for use with a three-, four or five-channel DF System.



WJ-9886-1 DF Antenna

- ▶ Has 2 bays of vertically polarized elements with external top hats
- ▶ 20 to 1000 MHz frequency range



WJ-9886-1A DF Antenna

- ▶ Same specifications as the WJ-9886-1, plus a 3rd array housed in a cylindrical radome situated above the main antenna dome
- ▶ 20 to 2000 MHz frequency range



WJ-9886-2 DF Antenna

- ▶ Same specifications as WJ-9886-1 & -1A, except the element top hats are enclosed within the main dome, and the HF elements are enclosed in upper top hats
- ▶ 20 to 1200 MHz frequency range

Demodulators

Some of CET's early demodulators (i.e.: DM-112, DMS-105 and -107, WJ-9525, WJ-9470, WJ-9471 and WJ-9472) are still in use today. The series now includes the WJ-9548 Digital FDM Demultiplexer, which incorporates the latest DSP technology, and the WJ-9424 Voice Grade Channel Demodulator.

WJ-9548 Digital FDM Demultiplexer

- ▶ Up to 24 tunable FDM channel demodulators in a single half-rack
- ▶ Can be configured as a 6-, 12-, 18-, or 24-channel unit
- ▶ Analog input tunable from 0 to 20 MHz in 1-Hz steps
- ▶ Very-low-differential group delay & flat amplitude response
- ▶ 4 analog baseband inputs connected in a nonblocking fashion to individual channel demodulators
- ▶ Independent channel control of gain, upright/invert detection & output routing
- ▶ Local or remote control
- ▶ Built-in test capability

Height	Width	Depth	Weight
3.5 in. (8.89 cm)	8.25 in. (20.95 cm)	20 in. (50.80 cm)	20 lbs. (9.04 kg)



WJ-9548 options include:

- ▶ High fidelity audio, CEPT & T1 format digital output
- ▶ Activity Monitor that identifies each tuned channel as being either voice, data classified as either FSK or PSK modulation types, signaling tones or no activity; identifies modem or VFT type
- ▶ Flexible Demodulator provides a single-channel voice-frequency data demodulator capable of demodulating & decoding a variety of modem, voice-frequency telegraph & FAX signal-formats

Applications:

Where a compact, cost-effective solution to FDM demodulation characterized by high performance, flexibility and reliability is needed.

WJ-9424 Voice Grade Channel Demodulator



Height	Width	Depth	Weight
3.5 in. (8.89 cm)	8.25 in. (20.95 cm)	22 in. (55.88 cm)	20 lbs. (9.04 kg)

- ▶ Up to 30 voice grade channel demodulators in a single half-rack
- ▶ Demodulates VFT, modem & FAX voice grade signals
- ▶ Input options include: analog audio, CEPT & T1. Interfaces directly with TDM bus from WJ-9548 FDM demodulator
- ▶ Built-in test
- ▶ Front panel or remote control (IEEE-488, RS-232, HPIL & Ethernet)
- ▶ Demodulated data outputs through 19.2k baud serial interfaces
- ▶ VFT-output data streams collapse into a single serial output; control characters are inserted to allow reconstruction
- ▶ Updates easily with low-cost plug-in firmware

Applications:

- ▶ Where a large number of modem, VFT or FAX signals are to be processed.

DEMODULATORS

WJ-9497 Tunable Demodulator



Height	Width	Depth	Weight
3.5 in. (8.89 cm)	8.5 in. (21.59 cm)	21 in. (53.34 cm)	20 lbs. (9.04 kg)

- ▶ 0 to 90 MHz analog tuning range; also accepts 160-MHz IF
- ▶ Digital inputs to 50 megasamples/second
- ▶ Digital & analog predetection, video & audio outputs
- ▶ AM, FM & SSB demodulators
- ▶ 1-Hz tuning
- ▶ Programmable bandwidth from 100 Hz to 20 MHz
- ▶ Low phase noise, passband ripple & differential group delay
- ▶ Built-in test
- ▶ Local or remote control from front panel, or via an RS-232 or IEEE-488 interface

Applications:

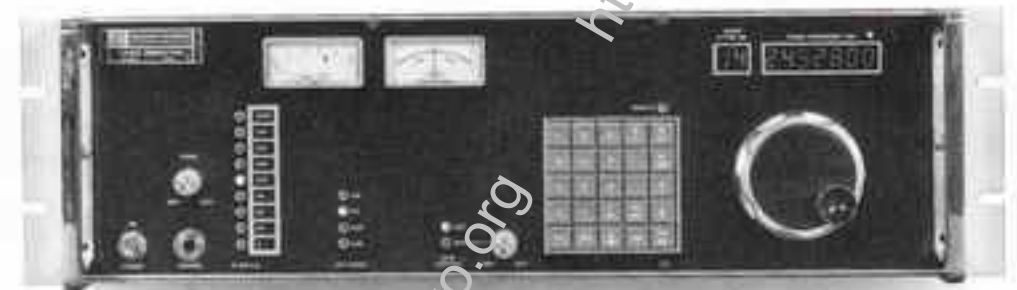
- ▶ Where flexible, precision tuning, filtering & demodulation of IF or baseband signals is required.

WJ-9477(G) Tunable Demodulator

- ▶ 0 to 31 MHz tuning range (10-Hz resolution)
- ▶ AM & FM demodulation (optional SSB)
- ▶ Up to 9 selectable IF bandwidths (3.2 kHz to 6 MHz)
- ▶ IEEE-488 compatible
- ▶ Optional IF converter, single or independent sideband, video output attenuator & video filters are available

Applications:

- ▶ Where flexible, precision tuning, filtering & demodulation of IF or baseband signals is required.



Height	Width	Depth	Weight
5.22 in. (13.25 cm)	19 in. (48.26 cm)	23.5 in. (59.69 cm)	40 lbs. (18.09 kg)

WJ-9480A Tunable Demodulator System



Height	Width	Depth	Weight	
			Tuner	Demodulator
5.25 in. (13.33 cm)	19 in. (48.26 cm)	22 in. (55.88 cm)	44 lbs. (19.9 kg)	54 lbs. (24.43 kg)

- ▶ Consists of a Tuner/IF Amplifier & a Demodulator Unit
- ▶ 100 kHz to 30 MHz range, 100-Hz resolution
- ▶ Simultaneous AM, FM & PM detection modes
- ▶ 13 IF bandwidths from 3 kHz to 20 MHz
- ▶ Selectable video bandwidths
- ▶ High dynamic range/intercept point
- ▶ Low phase noise
- ▶ Excellent group delay
- ▶ Local or remote control via IEEE-488
- ▶ RF gate for 21.4 or 160 MHz
- ▶ Built-in up & down converter
- ▶ 21.4-MHz, 70-MHz & 160-MHz outputs

Applications:

- ▶ Where flexible, precision tuning, filtering & demodulation of IF or baseband signals is required.

FSK Demodulator Family

The FSK Demodulator Family is a group of systems designed to provide state-of-the-art FSK or OOK demodulator performance for signal analysis of unknown parameters. Control-rack frames provide microprocessor-control and signal-interconnection for a variety of compact plug-in modules, permitting maximum flexibility in a

minimum of space. Each demodulator is microprocessor-controlled and remotely controlled with RS-232 and IEEE-488 optional interfaces. Weight and dimensions vary considerably depending on configurations selected. Contact factory for details.



WJ-9472 FSK/OOK Demodulator System

- ▶ 2-channel baud rate matched-filter-type demodulation
- ▶ Optional Double Frequency Shift Keying & Frequency Diversity demodulation capability
- ▶ Built-in signal monitor for tuning & detailed signal analysis

WJ-9476 FSK/OOK Demodulator System

- ▶ Same as the WJ-9472
- ▶ Handoff system
- ▶ Up to 24 channel demodulation
- ▶ Highly resistant to fading & interference

WJ-9471 "VFT" FSK Demodulator System

- ▶ Up to 24 independent demodulators
- ▶ 200 Hz to 9.999 kHz frequency tuning
- ▶ Phase-locked-loop demodulation
- ▶ Tuning parameter preset-feature
- ▶ Multichannel capability
- ▶ Built-in diversity function



Accessories

WJ-9205 Signal Monitor



- ▶ Wide on-screen dynamic range (60 db)
- ▶ Frequency spans from 5 kHz to 5 MHz with 10-kHz resolution
- ▶ Accepts inputs from up to 3 receivers
- ▶ Displays up to 3 spectrum traces simultaneously on a 4 in. (10.16 cm) CRT
- ▶ Digitally-refreshed display
- ▶ Automatic sweep rate & centering adjustments
- ▶ IEEE-488 interface optional
- ▶ Companion unit to WJ-8615P or other units with a 21.4-MHz output

Height	Width	Depth	Weight
3.5 in. (8.89 cm)	8.5 in. (21.59 cm)	22 in. (55.88 cm)	18 lbs. (8.1 kg)

WJ-9206 Signal Monitor



- ▶ 4 in. (10.16 cm) CRT
- ▶ 70-dB calibrated logarithmic range
- ▶ Selectable input attenuator
- ▶ 5-2-1 sequence calibrated sweep widths for dispersions of 0 kHz to 5 MHz with 10-kHz resolution
- ▶ Provides visual indication of signals within 2.5 MHz of the tuned frequency
- ▶ Companion unit to WJ-8615P or other units with 21.4-MHz output

Height	Width	Depth	Weight
3.5 in. (8.89 cm)	8.5 in. (21.59 cm)	22 in. (50.80 cm)	17 lbs. (7.69 kg)

WJ-9207 RF Panoramic Display Unit



- ▶ Digitally refreshed EL flat-panel display
- ▶ Displays up to 4 scanning receivers
- ▶ On-screen display of: start/stop frequencies, source receiver & tuned-frequency cursor when receiver not scanning
- ▶ Companion unit for CET receivers with Digital Status Output option (WJ-8607/DSO)
- ▶ Standard accessory kit with hardware for half-rack mounting with other units in 19 in. (48.26 cm) rack

Height	Width	Depth	Weight
5.25 in. (13.34 cm)	8.75 in. (22.23 cm)	22 in. (55.88 cm)	13 lbs. (5.89 kg)

SM-1662 and SM-1622-1 Signal Monitors



- ▶ 160-Mhz IF input
- ▶ Maximum sweep width of 20 MHz
- ▶ SM-1622: minimum resolution of 250 kHz; SM-1622-1: 1-MHz resolution (recommended when prime interest is pulse reception)

Height	Width	Depth	Weight
3.25 in. (8.25 cm)	7.9 in. (20.06 cm)	15.5 in. (39.37 cm)	11 lbs. (4.97 kg)

W-J 931X Multicouplers



A variety of multicouplers have been designed over the years by CET. Currently four units are available, which are designed for standard rack-mounting in only 1.75 inches (4.44 cm) of space and weigh between eight and twelve pounds (3.61 and 5.42 kg).

WJ-9310 provides optimum coupling between a single antenna and as many as twelve receivers operating in the 20 to 1000 MHz range.

WJ-9311 operates in the 0.5 to 30 MHz frequency range, and provides a gain of 2 dB nominal.

WJ-9314 provides optimum coupling between a single antenna and up to four receivers operating in the 20 to 1100 MHz range.

WJ-9315 is well-suited for applications using a number of receivers and single or multiple antennas. Up to twelve receivers operating over a 20 to 1100 MHz range may be employed.



S-9203A & S-9903E Speaker Panels

- ▶ Accept up to 7 audio inputs
- ▶ High input impedance
- ▶ 5 W output
- ▶ S-9203A mounts in EF-101 or EF-201D Equipment Frame

Height	Width	Depth	Weight
3.25 in. (8.25 cm)	7.9 in. (20.06 cm)	15.7 in. (39.87 cm)	5 lbs. (2.26 kg)



- ▶ S-9903E fits in standard 19 in. (48.26 cm) rack space

Height	Width	Depth	Weight
3.5 in. (8.89 cm)	9 in. (48.26 cm)	6 in. (15.24 cm)	5.5 lbs. (2.48 kg)

WJ-9948 Blower Module

- ▶ 1.75 in. (4.44 cm) rack unit
- ▶ 3, 6 or 9 blowers
- ▶ Adjustable positions
- ▶ 19 in. (48.26 cm) panel



ACCESSORIES

WJ-860X/MCS Miniceptor Control Software

This MS-DOS application software controls WJ-860X Miniceptors, as well as the WJ-8809 Microwave Receiver System and the WJ-8654 Microceptor. The software option is contained on one data disk and requires a 386 computer with a VGA color display monitor. The menu-driven program provides an RF spectral display that allows a user to:

- ▶ control manual, sweep & step operations
- ▶ send commands or queries to unit
- ▶ reset unit to default parameters
- ▶ upload or download between unit & a disk media
- ▶ automatically collect & store information
- ▶ analyze & playback data.





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▲ 2300 Peachford Road, Suite 1250
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Phone: (404) 458-9907
FAX: (404) 458-9900

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▲ 800 East Northwest Highway,
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Palatine, IL 60067-6510
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FAX: (708) 991-0384

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▲ 700 Quince Orchard Road
⚙ Gaithersburg, MD 20878-1794
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FAX: (301) 921-9479

⚙ 8530 Concor Road
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FAX: (301) 498-4316

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FAX: (617) 861-7178

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▲ 373 Route 111, Suite 10
Smithtown, NY 11787-4759
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FAX: (516) 724-0977

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▲ 2500 National Road, Suite 200
Fairborn, OH 45324-2011
Phone: (513) 426-8303
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▲ 3003 LBJ Freeway, Suite 215
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8039 Puchheim
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FAX: 49-89-803044

▲ Deutscherherrenstrasse 46
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FAX: 49-228-332095

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Piazza G. Marconi, 25
00144 Roma - EUR
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⚙ Dedworth Road
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▲ **Field Sales Offices**

⚙ **Operating Locations**



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