

Cushman

Radio
Maintenance
Products





CE-6A Communications Monitor— to meet the most demanding test requirements.

- AM, FM and SSB measurements
- Synthesized digital frequency selection to 1000 MHz
- 100-Hz dialing resolution
- Direct frequency, modulation and power measurements
- Off-the-air monitoring
- High level generator output
- Internal fixed and variable audio frequency modulating tones

The Cushman CE-6A. An instrument that combines the most modern and complete capabilities available for maintenance and service of two-way radio systems. The many unique features of the CE-6A make it the primary choice of service shops responsible for the most sophisticated communications systems.

The heart of the CE-6A is the frequency synthesizer, which uses modern, digital techniques to provide precise frequency tuning over the full range of the instrument. Indirect, out-of-band synthesis provides high reliability and freedom from spurious outputs.

The instrument is electrically and mechanically stable, and can be quickly set to any frequency with full confidence in its accuracy. It is also possible to use the synthesizer and any known external signal to self-calibrate the monitor in the field.

Frequency tuning in either the generate or receive mode is easily accomplished with digital controls to a resolution of 100 Hz. Frequency range of the signal generator is 10 kHz to 1000 MHz. In the receive mode the range can be 50 kHz to 1000 MHz, depending on the RF plug-in module used.

Receiver Maintenance

One of the outstanding and unique features of the CE-6A for serving AM or FM receivers is its high level output. Functioning as a signal generator, the instrument can produce clean, accurate signals at up to 0.7 volts to 512 MHz. For troubleshooting and circuit retuning requiring strong signals, the need for a separate generator is eliminated.

In all applications, the CE-6A falls in the class of more expensive frequency synthesizers in terms of spectral purity. There is no chance of making incorrect tuning adjustments because of misleading spurious signals.

For receiver sensitivity measurements, the CE-6A has a calibrated output from 0.1 to 100 μ V over the entire frequency range of the instrument.

Low residual FM also is important in preventing inaccurate measurements, both in the generate and receive modes. As an indication of how stable the signal is, residual FM in the CE-6A is typically under 50 Hz. This can be particularly important when working with tone-controlled radio systems.

Internal fixed and variable audio frequency oscillators can be used to modulate the signal generator. Five fixed frequencies of 300 Hz, 400 Hz, 1 kHz, 3 kHz, and 6 kHz are easily selectable. A variable oscillator adds flexibility by producing tones from 20 Hz to 20 kHz. In addition, external generators can be used to modulate the CE-6A, either alone or simultaneously with one of the internal tones.

The internal variable oscillator also provides the ability to perform sweep testing of IF and discriminator circuits without additional equipment. Details are discussed in Cushman Product Application No. 2.

Preemphasis, as well as deemphasis, is included in the CE-6A to make more critical measurements possible. In international and some marine applications particularly, transmitter preemphasis and receiver deemphasis must be accurately simulated during testing to meet government specifications.

Modulation acceptance bandwidth tests now are more easily made with the CE-6A using a built-in +6 dB switch.

Transmitter Maintenance

The great flexibility of the CE-6A communications monitor in the receiver mode centers around the plug-in module concept pioneered by Cushman. A full range of plug-ins allows the user to select exactly the right capability for his application whether it involves AM, FM or single sideband. A full discussion of these modules and various applications is contained in this brochure.

A major advantage of the monitor is its off-the-air testing capability. The CE-6A can make accurate measurements of frequency and modulation of remote AM, FM and SSB transmitters. Routine maintenance checks of remote and often inaccessible sites can be carried out quickly without leaving the shop.

On the left side of the monitor either a direct reading FM deviation meter or oscilloscope calibrated in FM deviation can be used.

The right plug-in compartment of the instrument holds a variety of FM RF

modules, including those with added capabilities for measuring power, testing duplexer performance, generating AF signaling tones, and measuring and monitoring AM and SSB signals.

Digital tuning of the monitor is continuous up to 1000 MHz with a resolution of 100 Hz. Any frequency error of a received signal can be read directly on the frequency meter to a resolution of 50 Hz. An optional meter is available to resolve frequency differences to 20 Hz. Depending on the plug-in used, a wide range of tests can then be performed.

An audible zero beat indicator is provided for convenience in setting transmitter frequencies without removing the radio from its mobile or base station installation. The operator can hear when he has accurately tuned the transmitter to the dialed-up frequency. The center panel frequency meter will indicate any variance from the correct frequency.

Both the fixed and variable internal audio frequency tones are available externally to modulate transmitters under test. A unique feature of the Cushman communications monitor is its ability to perform tests on radio duplexer units. A plug-in module allows measurement of receiver desensitization with the transmitter on. The module also includes a wattmeter and broadband FM mixer which allows simultaneous measurement of power, frequency error, and deviation.

An AM monitor plug-in module permits servicing of AM radios and provides direct measurements of percent modulation. Demodulated AM signals can be applied to the oscilloscope plug-in module for further analysis of distortion and other problems or monitored through a built-in speaker.

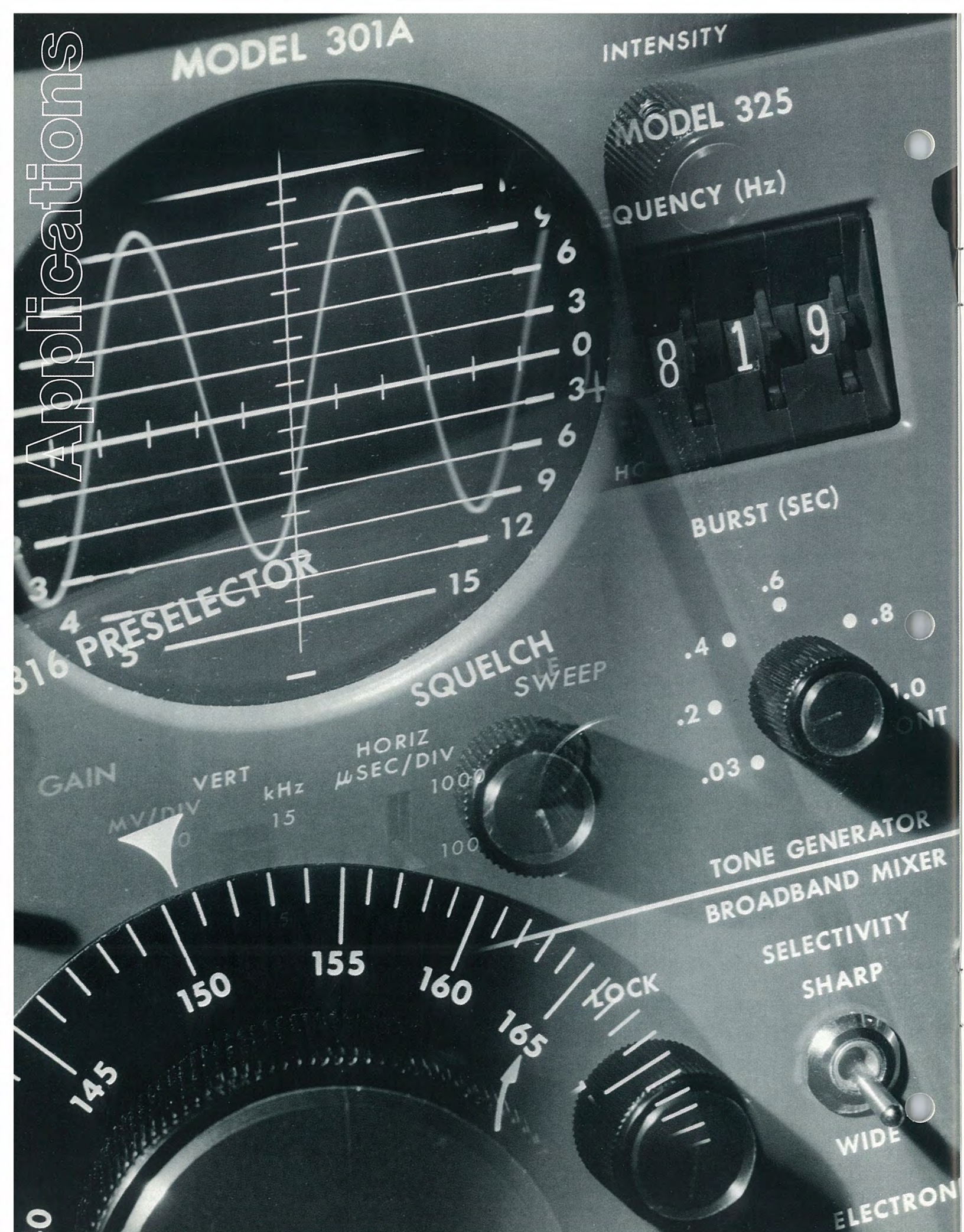
Plug-in modules available for use with the CE-6A:

FM Deviation Modules (Left Side)
301A Oscilloscope
311 Oscilloscope (under development)
302 FM Deviation Meter

RF Modules (Right Side)
FM Broadband Mixers
303 Low Sensitivity Broadband Mixer
314 High Sensitivity Broadband Mixer

FM Narrowband High Sensitivity Preselectors (with broadband capability)
304B 25-50 MHz
306E 400-520 MHz

315C 40-90 MHz
316 140-175 MHz
Special RF Modules (with broadband FM capability)
313 AM Monitor
317 High Sensitivity AM/FM/SSB Monitor
325 Tone Generator
330 Wattmeter/Duplexer Tester



Select the monitor and plug-in module combination for your application

Selecting the proper plug-in modules for your application should begin with a knowledge of the many built-in features of the various Cushman communications monitors.

100 kHz IF output. This monitor capability is used when it is desirable to obtain greater resolution in setting transmitter frequencies using an external low frequency counter.

Zero beat indicator. Provides aural indication of the difference between the dialed-in and received frequency. In a typical application, this allows a mobile transmitter to be adjusted when it is not convenient to see the frequency error meter.

6-dB switch. Provides a convenient means of making modulation acceptance bandwidth tests usually performed following the 12-dB SINAD test.

Preemphasis and deemphasis. To make accurate distortion and frequency measurements on radios utilizing preemphasis and deemphasis, the CE-6A includes the standard 6-dB per octave filtering required.

High level output. Used for troubleshooting or retuning misaligned receivers.

Demodulated output. Demodulated outputs from the monitors or plug-in modules can be used with external equipment to measure distortion and frequency of audio signals.

The broad, expanding line of plug-in modules and other accessories equip the monitors for most testing requirements in the two-way industry. Some of the modules are for specific purposes, others have a broader range of uses. There are plug-ins for off-the-air monitoring, for measuring AM, FM and single sideband modulation, power and frequency, and for generating synthesized audio frequency signaling and control tones.

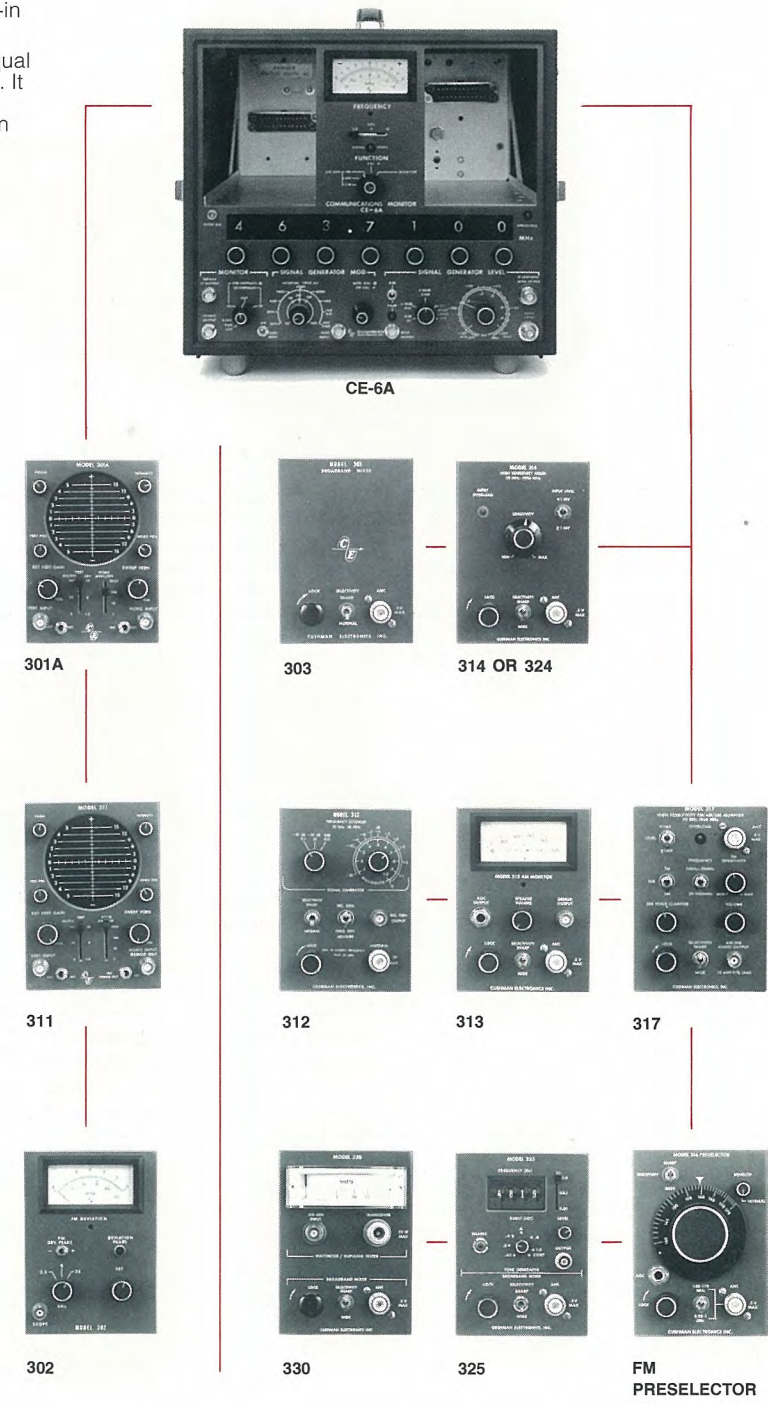
Several applications are discussed here to illustrate the versatility of the Cushman instruments.

Two compartments are available in the monitor for plug-in modules. All RF and special purpose modules are inserted in the right side and choice is determined by specific applications.

The left compartment is used for either the Model 301A or 311 Oscilloscopes, or the Model 302 FM Deviation Meter. The Model 302 indicates peak values of received and generated FM signals on a meter. This capability is satisfactory for many test procedures. For more detailed investigation of signal

waveforms, the oscilloscope plug-in modules are more useful.

The Model 311 Oscilloscope is equal in performance to the Model 301A. It has the additional capability of displaying digital pulse modulation waveforms with pulse repetition rates as low as 5 Hz.



Model 330



Model 330 Wattmeter/Duplexer Tester

The Model 330 is a combination wattmeter, duplexer tester, and broadband FM mixer. It allows the monitor to simultaneously measure power, frequency, and deviation in addition to measuring receiver desensitization in full duplex mobile systems such as emergency medical radio and mobile radio telephone systems.

A built-in wattmeter can measure up to 1000 MHz and to 25 watts directly. Higher power levels can be measured with an external attenuator.

Model 313



Model 313 AM Monitor and FM Broadband Mixer

This module measures percent modulation of AM signals received or generated by the monitor. The demodulated signals can be monitored on the unit's speaker or applied externally to the Model 301A or Model 311 oscilloscope or other external instrument for signal analysis. The module operates from 20 to 1000 MHz with input sensitivity of 10 mV. An FM broadband mixer is included in the 313 for monitoring and bench testing FM radios.

Models 314 and 324



Models 314 and 324 High Sensitivity FM Broadband Mixers

The mixers provide the communications monitor with 2- μ V sensitivity over its entire range for off-the-air monitoring and measurements of frequency and deviation.

Sensitivity controls attenuate strong signals to avoid distortion due to overloading. This condition is indicated by a front panel lamp.

Model 303



Model 303 FM Broadband Mixer

For close-in monitoring and bench testing of FM radios, the Model 303 provides 10-mV input sensitivity from 20 to 1150 MHz, depending upon the monitor.

Two switchable, selective bandwidths, NORMAL and SHARP, are provided. The sharp bandwidth is useful when making measurements in the presence of strong RF signals close to the dialed-in frequency of the monitor.

For the same capability plus tone generation, see the Model 325 module in the tone generator section.

Model 330 Specifications	
Compatible Monitors	CE-5, CE-6/6A, CE-7
Wattmeter	
Frequency Range	20 to 1000 MHz
Power Range	1 to 25 W extendable to higher power with external attenuators
Power Accuracy	$\pm 4\%$ of reading, ± 0.25 W
Input Impedance	50 Ω nominal
Duplexer Tester	
Signal Generator Input	Supplied by mainframe
Frequency Range	20 to 1000 MHz (depending on monitor)
Transceiver Output to Receiver Level Below Signal Generator	
Input	40 dB ± 1 dB
Sensitivity Range	
With CE-6 or CE-6A	0.1 to 100 μ V
With CE-5	0.1 to 10 μ V
Broadband Mixer	
Frequency Range	20 to 1000 MHz (depending on monitor)
Sensitivity	10 mV
Impedance	50 Ω nominal
Level (Maximum)	0.5 V
Connector	UHF
Power Requirements	Supplied by mainframe
Dimensions	5-1/2 in. (14.0 cm) high 4 in. (10.2 cm) wide 10 in. (25.4 cm) deep
Weight	3-1/2 lbs. (1.6 kg)

Model 313 Specifications	
Compatible Monitors	CE-3, CE-5, CE-6/6A, CE-7
Frequency Range	20 MHz to 1000 MHz (depending upon monitor)
Signal Modes	CW, AM, FM
Input	
Sensitivity	> 10 mV
Impedance	50 Ω
Level (maximum)	0.5 V
Connector	UHF
% Modulation Meter	
Range	5 to 90%
Accuracy (tone modulation)	$\pm 5\%$
Selectivity	
Wide	100 kHz
Sharp	22 kHz
AGC Voltage Output	
10 mV RF Input	1 Vdc
500 mV RF Input	10 Vdc
Demodulator Output	
Frequency Range	50 Hz to 20 kHz
Level	10 mV/% modulation
Impedance	600 Ω
Audio Output	Speaker
Power Requirements	Supplied by mainframe
Dimensions	5-1/2 in. (14.0 cm) high 4 in. (10.2 cm) wide 10 in. (25.4 cm) deep
Weight	4 lbs. (1.8 kg)

Models 314 and 324 Specifications	
Compatible Monitors	CE-5, CE-6/6A
314	CE-3
324	CE-7
Frequency Range	20 to 1000 MHz (depending on monitor)
Input	
Signal	CW or FM
Sensitivity*	
314	2 μ V
324	≤ 10 μ V at frequencies ≥ 25 MHz
Impedance	50 Ω nominal
Level (maximum)	0.5 V rms
Connector	UHF
Selectivity	
Wide	3 dB 65 kHz
Sharp	60 dB 22 kHz
Input Attenuator	Variable 65 kHz
Power Requirements	Supplied by mainframe
Dimensions	5-1/2 in. (14.0 cm) high 4 in. (10.2 cm) wide 10 in. (25.4 cm) deep
Weight	2 lbs. (.9 kg)

*Because broadband mixers have no preselection, sensitivity can be degraded at some frequencies due to interference from nearby transmitters.

Model 303 Specifications	
Compatible Monitors	CE-3, CE-5, CE-6/6A, CE-7
Frequency Range	20 to 1150 MHz (depending on monitor)
Input	
Signal	CW or FM
Sensitivity	10 mV
Impedance	50 Ω nominal
Level (maximum)	0.5 V
Connector	UHF
Selectivity	
Wide	3 dB 65 kHz
Sharp	60 dB 22 kHz
Power Requirements	Supplied by mainframe
Dimensions	5-1/2 in. (14.0 cm) high 4 in. (10.2 cm) wide 10 in. (25.4 cm) deep
Weight	2 lbs. (.9 kg)

Model 312



Model 312 Low Frequency Extender (CE-3 and CE-5 only)

The Model 312 plug-in module shifts the frequency range of the monitor for FM monitoring and signal generation to a 50 kHz to 20 MHz frequency range. Input sensitivity is 10 millivolts and output levels are adjustable in three ranges from 0 to 10 millivolts.

Applications of the 312 include:

1. Servicing low frequency paging receivers used in large factories or hospitals.
2. Generation and measurement of CW signals in the marine bands.
3. Generation of CW signals or FM modulated IF signals for receive stage gain measurements.

Model 312 Specifications	
Compatible Monitors	CE-3, CE-5
Frequency Range	50 kHz to 20 MHz
Measure Mode	
Input	
Sensitivity	10 mV
Impedance	50Ω
Level (maximum)	0.5 V
Connector	UHF
Selectivity (nominal)	3 dB
Wide	65 kHz
Sharp	22 kHz
Generate Mode	
Output Level Ranges	0 to 100 μV 0.1 to 1 mV 1 to 10 mV
Impedance	50Ω
Connector	BNC
Power Requirements	Supplied by mainframe
Dimensions	5-1/2 in. (14.0 cm) high 4 in. (10.2 cm) wide 12-1/2 in. (31.7 cm) deep
Weight	3 lbs. (1.4 kg)

FM Preselectors



FM Preselectors

In areas of heavy RF congestion, preselectors may have to be used to reject strong interfering signals. This capability can be particularly important when trying to make off-the-air measurements of a distant station.

Preselectors have a typical sensitivity of 10 microvolts. They can be switched to a broadband mode covering the 20 to 1000-MHz range with 10-millivolt sensitivity.

FM Preselectors Specifications	
Frequency Range (Narrowband)	
304B (CE-3, CE-5, CE-6/6A, CE-7)	25 to 50 MHz
315C (CE-3, CE-5, CE-6/6A, CE-7)	40 to 90 MHz
305B (CE-3, CE-5, CE-7)	140 to 175 MHz
316 (CE-6/6A)	140 to 175 MHz
306E (CE-3, CE-5, CE-6/6A, CE-7)	400 to 520 MHz
307B (CE-3, CE-5, CE-7)	120 to 140 MHz
Frequency Range (Broadband)	20 MHz to 1000 MHz
Input	
Sensitivity	20 μV, 10 μV typical
Narrowband	10 mV
Broadband	50Ω
Impedance	50Ω
Level (maximum)	0.5 V
Connector	UHF
Selectivity (nominal)	3 dB
Wide	65 kHz
Sharp	22 kHz
AGC Voltage Output (except 306E)	
20 mV RF Input	-3.3 Vdc
500 mV RF Input	-6.5 Vdc
Power Requirements	Supplied by mainframe
Dimensions	5-1/2 in. (14.0 cm) high 4 in. (10.2 cm) wide 10 in. (25.4 cm) deep
Weight	3 lbs. (1.4 kg)

Tone Generators

Tone Generators for testing tone operated radio systems

Cushman manufactures a selection of low frequency synthesized generators for testing radio systems that use tone control and selective signaling. These tone generators are typically used as accessories to provide modulated test signals for Cushman communications monitors.



CE-12. This two-tone generator has synthesizer accuracy and four-digit resolution with either single or two-tone sequential outputs. Tone duration, level and interval are all variable. Intertone delay can be set to zero.

The generator features an automatically sequenced tone control function for testing repeaters. With the Cushman Model 106 telephone dial accessory, the CE-12 can be used to generate MTS, IMTS, and interrupt signaling tones.



CE-14. This generator is for single-tone systems and has both continuous and burst tone modes. Its stable output is also produced by direct digital synthesis. It is a valuable aid in testing continuous tone-control squelch systems (CTCSS).



Model 325. Basically the same as the CE-14, this unit serves as a plug-in module for all Cushman monitors except the CE-7. When used with the CE-6A, two-tone simultaneous tests can be made without extra equipment. The module contains a broadband mixer with a frequency range of 20 to 1000 MHz.

Specifications

CE-12 Specifications	
Frequency (each tone)	10.00 Hz to 9999 Hz
Range	0.01 Hz to 9999 Hz
Resolution	0.01 Hz
10.00 Hz to 99.99 Hz	0.1 Hz
100.0 Hz to 999.9 Hz	1 Hz
1000 Hz to 9999 Hz	±0.005%
Accuracy	±0.005%
Aging	20 PPM per year
Output	
Number of Tones	2
Wave Shape	Sinusoidal
Distortion	≤1%
Phase Jitter	<2° peak-to-peak
Frequency Response (ref. 1 kHz)	±0.25 dB
Impedance	600Ω (single ended)
Level (separately settable for each tone)	0 to 2.45 V rms (+10 dBm) terminated
On/Off Ratio	≥55 dB
Tone Level ≥245 mV (-10 dBm)	Two 5-way binding posts
Connector	Separately settable for each tone
Tone Duration	0.03 to 1 sec
Ranges	0.3 to 10 sec
	Continuous
Repeat Delay	
Ranges	0 and 0.1 to 5 sec
Interval Delay	
Ranges	0 and 0.1 to 1.3 sec
Operating Modes	
One Tone Continuous	Either tone but TONE 1 overrides TONE 2.
Continuous	Sequence switch automatically disabled.
Single	Two tone sequential
Tone Control Sequence	Two tone sequential (burst)
Rest State	TONE 1 at -20 dB
Depress ENABLE	Switches to TONE 1 at ±10 dBm for 125 ms then TONE 2 at 0 dBm for 40 ms then TONE 1 at -20 dBm (rest state).
Level Accuracy	±1 dB
Delay Accuracy	±20%
Interrupt	A closure at the external gating terminals turns on TONE 1. An open turns off TONE 1. Starting with a closure at the external gating terminals, each open causes output to switch to the other tone.
MTS	Starting with a closure at the external gating terminals, each open switches the output from TONE 1 to TONE 2. The next closure switches it back to TONE 1.
IMTS	
External Gating	
Closure Requirements	Closure between red and black terminals of <1Ω.
Connector	Two 5-way binding posts.
Current Sync	50-mA peak for <1 ms; <2 mA dc
Power Requirements	115 or 230 Vac ±10%, 50-400 Hz, 8 W
Dimensions	6 in. (15.2 cm) high 9 in. (22.9 cm) wide 10-1/2 in. (26.7 cm) deep 7 lbs. (3.2 kg)
Weight	
Environmental	
Temperature, Operating	0°C to 55°C (32°F to 131°F)
Temperature, Storage	-40°C to +75°C (-40°F to 167°F)

CE-14 and 325 Specifications	
Compatible Monitors (Model 325)	CE-3, CE-5, CE-6/6A*
Broadband Mixer (in Model 325 only)	
Frequency Range	20 to 1000 MHz
Input	
Signal	CW or FM
Sensitivity	10 mV
Impedance	50Ω nominal
Connector	UHF
Selectivity (nominal)	3 dB
Wide	65 kHz
Sharp	22 kHz
60 dB	65 kHz
Tone Generator (CE-14 and 325)	
Frequency Range	10.00 Hz to 9999 Hz
Resolution	
10.00-99.99 Hz	0.01 Hz
100.0-999.9 Hz	0.1 Hz
1000-9999 Hz	1 Hz
Accuracy	±0.005% ±0.002%/year aging
Output	
Wave Form	Sinusoidal
Distortion	≤1%
Phase Jitter	<2° peak-to-peak
Frequency Response (ref. 1 kHz)	±0.25 dB
Impedance	600Ω (single ended)
Level	0-3 V rms terminated
On/Off Ratio (burst mode)	≥55 dB
Tone Level	≥245 mV rms
Connector	BNC
Modes	Continuous and burst
Burst Duration Range	0.03 to 1 sec
Temperature Range, Operating	0°C to 55°C (32°F to 131°F)
Power	
CE-14	115 or 230 Vac ±10%, 50-400 Hz, 8 W
325	Supplied by mainframe
Dimensions	
CE-14	4 in. (10.2 cm) high 5-3/4 in. (14.6 cm) wide 11-3/4 in. (29.8 cm) deep
325	5-3/4 in. (14.6 cm) high 4 in. (10.2 cm) wide 11-3/4 in. (29.8 cm) deep 5 lbs. (2.3 kg)

*Note: CE-6/6A modification kit No. 7001-0073 required for CE-6, Serial No. ≤456 and CE-6A, Serial No. ≤180, when using the 325.

Model 301A Oscilloscope



Model 301A Oscilloscope

The oscilloscope displays the peak-to-peak frequency deviation of FM signals both received and generated by the monitor. It is also useful in analyzing AM and SSB signals, and can be calibrated to measure percent AM.

With the oscilloscope, noise or other extraneous signals can be detected and identified much more rapidly and accurately than with a deviation meter. Internal dc coupling allows the scope to easily display FM deviation.

The scope can also be used to investigate distortion, clipping, and other signal-degrading factors, and for making numerous other tests including swept measurements of IF and discriminator circuits.

For FM measurements, the vertical display is calibrated in three deviation ranges from 1.5 to 15 kHz. Sweep rates are adjustable from .01 to 10 milliseconds.

Used in conjunction with a tone generator, the scope can produce Lissajous patterns for measuring the frequency of AF signaling and control tones.

The unit can be used as an independent, general purpose 100 kHz oscilloscope with calibrated vertical and horizontal sweeps. The large screen of the Model 301A provides high resolution and accuracy for all waveforms.

Model 311



Model 311 Oscilloscope

This oscilloscope, now under development, is being designed specifically to display digital pulse modulation signals now being used for signaling in two-way radio systems.

The external frequency range of the Model 311 extends from 5 Hz to 100 kHz, providing the low frequency capability required to display digital waveforms.

In all other ways, the Model 311 Oscilloscope performs the same functions as the Model 301A.

Model 302



Model 302 FM Deviation Meter

The Model 302 measures the positive or negative peak deviations of FM signals generated or received by the monitor.

The unit can measure deviation up to 25 kHz, which makes it useful in measuring per-channel deviation of point-to-point multi-channel radio systems.

A warning lamp on the front panel flashes when instantaneous deviation exceeds a preset level.

An output connector provides a means of applying demodulated signals to external test instruments such as a distortion meter or an oscilloscope.

Model 317



Model 317 High Sensitivity AM/FM/SSB Monitor

This new plug-in, now under development, greatly expands the versatility of the Cushman CE-6 and CE-6A communications monitors by providing AM, FM, and single sideband capabilities all in one module. With an expanded frequency range of 50 kHz to 1000 MHz, this unit has many applications, including land-mobile, marine, military, and aircraft systems.

Its high sensitivity allows off-the-air monitoring and measurement of frequency error and modulation at remote FM, AM, and SSB transmitters without leaving the service shop.

With SSB systems, the monitor can make frequency error measurements of the suppressed carrier. The module also provides a demodulated audio output, with a built-in speaker, for monitoring AM and SSB communications.

A calibrated demodulated output from the Model 317, allows percent AM modulation to be measured directly on the Model 301A or 311 Oscilloscope.

The FM broadband mixer in the Model 317 allows the monitor to make frequency and deviation measurements, off the air and on the bench.

Specifications

Model 301A and Model 311 Specifications

Compatible Monitors	CE-3, CE-5, CE-6/6A, CE-7
Deviation Ranges	±1.5 kHz, ±5 kHz, ±15 kHz
Accuracy (full scale)	±5%
Sync Control (input signal must exceed one division in peak-to-peak amplitude)	Automatic
Sweep Rate (adjustable)	.01, 0.1, 1, 10 ms
Frequency Response (Internal FM)	Dc to 19 kHz typical
External Inputs (BNC Connectors)	Horizontal and vertical
Vertical Ranges	±25, 100, 500 mV
Frequency Range	
301A	20 Hz to 100 kHz
311	5 Hz to 100 kHz
Demodulated Output Frequency Range	5 Hz to 100 kHz
Level	10 mV peak-to-peak with ±5 kHz deviation
Output Level	≥ 1 kΩ
Connector	BNC (same as horizontal input)
Power Requirements	Supplied by mainframe
Dimensions	5-½ in. (14.0 cm) high 4 in. (10.2 cm) wide 12-½ in. (31.7 cm) deep
Weight	5 lbs. (2.3 kg)

Model 302 Specifications

Compatible Monitors	CE-3, CE-5, CE-6/6A, CE-7
Deviation Ranges	0 to 2.5 kHz 0 to 6 kHz 0 to 25 kHz 60 Hz to 20 kHz
Frequency Range	±4%
Accuracy (full scale)	BNC
Scope Output Connector	Supplied by mainframe
Power Requirements	5-½ in. (14.0 cm) high 4 in. (10.2 cm) wide 12-½ in. (31.7 cm) deep
Dimensions	2 lbs. (.9 kg)
Weight	

Model 317 Proposed Specifications (under development)

Compatible Monitor	CE-6/6A
Frequency Range	50 kHz to 1000 MHz*
Input Modes	AM, FM, CW, SSB
Sensitivity**	
50 kHz to 500 MHz	2 μV typical for 10-dB SINAD or 10-dB S/N
500 MHz to 1000 MHz	10 μV typical
Audio Output	
AM	Calibrated 10 mV peak-to-peak/% AM
SSB	1 V peak-to-peak for scope display
Speaker	For monitoring AM and SSB

*Internal filters reject AM and FM broadcast bands, 500-1500 kHz and 75-115 MHz respectively.
**Because the 317 has no preselection, sensitivity may be degraded at some frequencies due to interference from nearby transmitters.

Plug-in Modules



Plug-in modules
keep your monitor
up to date

The plug-in module concept for communications monitors was pioneered by Cushman with the introduction of the Model CE-3 in 1967. This approach is the best way to satisfy today's radio servicing needs with the ability to expand the monitor to meet future requirements.

Cushman is constantly investigating industry requirements so that new plug-in modules can be designed to meet future needs. Only by utilizing this concept can the instrument you buy today be kept up to date with the technical innovations and regulations of the future.

And when selecting the plug-in modules you need, remember that you can add other units at any time. You pay only for the capability you need now.

Most modules can be used with any of the Cushman monitor family, as seen in the plug-in module selection guide.

The left side of the monitor holds either an FM deviation meter or an oscilloscope calibrated in FM deviation. The right-hand position is used for all RF modules.

All RF modules have a wide and sharp selectivity mode. The wide position aids in quick tuning. The sharp position helps to eliminate adjacent channel interference.

Quick Selection Guide to Plug-In Modules

Instrument	301A	311	302	303	304B	305B	306E	307B	312	313	314	315C	316	317	324	325	330
CE-3*	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
CE-5	X	X	X	X	X	X	X	X	X	X	X	X				X	X
CE-6*/6A	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
CE-7	X	X	X	X	X	X	X	X		X		X					X

*No longer in production

Swept IF testing.

To easily adjust IF filters and FM discriminators, a swept display of the IF passband and FM discriminator characteristics can be observed on the 301A or 311 oscilloscope.

This swept display is provided by sweeping the monitor's generated RF signal to the receiver with an internal or external 20-Hz sine wave. The output from the receiver IF is connected directly to the 301A or 311 oscilloscope.

For further details on this application, see Cushman Product Application No. 2.



FM radios. Off-the-air testing.

Being able to monitor remote radio transmitters off the air without leaving the service shop can have major advantages. This can be accomplished with a number of plug-ins depending on your application.

Using the Model 314 low level signals can be monitored from remote transmitters within the frequency range of the monitor. Frequency errors and peak deviation can be measured quickly and accurately. For CE-3 monitors, the equivalent Model 324 plug-in is used.

When it is necessary to reject strong interfering signals, a high gain FM preselector for the frequency band is used. Each of these narrowband preselectors can also be operated in

a wideband mode covering the entire frequency range of the monitor.



AM/FM radios. Bench testing.

For the service shop that maintains citizens band, marine and aviation AM radios, as well as FM radios, the Model 313 AM monitor plug-in module expands the capability of the Cushman monitors.

With this plug-in module, Cushman monitors can now measure AM modulation, frequency deviation, frequency error of FM and AM transmitters, and generate calibrated AM and FM signals.



AM/FM/SSB radio. Off-the-air and bench testing.

Using the Model 317 plug-in and one of the Cushman oscilloscopes (Model 301A or 311), the two-way repair shop has an almost universal test set for AM, FM or SSB measurements.

Sensitivity of 2 to 10 μV allows off-the-air measurements of frequency and modulation characteristics for all three types of transmission. This includes radios operating from 50 kHz to 1000 MHz.

When listening to SSB communications, a clarifier control is provided to improve audio reception. In addition, a calibrated AM output is provided for measuring percent AM and displaying SSB modulation on the scope.



Tone-controlled radio systems. Bench testing.

For two-way FM radios and repeaters using audio tones for signaling and control, the Model 325 plug-in module expands the capability of the Cushman monitors by providing synthesized audio tones as well as an FM broadband mixer.

Synthesized audio frequency tones modulate the signal generator in the monitor when required to test tone operated two-way radio systems.

With a Model 325 and the Model 301A or 311 Oscilloscope, it is possible to verify the tone frequency of a received control signal. The incoming signal drives the vertical input of the scope while the output signal of the Model 325 is fed to the scope's horizontal input. The

resulting Lissajous pattern determines the received tone frequency very accurately. This method eliminates the need for an audio counter.



Duplexers

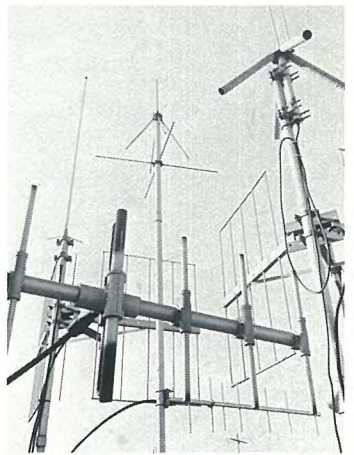
Using the Model 330 you can simultaneously measure power, frequency error, deviation and receiver desensitization of duplex radios.

Desensitization is caused by leakage of transmitter power through the duplexer into the receiver. This condition can be measured by introducing a calibrated low level signal to the receiver of a full duplex radio while the transmitter is operating at full power.

If power is greater than 25 watts, an external attenuator is used. A 6-dB switch on the CE-6A allows direct reading of duplexer radio desensitization when using the external 6-dB accessory pad for extending power measurements to 100 watts.

The plug-in module also includes a broadband mixer to allow frequency error and deviation measurements to be made during the same set up.

Other details are available in Cushman Product Application No.5.



Protective Cover—Part No. 5287-0010

This handy zipper cover is made of fire retardent nylon, with a half-inch quilted lining to protect the instrument from moisture and damage during transport or storage.



Plug-in Module Carrying Case—Part No. 5287-0042

Built of the same rugged construction as the monitor trunk, this case holds up to four plug-in modules.



Monitor Shipping Trunk—Part No. 5287-0034

Rugged fiberglass trunk for all monitors. The trunk is foam padded and is ideal for shipping instruments by air or surface vehicles.



Test Equipment Cart—Part No. 7101-0050

The cart features a tilting top shelf, built-in drawer, and a multiple ac receptacle strip.



Converter, 12 Vdc to 115 Vac

(To be ordered directly from the manufacturer)

Terado Corporation, Tempest Model 50-170. Provides 200 watts continuous, 250 watts intermittent.



Auxilliary Equipment

Items furnished with the CE-5, CE-6A, and CE-7 communications monitors at no charge include:

- Front panel cover
- Frequency log
- RF cable with BNC connectors at both ends
- 40-dB pad/fuse (CE-6A)
- 20-dB pad/fuse (CE-5 and CE-7)
- 30-inch telescoping antenna assembly with UHF connector
- PC board extractor
- PC board extender
- Instruction manual



Cushman Product Application notes are available on several subjects. They may be requested from your regional sales representative, or from our main office.

- No. 1. A Portable Test Set for Microwave Radio Installation and Maintenance.
- No. 2. Speeding Up With Sweep Testing.
- No. 3. Modern Test Equipment Lowers Communications Maintenance Cost in the State of California.
- No. 4. CE-6 Service Monitor Used to Maintain Aviation Navigation Aids and Communications Radios.
- No. 5. Duplexer Testing is Easy and Accurate With All Cushman Service Monitors.

Cushman instruments are guaranteed for 3 years from date of original purchase. During this warranty period, Cushman will repair any instrument found to be defective. Parts and labor required by Cushman to repair an instrument are free during the first year. During the second and third year, parts required by Cushman to repair an instrument are free. Additionally, a free annual instrument calibration is offered during the 3-year warranty period by any authorized Cushman service center.

Trained sales engineers and regional service centers throughout the country are there to assist the Cushman customer in any way possible. This may take the form of helping you select the right instrument and accessories for your specific requirements. Or to offer professional maintenance service if a problem develops.

During and after the Cushman 3-year warranty period, we offer a convenient PC board exchange program designed to get your instrument back in service as quickly as possible. Our telephone troubleshooting service can usually help you identify the problem without the instrument leaving your shop. A replacement board is quickly shipped to you in exchange for the defective board.

The Cushman reputation of excellence extends beyond providing test instruments for servicing two-way radio systems.

In the telecommunications industry, we offer several proven instruments, including a telecommunications test system (TTS) for measurement of frequency division multiplex basebands up to 9.1 MHz. Under development is a TTS system with expanded capability to 25 MHz.

The Culbertson division of Cushman manufactures a digital microwave radio system for common carriers operating in the 11-GHz band. The radios and associated multiplexers are compatible with existing PCM transmission systems.

To find out how Cushman can help improve your radio servicing capability, call for a demonstration. Our field representatives will arrange for you to personally evaluate the radio maintenance products that could best serve you.

For the name of your nearest representative, contact Cushman Electronics in Sunnyvale.

Cushman Electronics, Inc.
830 Stewart Drive
Sunnyvale, CA 94086
(408) 739-6760

A subsidiary of
Dana Electronics, Inc.

Tele-Radio Systems
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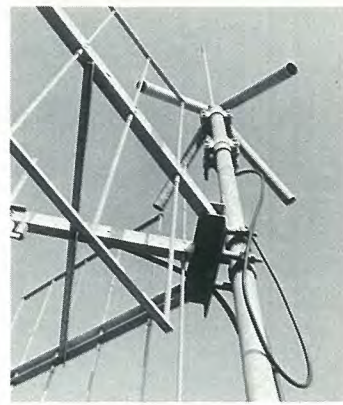
Dana Electronics Ltd.
Luton, England
Telex 851 82430

Dana Laboratories SARL
Meudon-Bellevue, France
Telex 842 200207F

Dana Labs GmbH
Riedstrasse, Germany
Telex 841 419644



Cushman



Operating Modes	Monitor Signal Generator—AM, FM, CW Calibrate	
MONITOR MODE		
Frequency		
Range	Up to 1000 MHz. Depends on RF plug-in module. See specifications for individual plug-in modules.	
Display	7 digits individually selectable in decade steps, 100 Hz to 100 MHz/step	
Resolution	100 Hz	
Accuracy	$\pm 1 \times 10^{-7}$ \pm time base	
Frequency Error Meter	Displays frequency difference between incoming signal and dialed-in frequency on a zero centered meter.	
Ranges	Standard ± 1.5 kHz ± 5 kHz ± 15 kHz 50 Hz	M-2 Option ± 500 Hz ± 1.5 kHz ± 5 kHz 20 Hz
Resolution		
Input Sensitivity	Depends on RF plug-in module. Range is from 2 μ V to 10 mV. See specifications for individual plug-in modules.	
100-kHz IF Output		
Frequency	100 kHz \pm difference between dialed-in frequency and incoming carrier.	
Accuracy	$\pm 1 \times 10^{-7}$ \pm time base	
Level	100 mV rms minimum into 10 k Ω minimum	
Connector	BNC	
Demod Output		
Level for 25-kHz peak deviation	5 V rms into 1 k Ω	
Distortion	<5%	
Frequency Response		
Deemphasis out	± 3 dB from 60 Hz to 20 kHz	
Deemphasis in	6 dB/octave +1, -3 dB from 300 to 3000 Hz	
Connector	BNC	
Zero Beat	In ON position, signal from speaker and DEMOD OUTPUT is the difference in frequency between incoming carrier and dialed-in frequency.	
SIGNAL GENERATOR MODE		
Frequency		
Range	10 kHz to 1000 MHz	
Display	7 digits individually selectable in decade steps, 100 Hz to 100 MHz per step.	
Digital Resolution	100 Hz	
Accuracy	CW and AM: $\pm 1 \times 10^{-7}$ \pm time base FM: ± 50 Hz additional	
Level (into 50Ω)		
Low Level Output (after external 40-dB attenuator/fuse)		
Range	0.1 μ V to 100 μ V (-127 to -67 dBm) in 3 ranges	
Accuracy (at 100 μ V)		
Frequency		
10 kHz to 512 MHz	± 2 dB	
512 to 1000 MHz	± 0.5 dB additional	
Dial Attenuator	± 1 dB typical	
Step Attenuator	± 2 dB	
+6 dB Switch		
25 $^{\circ}$ $\pm 5^{\circ}$ C	± 0.5 dB	
0 $^{\circ}$ to +55 $^{\circ}$ C	± 0.5 dB additional	
Spurious Output		
Harmonics (carrier frequency ≥ 1 MHz)	-40 dB	
Non-harmonic Products ≥ 60 Hz from carrier	-35 dB (-40 dB typical)	
At Integer Multiples of 100 MHz and at Integer Multiples of 5 MHz for Output Frequencies ≤ 30 MHz	-100 dBm (-130 dBm typical)	
Impedance:	50 Ω nominal	
Connector:	BNC	
High Level Output (uncalibrated) Level		
10 kHz to 512 MHz	7 mV to 700 mV rms (-30 to +10 dBm typical)	
512 to 1000 MHz	>100 mV (-7 dBm) 175 mV (-2 dBm) typical maximum output	
Frequency Response	6 dB peak-to-peak typical	
Impedance	50 Ω nominal	
Connector	BNC	

Output Modes	CW, AM, FM
Modulation	
Internal	
Fixed Frequencies	300, 400, 1000, 3000, 6000 Hz $\pm 5\%$
Variable (3 ranges)	Var: 20 to 200 Hz Var $\times 10$: 200 to 2000 Hz Var $\times 100$: 2 to 20 kHz
Output	
Level	Variable 0 to 5 V rms into 1 k Ω
Distortion	5% maximum at 1.5 V rms output
Connector	BNC on front panel
Frequency Modulation	
Internal	
Frequency	Internal fixed or variable frequencies, 20 Hz to 20 kHz
Deviation	Variable with front panel MOD ADJ control
Preemphasis out	0 - 25 kHz
Preemphasis in	
50 Hz to 300 Hz	0 to 2.5 kHz peak
300 Hz to 3000 Hz	+6 dB/octave ± 2 dB
3 kHz to 20 kHz	0 to 25 kHz peak
Distortion	15 kHz deviation, 5% maximum
External	
Frequency	
Sine wave	5 Hz to 20 kHz
Square wave	5 Hz to 1 kHz
Pulse	5 Hz (5% to 95% duty cycle)
Deviation	
Sine wave	0 to 25 kHz
Square wave/Pulse	0 to 2 kHz
Deviation Sensitivity (MOD ADJ Fully CW)	
Preemphasis out	1 kHz/6 mV rms typical
Preemphasis in	
50 Hz to 300 Hz	100 Hz/6 mV rms typical
300 Hz to 3000 Hz	+6dB/octave ± 2 dB
3 kHz to 20 kHz	1 kHz/6 mV rms typical
Input Impedance	1 k Ω
Connector	BNC
Simultaneous	Signal generator output can be simultaneously modulated with both external and internal tones.
Amplitude Modulation	
Range	
Low Level Output	0 to 80%
High Level Output	0 to 30% (3 dB below maximum output)
Internal	
Fixed Frequencies	300, 400, 1000, 3000 Hz (usable to 6000 Hz) $\pm 5\%$
Variable Frequencies	50 Hz to 3 kHz (usable to 20 Hz) in 3 ranges
External	
Frequency	60 Hz to 3 kHz (usable to 20 Hz)
Sensitivity	80% AM for 150 mV rms
Input	
Impedance	1 k Ω nominal
Connector	BNC
Distortion	
Low Level Output	
30% AM	5% typical
80% AM	10% typical
High Level Output	
0 to 30% AM	10% typical
Simultaneous	Signal generator output can be simultaneously modulated with both external and internal tones.
GENERAL	
Time Base*	
Aging	$\pm 2 \times 10^{-7}$ /year
Stability	$\pm 5 \times 10^{-6}$ from 0 $^{\circ}$ C to 55 $^{\circ}$ C
Warm Up	<10 minutes at $\geq 20^{\circ}$ C to $< 1 \times 10^{-6}$ of final value <25 minutes at $\geq 25^{\circ}$ C to $< 1 \times 10^{-7}$ of final value
Power	
M-1 Option	115 Vac $\pm 10\%$, 50 - 400 Hz, 150 W
Temperature Range	12 Vdc with external power inverter
Operating	230 Vac $\pm 10\%$, 50 - 400 Hz, 150 W
Storage	
Dimensions	0 $^{\circ}$ C to +55 $^{\circ}$ C (32 $^{\circ}$ F to 131 $^{\circ}$ F) -40 $^{\circ}$ C to +75 $^{\circ}$ C (-40 $^{\circ}$ F to 167 $^{\circ}$ F)
Weight (without plug-ins)	12-1/4 in. (31.2 cm) high 13 in. (33.1 cm) wide 18 in. (45.7 cm) deep 40 lbs. (18.1 kg)

*Recalibration required at 6-month intervals during first year; every 12 months thereafter to maintain specified accuracy.



CE-5
Communications Monitor—
 economy backed by years
 of field-proven experience



- **Digitally controlled frequency synthesizer**
- **20 MHz to 520 MHz, or 50 kHz to 20 MHz**
- **1000 Hz (6 digit) dialing resolution**
- **Direct frequency, modulation and power measurements**
- **Off-the-air monitoring**
- **Internal 1-kHz tone**

The CE-5 is in the middle of the Cushman family of communications monitors and is designed to satisfy those applications with frequency requirements up to 520 MHz. Every plug-in capability, *except that of the Model 317*, is available for the CE-5 providing it with much of the same functional capability of the CE-6A.

The CE-5 is the successor to the CE-3, which stood as the industry standard for many years. Relying

on the same, field-proven circuit technology, the ruggedness and reliability of the CE-5 is backed by the thousands of Cushman monitors in use throughout the communications industry.

As with all Cushman products, the CE-5 carries with it a high degree of customer confidence. The basic concept of using plug-in modules allows for future expansion of the instrument's capability. And changes in industry requirements that lead to new modules extends the usefulness and life of the monitor.

One unique feature of the CE-5 is its ability to generate and receive CW and FM signals from 50 kHz to 20 MHz with a special extender plug-in module. The instrument can thus provide modulated IF signals at calibrated levels.

Transmitters can easily be checked

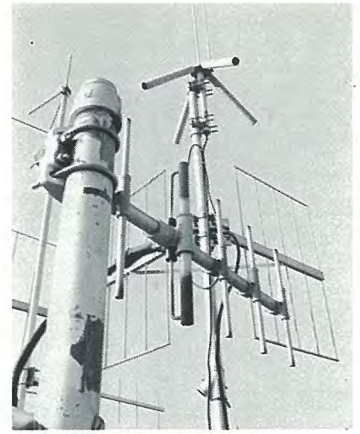
off-the-air or on the bench for a variety of conditions. Carrier frequency error is read directly on the center meter. At the same time FM deviation or AM percent modulation can be determined depending on the application. The oscilloscope plug-in adds capability for more critical waveform analysis.

An internal 1-kHz modulating tone is available. This, or any external tone, can be used to modulate the generator for testing AM or FM receivers. Both can be used simultaneously for maintenance of tone controlled radios. The 1-kHz tone is also available to externally modulate transmitters under test.

Plug-in modules available for use with the CE-5:

FM Deviation Modules (Left Side)
 301A Oscilloscope

- 311 Oscilloscope (under development)
- 302 FM Deviation Meter
- RF Modules (Right Side)
- FM Broadband Mixers
- 303 Low Sensitivity Broadband Mixer
- 314 High Sensitivity Broadband Mixer
- FM Narrowband High Sensitivity Preselectors (with broadband capability)
- 304B 25-50 MHz
- 305B 140-175 MHz
- 306E 400-520 MHz
- 307B 120-140 MHz
- 315C 40-90 MHz
- Special RF Modules (with broadband FM capability)
- 312 Low Frequency Extender
- 313 AM Monitor
- 325 Tone Generator
- 330 Wattmeter/Duplexer Tester



CE-5
Specifications

Operating Modes	Monitor Signal Generator—FM Signal Generator—AM/CW Calibrate	
MONITOR MODE		
Frequency		
Range	Up to 520 MHz. Depends on plug-in module. See specifications for modules.	
Display	6 digits—individually selectable in decade steps, 1 kHz to 100 MHz/step	
Digital Resolution	1 kHz	
Accuracy	$\pm 3 \times 10^{-7}$ \pm time base	
Frequency Error Meter	Displays frequency difference between incoming signal and dialed-in frequency on a zero centered meter.	
Ranges	Standard ± 1.5 kHz ± 5 kHz ± 15 kHz 50 Hz	M-2 Option ± 500 Hz ± 1.5 kHz ± 5 kHz 20 Hz
Resolution		
Input Sensitivity	Depends on plug-in module. Range is 2 μ V to 10 mV. See specifications on individual plug-ins.	
100 kHz IF Output		
Frequency	100 kHz \pm difference between dialed-in frequency and incoming carrier.	
Accuracy	$\pm 3 \times 10^{-7}$ \pm time base	
Level	100 mV rms minimum into 10 k Ω minimum	
Connector	BNC	
SIGNAL GENERATOR MODE		
Frequency		
Range	20 to 520 MHz*	
Display	6 digits individually selectable in decade steps, 1 kHz to 100 MHz/step	
Digital Resolution	1 kHz	
Accuracy		
CW, AM	$\pm 3 \times 10^{-7}$ \pm time base	
FM	± 50 Hz additional	
Level (Into 50Ω)		
Range	0.1 μ V to 100 μ V in 3 ranges (after external 20-dB attenuator/fuse)	
Accuracy at 100 μ V	± 3 dB	
Dial attenuator	± 2 dB	
Step Attenuator	± 2 dB	
Output Impedance	50 Ω nominal after external attenuator/fuse.	
Connector	BNC	
IF Signal Generation (CW)		
Ranges	1 kHz to 4 MHz 4 to 40 MHz (harmonics of 4 kHz to 4 MHz) 5 digits individually selectable in decade steps: 100 Hz to 1 MHz/step (1 kHz to 4 MHz range only)	
Display		
Digital Resolution	100 Hz on 1 kHz to 4 MHz range	
Accuracy	$\pm 3 \times 10^{-7}$ \pm time base	
Level (Into 600 Ω)		
1 kHz to 4 MHz	0 to 1 V nominal	
4 to 40 MHz	0 to 5 V nominal	
Output		
Impedance	600 Ω nominal	
Connector	BNC	
Output Modes	CW, AM, FM	

Internal Modulation	
Frequency	1000 Hz
Mode Switch	Internal modulation on/off
Output	
Level	1 V peak-to-peak nominal into 600 Ω
Distortion	2%
Connector	BNC
Frequency Modulation	
Internal	
Frequency	1000 Hz
Modulation Range	0 to 25 kHz peak
Distortion	2% from 3.3 to 15 kHz peak deviation
External	
Frequency	20 Hz to 20 kHz
Deviation	0 to 25 kHz
Input	
Sensitivity	1 kHz/10 mV rms
Connector	BNC
Impedance	600 Ω
Simultaneous	
Frequency	Internal 1000 Hz plus external 20 Hz to 20 kHz tone
Amplitude Modulation	
Internal	
Frequency	1000 Hz
Modulation Range	0 to 80%
Distortion	$\leq 5\%$ at 30% AM $\leq 10\%$ at 80% AM
External	
Frequency Range	20 Hz to 20 kHz
Modulation Range	0 to 80%
Distortion	$\leq 5\%$ at 30% AM $\leq 10\%$ at 80% AM
Input	
Impedance	600 Ω nominal
Connector	BNC
Simultaneous	
Frequency	Internal 1000 Hz plus external 20 Hz to 20 kHz tone
General	
Time Base**	
Aging	$\pm 6 \times 10^{-7}$ /year
Warm Up	<10 minutes at $\geq 20^\circ\text{C}$ to $< 1 \times 10^{-6}$ of final value <25 minutes at $\geq 25^\circ\text{C}$ to $< 3 \times 10^{-7}$ of final value
Power	115 Vac $\pm 10\%$, 50 - 400 Hz, 85 W 12 Vdc with external power inverter 230 Vac $\pm 10\%$, 50 - 400 Hz, 85 W
M-1 Option	
Temperature Range	
Operating	0 $^\circ\text{C}$ to +55 $^\circ\text{C}$ (32 $^\circ\text{F}$ to 131 $^\circ\text{F}$)
Storage	-40 $^\circ\text{C}$ to +75 $^\circ\text{C}$ (-40 $^\circ\text{F}$ to 167 $^\circ\text{F}$)
Dimensions	12-1/4 in. (31.2 cm) high 13 in. (33.1 cm) wide 18 in. (45.7 cm) deep
Weight (without plug-ins)	31 lbs. (14.1 kg)

*50 kHz to 20 MHz using Model 312 RF plug-in module. CE-5 is also usable from 810 - 890 MHz and 910 - 1010 MHz on harmonics.
 **Recalibration required at 6-month intervals during the first year; every 12 months thereafter to maintain specified accuracy.

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Cushman communications monitors.

Built with pride to outlast change.

Cushman Electronics was the first manufacturer to combine in one package the many test functions necessary for efficient maintenance of two-way radio systems.

Now there are three Cushman communications monitors to choose from, each with capabilities to fit your specific need. Plug-in modules and other accessory units customize your instrument for precise applications. And with advanced engineering flexibility built in, your investment is protected from obsolescence.

Cushman test instruments are found wherever exacting standards are demanded. This is true in the largest self-maintained communications system, and in the smallest commercial repair shop. And most major domestic manufacturers of two-way radios use our instruments in their own plants.

Traditionally, the applications of Cushman monitors have been in two-way mobile radio systems. But the versatility of the instruments has led to many other areas, including maintenance of personal paging systems, point-to-point microwave, and aviation navigational aids.

Cushman communications monitors. A family of radio test instruments that combines quality performance with user convenience. For years to come.

A family of products for versatility and economy.

The choice of communications monitors from Cushman allows you to achieve an exact fit between your application and the proper test instrument. You buy only the capability required in your service shop.



CE-6A. The newest and most versatile communications monitor. Tuning is continuous up to 1000-MHz range, with 100-Hz digital resolution. It provides the most exacting test system possible for AM, FM and single sideband radios.



CE-5. The middle of the Cushman line for users with frequency requirements between 20 MHz and 520 MHz. A plug-in module is available to shift the frequency range of the CE-5 to operate in the 50-kHz to 20-MHz range.



CE-7. Ideal for applications with a limited number of operating frequencies. 23 crystal-controlled channels can be selected between 20 MHz and 1150 MHz. The instrument also generates up to ten different crystal-controlled IF signals between 250 kHz and 20 MHz.

Radio
Maintenance
Products

Cushman

