AILTECH
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instrumentation and systems catalog

EATON

Advanced Electronics

The heart of Eaton's business is the application of advanced technology to the needs of our customers.

Innovation in the development of new products... in the manufacture of products ... in the improvement of existing products ... is the cornerstone of the company's success in its global transportation and industrial markets. Creative application of advanced technology will be the key to market leadership in the 1980's.

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Product Index by Model Number

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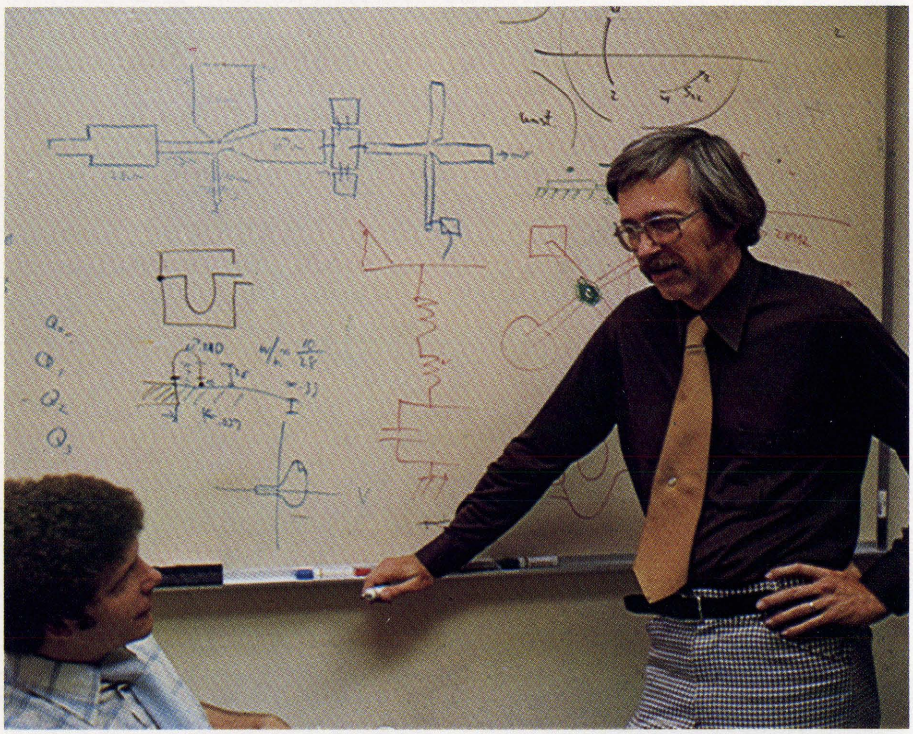
Eaton Corporation, Electronic Instrumentation Division

Eaton Corporation's Electronic Instrumentation Division is dedicated to the design/development, manufacture and sale of advanced electronic test and measurement equipment and systems. These products are based on advanced state-of-the-art electronic technology and meet the highest government and industrial standards of quality.

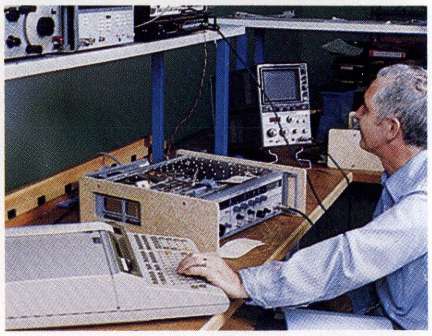
The present Electronic Instrumentation Division is an outgrowth of what was, at one time, a semi-autonomous operation within Eaton Corporation's AIL Division. Since 1966 the organization has designed, developed and manufactured electronic test and measurement equipment under the AILTECH trade name.



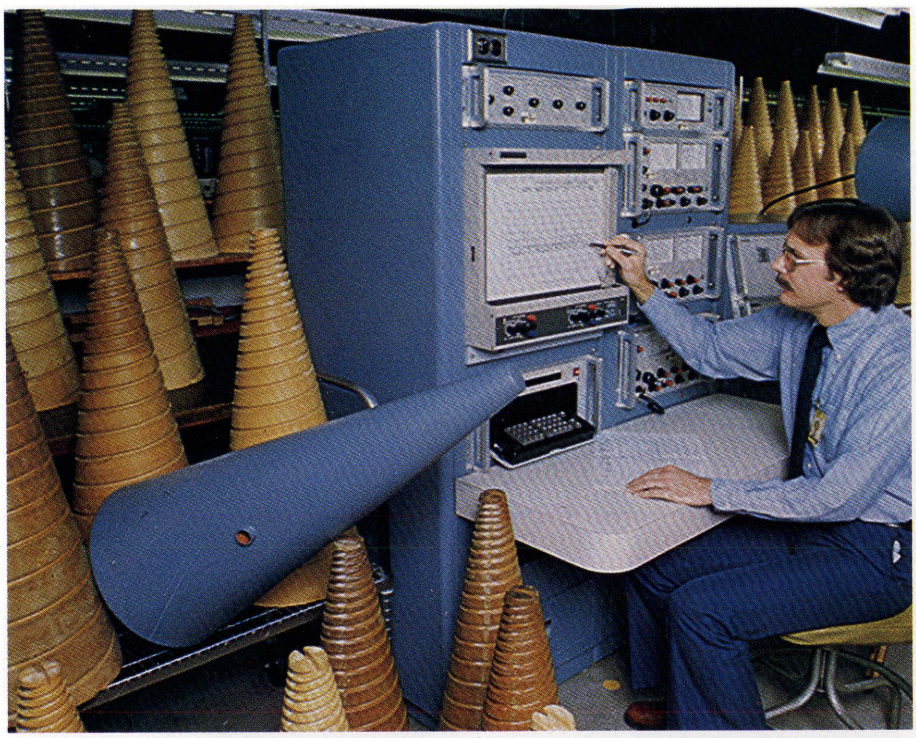
The Technical Director, discusses the design of wideband YIG-tuned oscillators.

Software development for microprocessor based instruments.

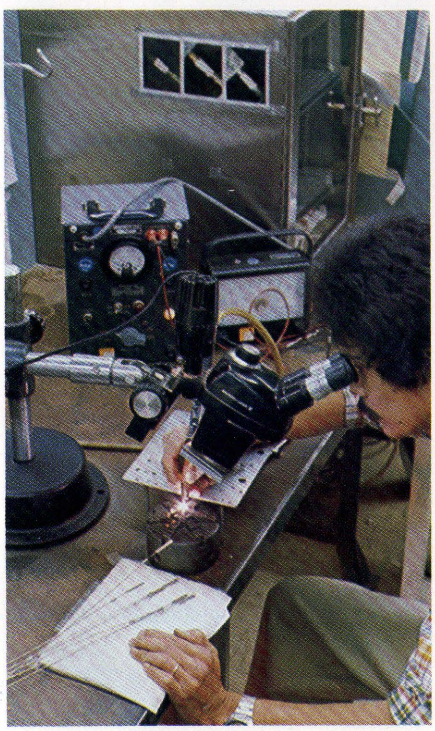
Advanced bonder-combines thermo compression and ultrasonic bonding.



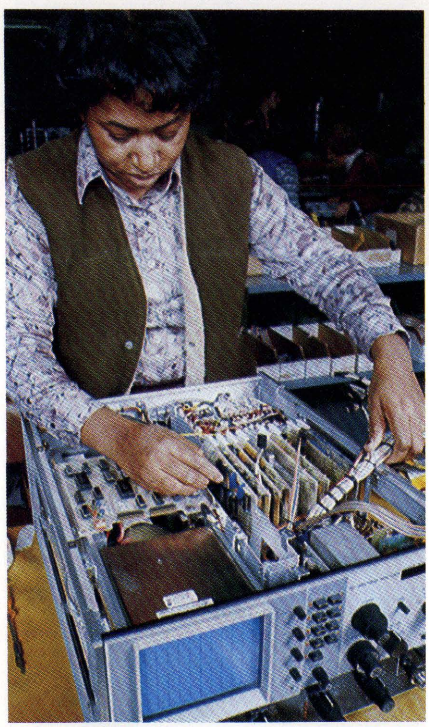
Automatic testing—460 Synthesizer.



Programming engineer checks out microprocessor controlled automatic EMI Data Collection System through the 20 Hz to 40 GHz range.



Microwelding Strain Gage assemblies under inert gas atmosphere.



Electrical assembly—757 Spectrum Analyzer.

From its headquarters in Ronkonkoma, Long Island, New York which is also a manufacturing facility, the Electronic Instrumentation Division directs the operation of modern plants in Los Angeles, California and Troy, Michigan. The Troy plant produces strain gauge measurement equipment under the Lebow trade name.

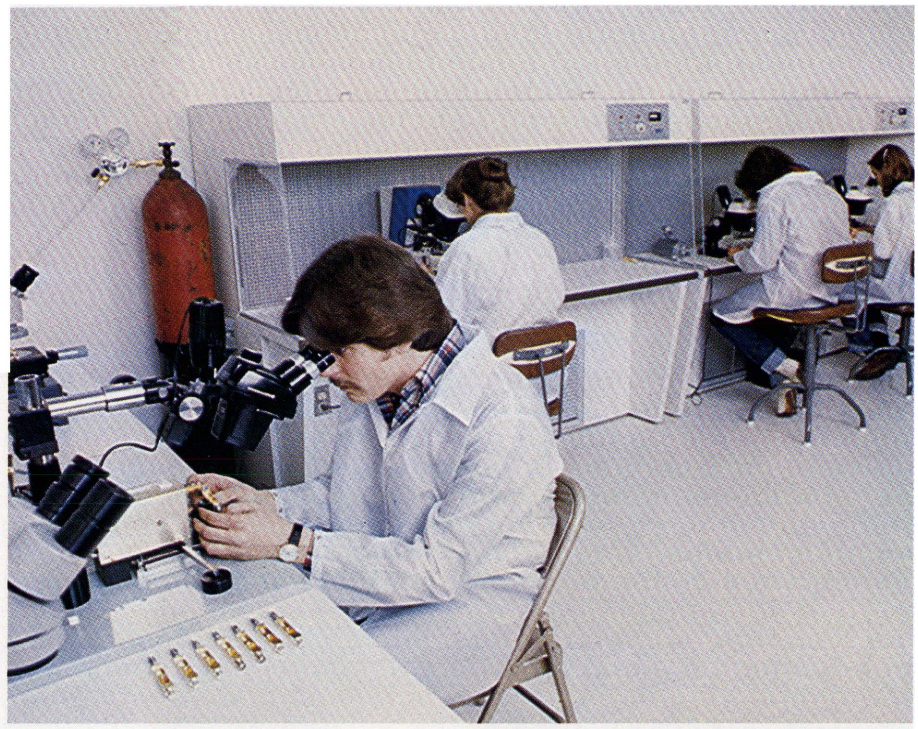
Staffing these facilities are over 600 engineering, manufacturing, quality control and field service personnel responsible for an annual sales volume approaching $40 million a year in high technology equipment.

Supporting the efforts of the four operating facilities are Electronic

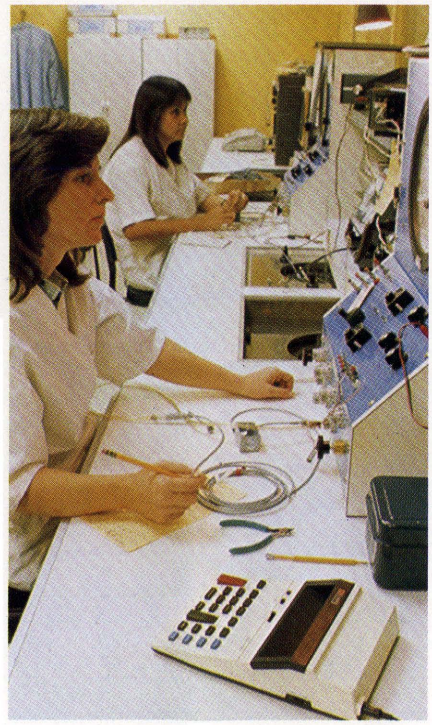
Instrumentation Division foreign sales service operations in the United Kingdom, France, Germany, Holland and Japan. A world-wide network of agents and representatives provide sales-service in even the out-most of market areas.

Recognizing the rapid advances in electronic technology which make products obsolescent in only a few years, the Electronic Instrumentation Division established a Microwave Component Development Center in Sunnyvale, California to further the state-of-the-art performance of AILTECH products.

Under the direction of Dr. Gunther Sorger, one of the nation's leading scientists, this modern research and development facility is

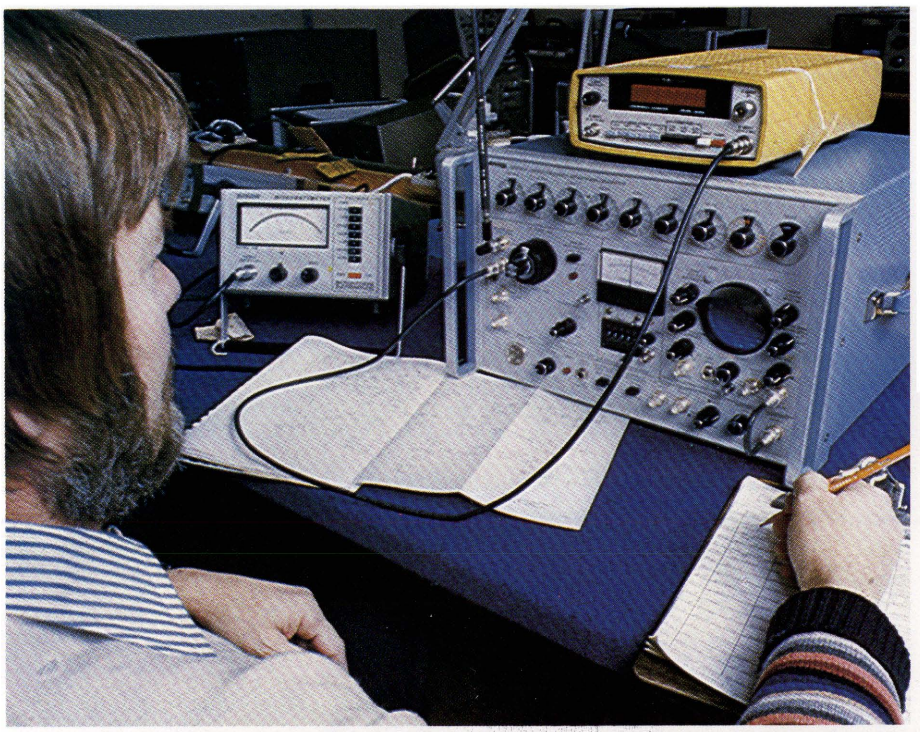


Microcircuit technology laboratory.

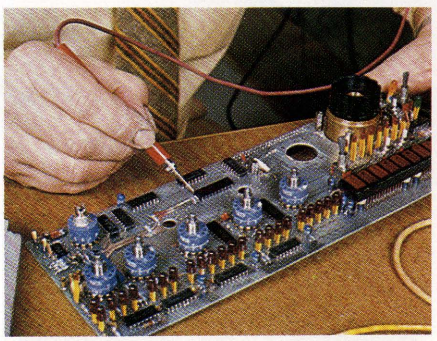


Calibration—Medical Pressure Transducers.

Stereo microscope inspection—Sweep Oscillators.



Field Service department — repair and recalibration



Assembly of synthesizer printed circuit board.

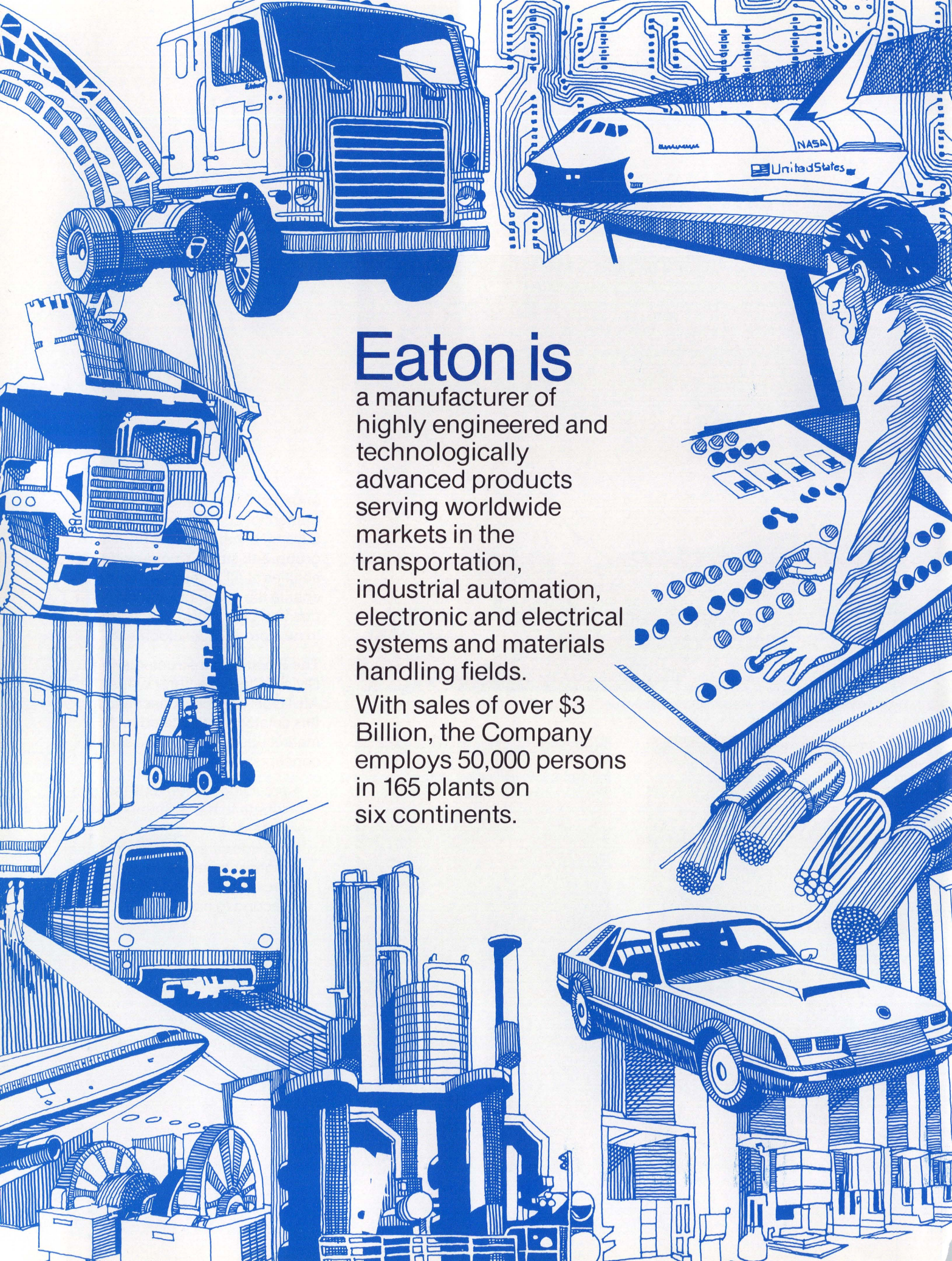
Bonding and welding — integrated circuits.

380 Synthesizer undergoes on-line inspection.

engaged in the design and development of components for advanced instrumentation. This group, and strong engineering capabilities at all of the plant locations, enable the company to maintain a position of technical leadership in new product development.

The Electronic Instrumentation Division, manufacturer of the AILTECH products described in this catalog, is dedicated in its market approach to three simple concepts:

- providing instruments that contribute to the technological state-of-the-art.
- provide sales assistance at the highest technical level.
- provide after-sales-service second to none.



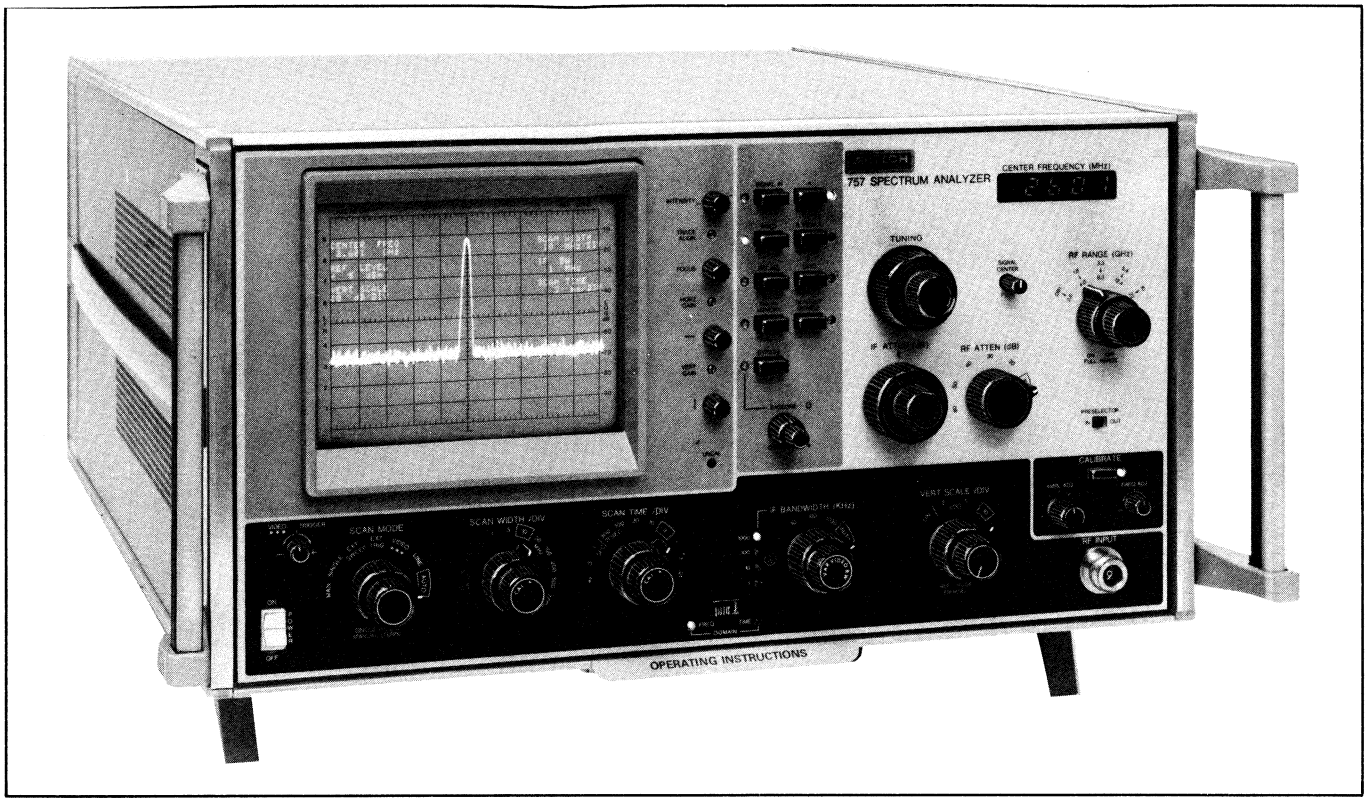
Eaton is

a manufacturer of highly engineered and technologically advanced products serving worldwide markets in the transportation, industrial automation, electronic and electrical systems and materials handling fields.

With sales of over $3 Billion, the Company employs 50,000 persons in 165 plants on six continents.

Model 757 Spectrum Analyzer

Superior Performance gives you Confidence in your Measurements



Designed for your Application

Communications

- High Sensitivity —
  —125 dBm/kHz up to 2 GHz
  —90 dBm/kHz from 12 GHz to 22 GHz
- Full Range Dispersion — up to 12 GHz
- Narrow Dispersion — down to 100 Hz/Div.

Radar

- High Selective Filters with 5:1 Shape Factors, Produce Well Defined Nulls
- Digital Storage — 1024 Horizontal Points and 512 Vertical Points Assures a Sharp, Accurate, Non-blooming Image
- Adjustable Video Trigger for ease of Synchronizing Modulation measurements

Production Test

- Remote Tuning
- Digitized Outputs
- Internal Calibration — All Bands
- Alphanumeric Readout of Controls on CRT

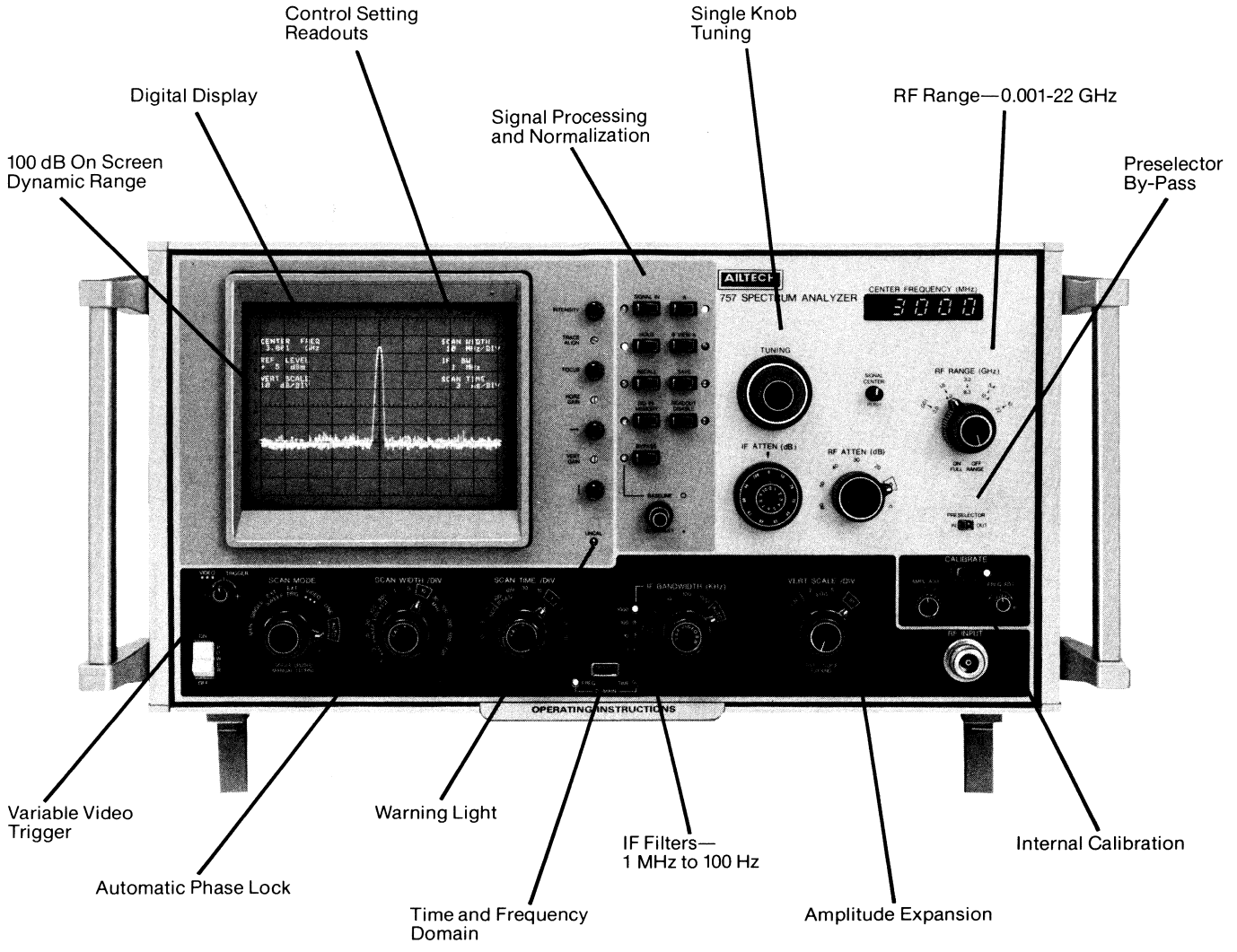
EMI/RFI

- 100 dB On-Screen Dynamic Range
- Very Low Spurious & Distortion Responses
- Wide Scans — Up to 12 GHz, Flicker Free Display
- Variable Bandwidth Selection

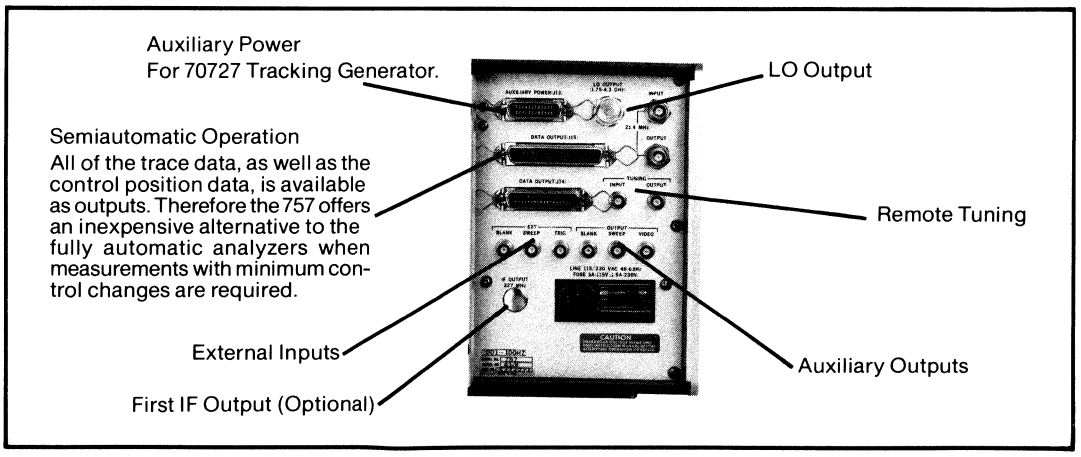
General Purpose

- Easy to Use
- Automatic Bandwidth Selection and Automatic Phase Lock
- Power Reference — Readout Follows Attenuators
- Uncal Light — reduces Chance of Operator Error
- Preselector Bypass — Increases Sensitivity by 10 dB
- Companion Tracking Generator — to 12 GHz

spectrum analyzer



REAR PANEL



AILTECH 757

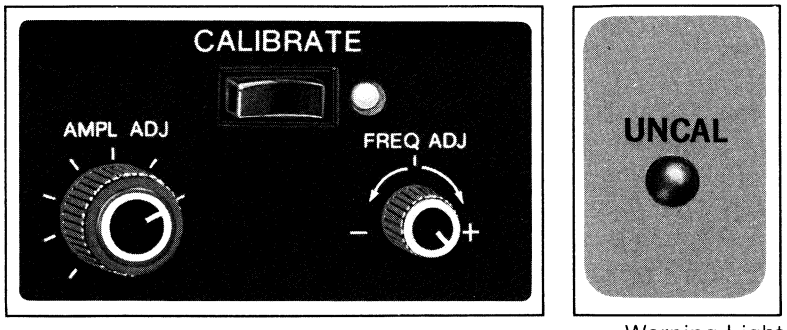
Features:

INTERNAL FREQUENCY AND AMPLITUDE CALIBRATION

The 757 Spectrum Analyzer provides more precise measurements with the addition of an internal 100 MHz Comb Generator. Calibration signals are generated in exact (±.005 percent) multiples of 100 MHz throughout the entire 22 GHz range of the analyzer. Signal frequencies can be typically measured to within ±1 MHz.

Also, the power level of the 1, 3, 5.8, 8.9 and 16 GHz calibration signals are specified to ±0.5 dBm, providing amplitude calibration for each frequency band. These values are noted on a calibration chart attached to the instrument.

Internal Frequency and Amplitude Calibration



Warning Light

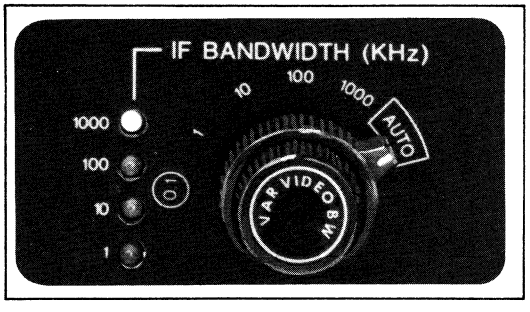
WARNING LIGHT

The 757 automatically cautions the operator when the display may be in an uncalibrated mode. Data misinterpretation is virtually eliminated, and an overall savings in measurement time is assured.

AUTOMATIC FEATURES

Complex measurements are made more easily with the 757 since it automatically stabilizes itself for narrow scan widths, and also selects the correct IF and video bandwidths. Thus, the operator has greater freedom to concentrate on the measurement data.

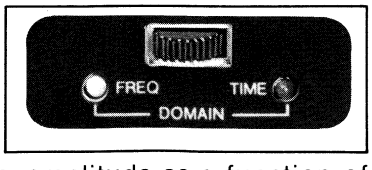
Automatic Features and LED Switch Indicator



LED SWITCH INDICATOR

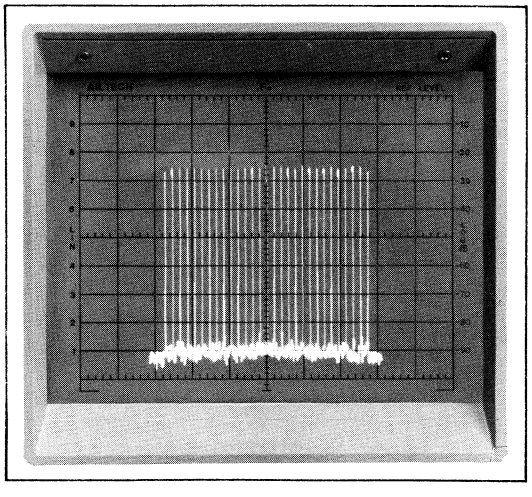
The status of the 757 controls is readily apparent, even from a distance, adding to the simplicity of operation that has always been a key feature in AILTECH spectrum analyzers.

TIME AND FREQUENCY DOMAIN



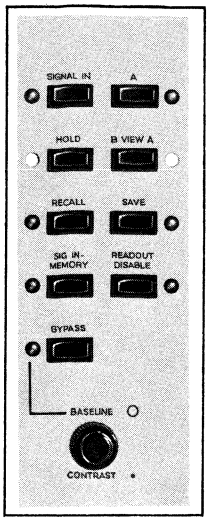
Converts the instrument from a standard swept frequency analyzer to a fixed frequency receiver displaying the signal's amplitude as a function of time. Very useful for AM and pulse analysis.

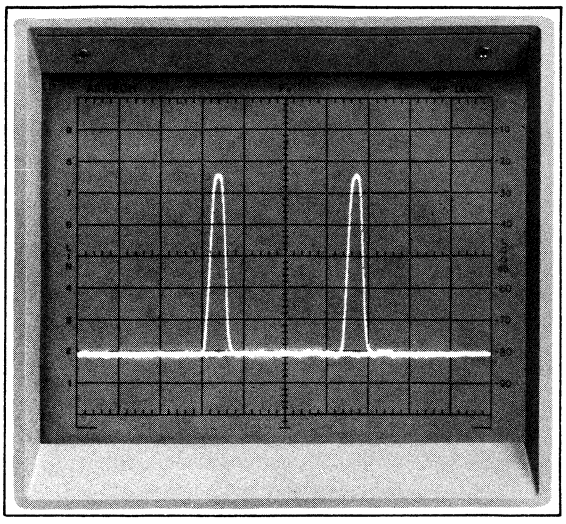
End of Band Blanking



END OF BAND BLANKING

An erroneous signal from "out-of-band" can never be present on the 757 to confuse an inexperienced operator, because all frequencies beyond the band of interest are blanked.

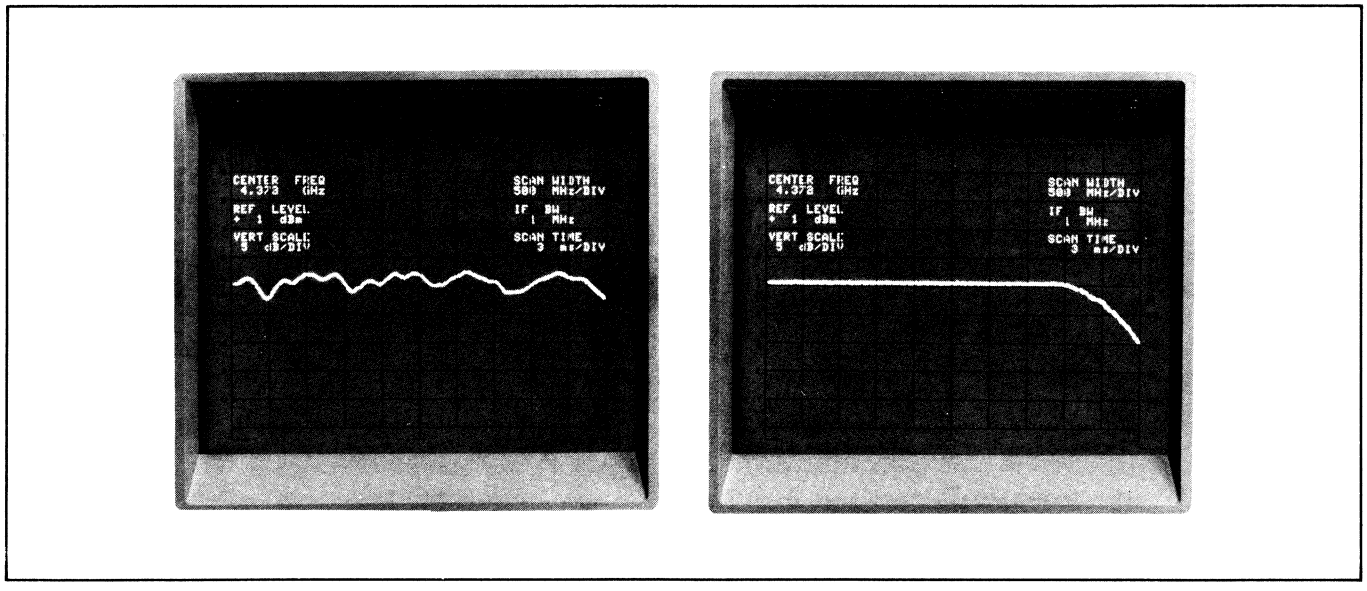




spectrum analyzer

SIGNAL PROCESSING

A modern, versatile display, incorporating the latest digital techniques, increases the usefulness of the 757. A flicker-free presentation is obtainable at all scan rates, through the temporary storage of the signal data in memory. Increased flexibility is provided for multiple trace analysis, by the addition of a second memory which allows the "infinite" storage of data for thorough analysis.



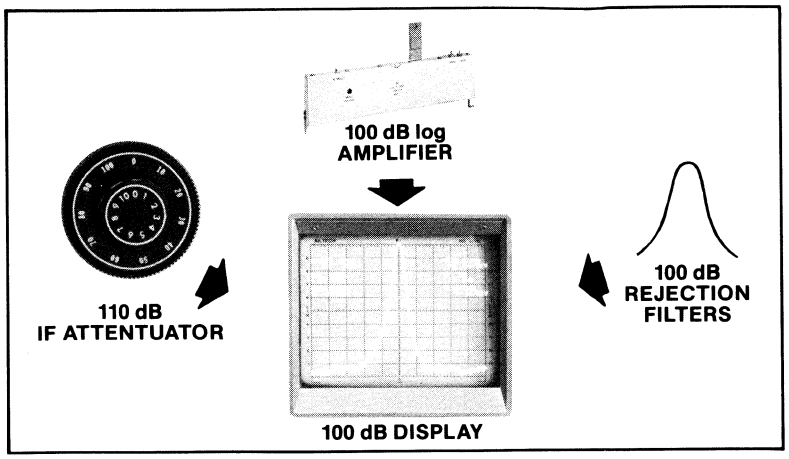
NORMALIZED DISPLAY

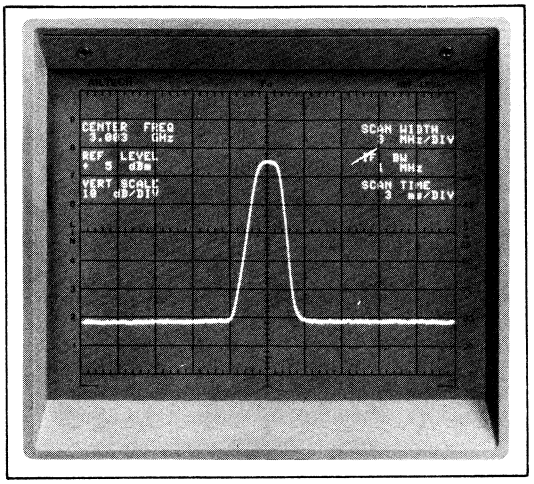
Improved accuracy results from the ability to normalize a measurement to the actual test set-up in use. The photos (above) illustrate a typical frequency response measurement of a low pass filter using the AILTECH 70727 Tracking Generator with the 757 Spectrum Analyzer. The left photo depicts the distorted response that normally results, due to the frequency response and mismatch errors of the test equipment. When these errors are placed in memory, by taking a calibration measurement with the filter short circuited, the normalizing feature allows the true response of the right photo to be obtained.

ALPHANUMERIC READOUT OF CONTROLS ON CRT

Operator convenience is enhanced with a CRT readout of the following analyzer operating conditions: Center-Frequency, Scan Width, Scan Time, IF Bandwidth, Reference Level and

Amplitude Scale. Rapid, permanent records of any measurement may easily be made by photographing the CRT. A "disable" pushbutton control is also provided to remove the data from the CRT, at the discretion of the operator.

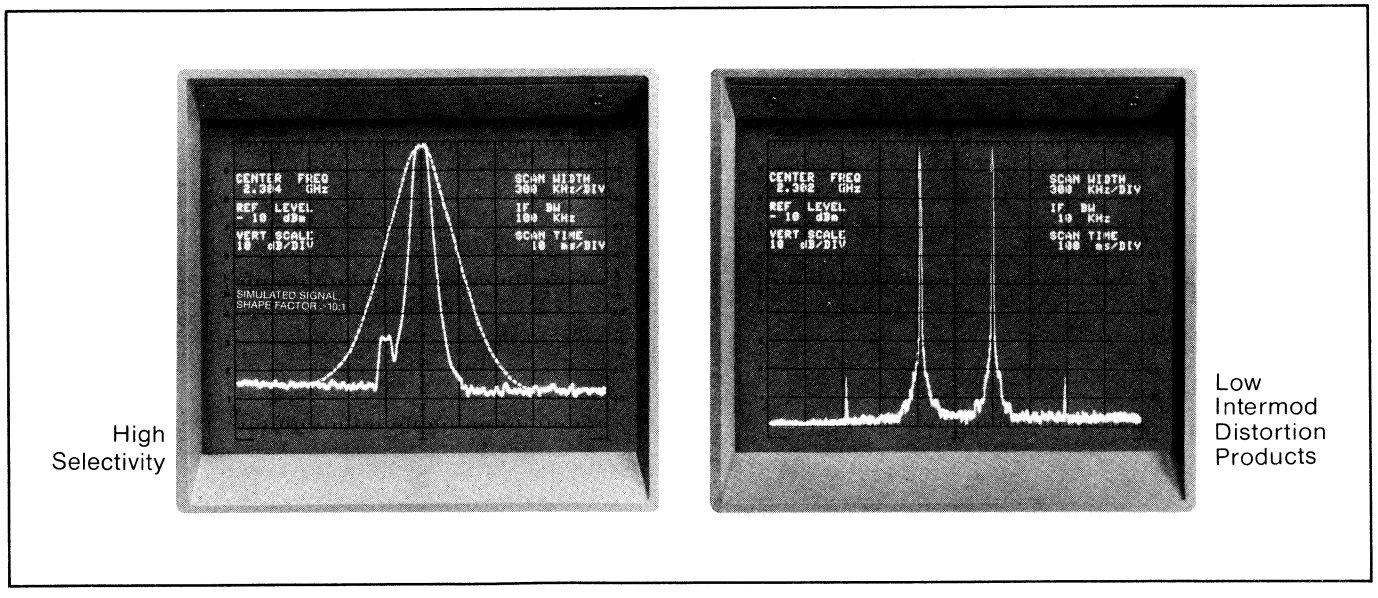




spectrum analyzer

100 dB ON-SCREEN DYNAMIC RANGE

Total 100 dB on-screen performance is attainable with the 757 Spectrum Analyzer. Low level noise and spurious signals, originating in oscillators, amplifiers, receiving systems, etc., can be viewed simultaneously with their high power fundamental output. Consequently, the effect of circuit changes can readily be observed on both the high and low power outputs.



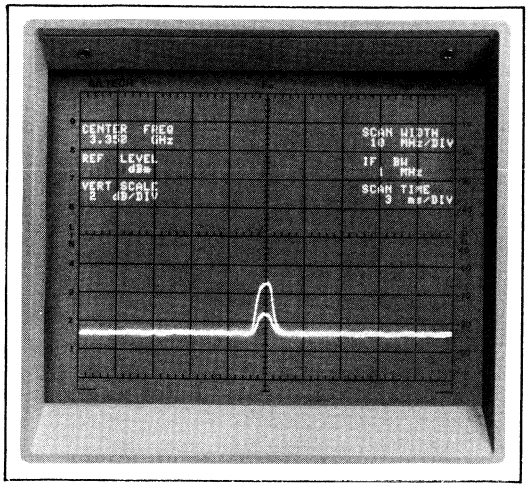
HIGH SELECTIVITY

The highly selective IF filters in the 757 (shape factor $< 5{:}1$) give the user two important advantages:

1. They minimize the possibility of overlooking a weak signal in the presence of a strong one, and
2. The nulls in a $(\sin x)/x$ spectral display of a pulsed signal are more clearly defined.

LOW INTERMOD DISTORTION PRODUCTS

Exact signal analysis can be more easily achieved using the 757 Spectrum Analyzer because of its extended dynamic range. As an example, the third order IMP's are guaranteed to be 100 dB below two —30 dBm signals from 1.8 GHz to 22 GHz. Thus, any small distortion products observed on screen will normally originate in the system under test.

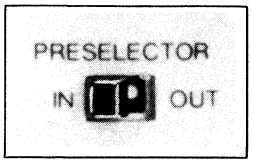


PRESELECTOR BY-PASS

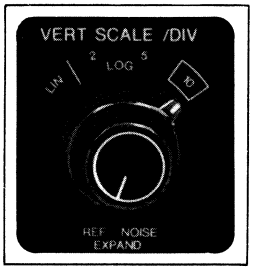
An increase in sensitivity of approximately 10 dB is attainable with the preselector by-pass. The average noise level is typically lowered to:

FREQUENCY	AVG. NOISE LEVEL
1.8-4.0 GHz	-120 dBm/kHz
3.3-8.3 GHz	-115 dBm/kHz
5.4-12.4 GHz	-110 dBm/kHz
10-22 GHz	-100 dBm/kHz

For many measurements, the cost and inconvenience of an external preamplifier can be saved.



Preselector By-Pass



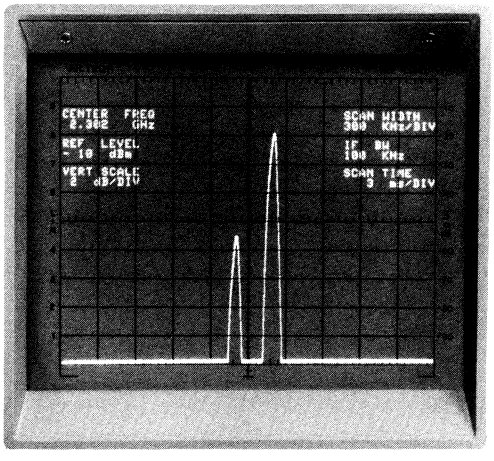
Amplitude Expansion Reference/Noise

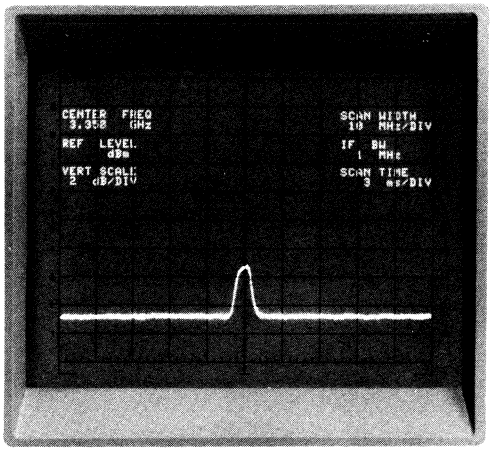
AMPLITUDE EXPANSION REFERENCE/NOISE

The amplitude expansion capability of an analyzer is usually required to satisfy either of the following needs:

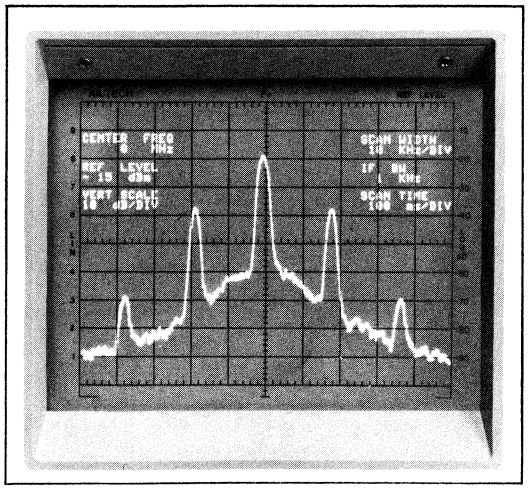
1. Accurately determine the difference between two strong signals (See photo below on left).
2. Amplify a very weak signal close to the noise threshold of the analyzer (See photo below on right).

Each of these needs is best satisfied with the 757, by offering the operator the choice of expanding from a Reference at the top of the display, or from the noise level at the bottom.





Low Frequency Measurements



LOW FREQUENCY MEASUREMENTS

A microwave engineer's occasional need to examine a low frequency signal can readily be satisfied with the 757.

Using the LO feedthru as a zero frequency marker, and the calibrated Scan Width switch, any signal below 1 MHz can be analyzed. The photo illustrates the typical sensitivity at 20 kHz is -87 dBm.

757 spectrum analyzer specifications

FREQUENCY SPECIFICATIONS

Frequency Range

Tuning Range: 0.001* to 22 GHz covered in 5 Bands.

Band 1	0.001*-2.0 GHz
Band 2	1.8-4.0 GHz
Band 3	3.3-8.3 GHz
Band 4	5.4-12.4 GHz
Band 5	10-22 GHz

*Usable down to 1.0 kHz.

Range Extension: With external converter to 60 GHz.

Frequency Dispersion

Fixed Scan: 14 Calibrated positions from 1 kHz/Div. to 700 MHz/Div.

Variable Scan: Additional control for selection of scan widths in between calibrated values. Reduction to zero scan possible.

Full Range Scan: The entire frequency range of each band can be displayed with a frequency marker positioned by the TUNING control. A signal identified by the marker becomes the center frequency when switched out of this mode.

Time Domain: Analyzer becomes fixed tuned (zero scan width) receiver. The demodulated signal is displayed as a function of time. Usable over entire frequency range.

Frequency Accuracy

Digital Frequency Readout: 0.2% from 2 to 22 GHz, ±6 MHz from 1 MHz to 1 GHz, ±8 MHz from 1 GHz to 2 GHz can be set to ±1 MHz at 100 MHz calibration intervals by Calibration Frequency Adjust control.

Scan Accuracy: Frequency span between any two points on the display is typically within ±10% of the indicated separation.

Residual FM: Less than 200 Hz peak to peak over entire frequency range of 0.001 to 22 GHz when phase locked.

Less than 10 KHz peak to peak for fundamental mixing (1 MHz to 4 GHz) non phase locked.

Noise Sidebands: For fundamental mixing with a 1 kHz IF bandwidth and 10 Hz video bandwidth.

Separation from Signal	Level below CW Signal
30 kHz	70 dB
90 kHz	80 dB
300 kHz	90 dB
1 MHz	95 dB

Frequency Resolution IF Bandwidth

Ranges: 1, 10, 100 and 1000 kHz.

Accuracy: 1 kHz typically 1.3 kHz ±20%; 10 kHz ±10%; 100 kHz ±10%; 1 MHz typically 1.5 MHz ±20%.

Selection Method: Automatic selection as a function of Scan Width and Scan Time. Manual override also provided.

Selectivity: 60 dB to 3 dB ratio of all filters <5:1, 100 dB to 3 dB ratio of all filters <10:1. Off resonance rejection of all filters >100 dB.

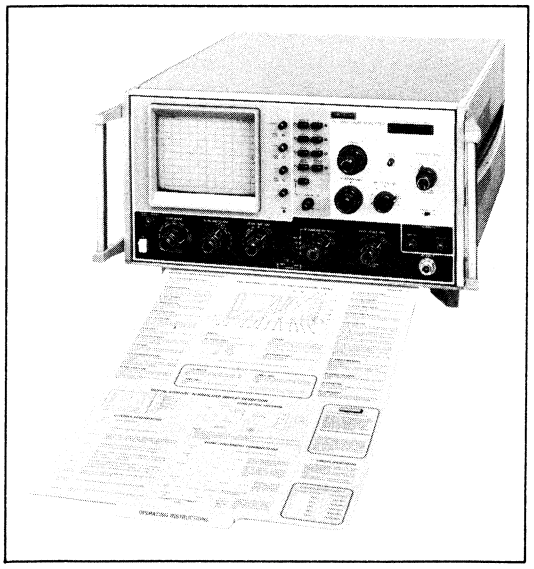
Video Bandwidth

Ranges: Variable from 10 Hz to 1000 kHz, or Fixed at 1, 10, 100, 1000 kHz.

Selection Method: Automatic selection of 1, 10, 100 and 1000 kHz filters with variable selector in OFF position.

Specifications subject to change without notice.

757 spectrum analyzer specifications



Pull-Out Information Card

Frequency Drift

Long Term: 3 kHz per 10 min., typical in phase lock, after 1 hour warm-up.

AMPLITUDE SPECIFICATIONS

Full Screen Display Range

Logarithmic: 100, 50 and 20 dB (10 DIVISIONS).

Linear: 1 μV to 10 volts (10 DIVISIONS).

Sensitivity

Average Noise Level in 1 kHz Bandwidth:

RF Range (GHz)	Avg. Noise Level (dBm)
0.001-2.0	-105*
1.8-4.0	-110
3.3-8.3	-105
5.4-12.4	-100
10-22	-90

*-125 dBm with 001Option

Residual Responses: Less than -90 dBm referred to signal level at RF input.

Preselector: Three pole filter normally 18 dB/octive, with 3 dB bandwidth typically varying between 25 MHz (at 1.8 GHz) to 90 MHz (at 22 GHz).

Frequency Response: (Flatness)

RF Range (GHz)	Response (dB)—Includes Preselector
0.001-2.0	±1.5
1.8-4.0	±2.0
3.3-8.3	±2.5
5.4-12.4	±2.5
10-22	±3.0

Out of Range Blanking: CRT trace is automatically blanked whenever the band edges are exceeded.

ABSOLUTE CALIBRATION

Internal calibration reference signals every 100 MHz. Power level specified at 1, 3, 5.8, 8.9 and 16 GHz. With amplitude adjust of Ref level accurate to ±1 dB.

Maximum Input Power: +20 dBm (0.1 watt) with 0 RF attenuation +33 dBm (2.0 watts) with 20 dB or more RF attenuation.

Relative Gain Variation Between RF Ranges: ±1.0 dB maximum.

IF Gain Variation with Different Bandwidth Settings: ±1.0 dB maximum.

RF Attenuator: 0-60 dB in 10 dB steps. Frequency response typically ±0.7 dB from 0.001 to 22 GHz.

IF Attenuator: 0-110 dB in 1 dB steps. Accuracy ±0.25 dB per 10 dB steps but not more than ±1.5 dB over full range.

Log Display Accuracy: ±0.2 dB/dB but not more than ±2 dB over 100 dB range.

Input Impedance: With RF attentuator at 0 dB. Typically
SWR: <1.5 0.001 to 2.0 GHz
<1.6 1.8 to 22 GHz at analyzer tuned frequency.

Spurious Responses

Second Harmonic Distortion

Frequency	Power Input	Distortion Level
0.001 to 1.8 GHz	-30 dBm	-70 dB
1.8-22 GHz	0 dBm	-120 dB

Specifications are continued on the following page.

Third Order Intermodulation Distortion

Frequency	Signal Separation	Power Input	Distortion Level
0.001-1.8 GHz	200 kHz	-30 dBm	-90 dB
1.8-22 GHz	200 kHz	-30 dBm	-100 dB
1.8-22 GHz	100 MHz	0 dBm	-120 dB

Image Response:

Frequency	Power Input	Distortion Level
0.001-2.0 GHz	Any	Non Existent
2.0-22 GHz	Any	-70 dB

Local Oscillator Emission at RF Input Port (RF Attenuator Set to 0 dB):

Frequency	Emission Level
0.001-2.0 GHz	-70 dBm typical
2.0-22 GHz	-75 dBm typical

LO Output: Swept LO typically from 1.7 to 4.5 GHz; Level typically 0 dBm.

Scan Time Specifications

Sweep Time: 11 calibrated sweep times from .01 msec to 10 sec with time domain/freq. domain switch which allows selection of time domain for all 11 positions and frequency domain for 8 positions.

Scan Time Accuracy: ±10% from 10 sec to .01 msec.

Display Specifications

CRT Phosphor: Aluminized P31 phosphor.

Graticule: 10 x 10 divisions, internal (parallax free).

Viewing Area: Horizontal 4.4 in. (11.18 cm)—Vertical 3.35 in. (8.51 cm).

Digitizing Sweep Rates: 10 sec/div through 3 ms/div.

Horizontal Resolution: 1024 data points.

Vertical Resolution: 512 data points.

Digitized Waveform Display: One or two waveforms which may be in an active, stored or normalized mode.

Readout Parameters Displayed: Center Frequency, Reference Level, Vertical Scale, Scan Width, IF Bandwidth, Scan Time.

Readout Enable: The readout may be enabled in all digitized modes and in the analog mode for a sweep of 3 msec/div.

Digital Waveform Bypass: The digital waveform may be disabled on any range, however, it will automatically be disabled on sweeps of 1 msec/div through .01 msec/div.

External Digital Output: Two rear panel connectors provide the digitized waveform data and the spectrum analyzer control positions.

The waveform data is available on one connector. Ten (10) bits of horizontal position data and nine (9) bits of vertical position data are presented in a binary weighted format with open collector outputs.

The six sets of control position data are in binary format with open collector output.

Three additional data lines are provided to indicate whether waveform data is:

1. From Channel A or B
2. From Input Memory or Recall Memory
3. Valid or Invalid

A strobe line clocks the output data.

Remote Tuning Voltage: DC voltage ±6 volts permits tuning to any frequency in any band.

757 spectrum analyzer specifications

Specifications subject to change without notice.

spectrum analyzer, options & accessories

GENERAL CHARACTERISTICS

TEMPERATURE RANGE

Operating: 0° to 55° C.

Storage: -40° to +75° C.

Humidity: 95% R.H. 0° to 40° C.

POWER REQUIREMENTS

Line Voltage: 115/230 VAC ±10%.

Line Frequency: 50/60 Hz—400 Hz Optional.

Line Power: Less than 220 watts.

DIMENSIONS

Height: 8¾ inches (222 mm).

Width: 16¾ inches; (425 mm). Rack mount adaptor available for 19" rack (P/N 757-49).

Depth: 21⅞ inches; (530 mm).

Weight: 65 pounds (29.5 kg.).

Options

001 Increased Sensitivity Option: A 20 dB gain amplifier is added at the first IF frequency reducing the noise figure of the analyzer over the full 0.001 to 2 GHz range, to 19 dB maximum. This permits a sensitivity with the 1 KHz bandwidth of better than —125 dBm.

002 Receiver Option: The 227 MHz first IF is brought out to a BNC Type connector on the rear panel with a bandwidth of 10 MHz. The conversion loss between the RF input signal and IF signal is typically 10 dB for fundamental mixing. This output is fixed tuned when the Time Domain mode is selected or the analyzer is operated in the phase lock mode.

014 Low Band Range Extension: The Low Band Range Extension to 1 KHz Option consists of 100 Hz IF Filter for improvement of signal to noise ratio and the low band 001 option to increase sensitivity from 1 KHz to 2.0 GHz.

—80 400 Hz Line Frequency: Permits operation of analyzer at line frequencies between 50 and 400 Hz.

—100 100 Hz IF Filter: The addition of a 100 Hz IF filter for narrow band applications. A signal to noise improvement of approximately 10 dB is achieved. The filter is selected manually via a front panel switch.

—300 300 MHz IF Filter: The addition of a 300 Hz IF Filter for narrow band applications. A signal to noise improvement of approximately 10 dB is achieved. The filter is selected manually via a front panel switch.

—46 Camera An economical, easy to use Tektronix C5A camera with a fixed focus lens, an aperture of f-16 (fixed), and an adaptable magnification of .67 or .85. A variable intensity flash lamp provides graticule illumination. The camera attaches directly to the display. It accepts 3000 speed pack film and operates on two AA penlight batteries.

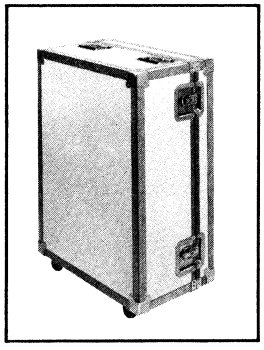
—47 Rack Mount: For rack mounting the 70726/70727 Tracking Generator. Consists of two angle tabs and required hardware. P/N 70747.

—49 Rack Mounting Adaptor: Consists of mounting brackets to provide a convenient means of mounting the spectrum analyzer in a standard 19 inch rack.

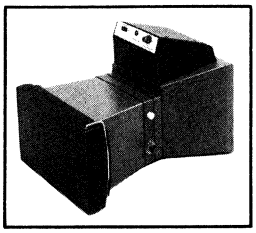
—50 Slide Mounting Adaptor: Consists of two sides and —49 Rack Mounting Adaptor which allow the slides to be mounted. The recommended slides are Jonathan Mfg. Co. P/N 310-L-18-22.

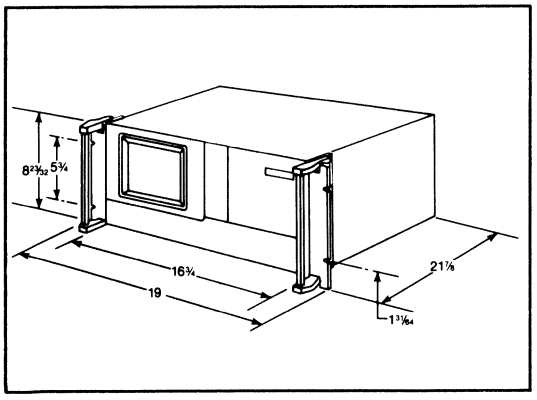
—51 Transit Case: Allows unit to be easily shipped.

Transit Case



Display Camera





70790 Comb Generator

For Alignment and Test of UHF-Microwave Instruments and Components

The AILTECH 70790 Comb Generator consists of a crystal-controlled, 100 MHz oscillator and a step-recovery diode multiplier. The oscillator, constructed in a small cabinet enclosure, is capable of delivering 500 milliwatts of signal to a 50-ohm load. This signal is used to drive the multiplier, mounted in a separate, in-line, coaxial package. The multiplier is stored on a removable panel inside the oscillator enclosure.

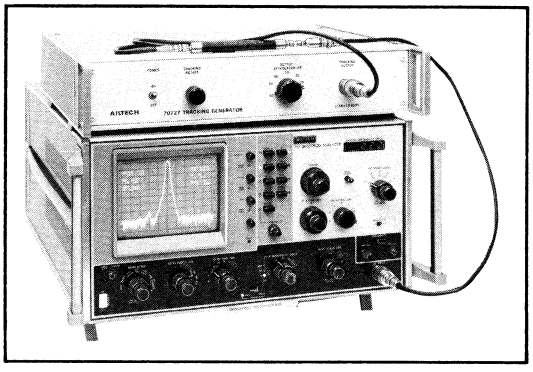
The output of the multiplier consists of a series of discrete signals starting at 100 MHz and extending well beyond 18 GHz. The frequency spacing between signals is exactly the frequency of the fundamental oscillator. This is a highly complex signal which, therefore, can be used for checking flatness, spurious signal generation, overload characteristics, and other wideband phenomena of broad-scanned receivers.

Specifications

Fundamental frequency: 100 MHz.
Accuracy: ±0.002%.
Fundamental oscillator output: 500 mW.
Multiplier output at 2 GHz: −10 dBm typical.
Amplitude decay 2 to 12 GHz: 25 dB typical.
Oscillator output connector: BNC female.
Multiplier input connector: BNC female.
Multiplier output connector: N male.
Power requirements: 115/230 VAC, 0.4/0.2A 50/60 Hz.
Size: Oscillator 3½" (H) x 8½" (W) x 13" (D) (8.9cm x 21.6cm x 33.0cm).
Multiplier 5" (L) x 1" Dia. approx. (12.7cm x 2.54cm Dia.).
Weight (shipped): 9 lb. (4.1kg.) total.
Weight (net): 7¼ lb. (4.1kg.) oscillator.
4 oz. (114g.) multiplier.

spectrum analyzer accessories

70727 Tracking Generator



The AILTECH Tracking Generators provide a signal in synchronism with any AILTECH Spectrum Analyzer modified with a 003 option (included in 757 model as standard) over the entire frequency range of 10 kHz to 12.4 GHz. They may be used as a swept frequency source to measure the frequency response of a device, or as a stable signal generator. With the aid of an external counter, they also allow precision frequency measurements to be made. A variable attenuator is provided to control the output power of each unit.

Specifications

Frequency Range: Controlled by 757 Spectrum Analyzer.

	Model 70727 10 kHz- 12.4 GHz
Output Power (Maximum)	
10 kHz-2 GHz	−5 dBm
2 GHz-4 GHz	−5 dBm
4 GHz-8 GHz	−15 dBm
8 GHz-12.4 GHz	−25 dBm

Flatness: (Across band with 10 dB attenuation). For narrow scans flatness is typically 2:1 better than specified.

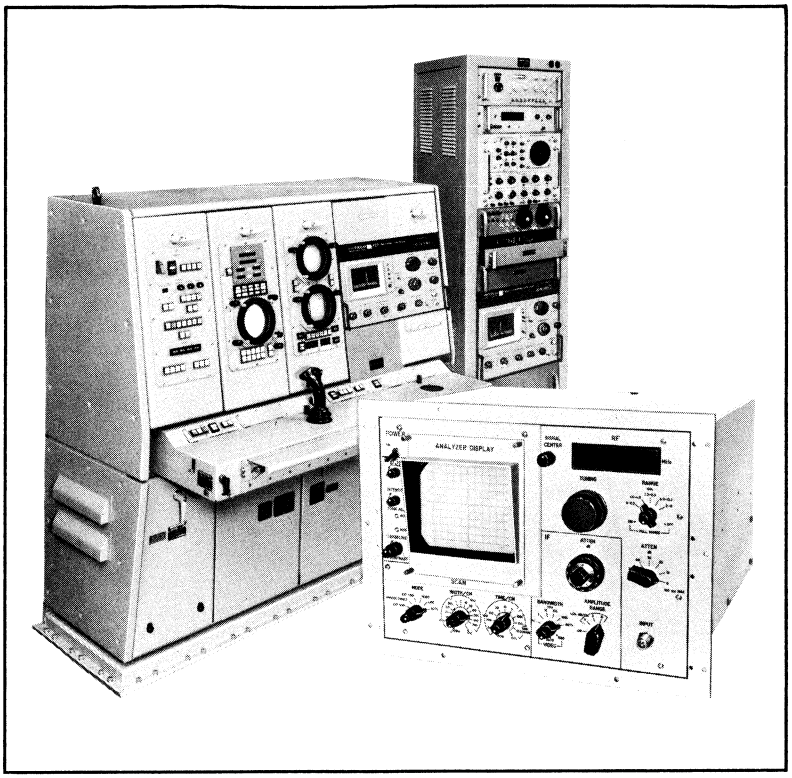
10 KHz-2 GHz (Typ)	± .5 dB
2 GHz-4 GHz (Typ)	±1.0 dB
4 GHz-8 GHz (Typ)	±2.0 dB
8 GHz-12.4 GHz (Typ)	±3.0 dB

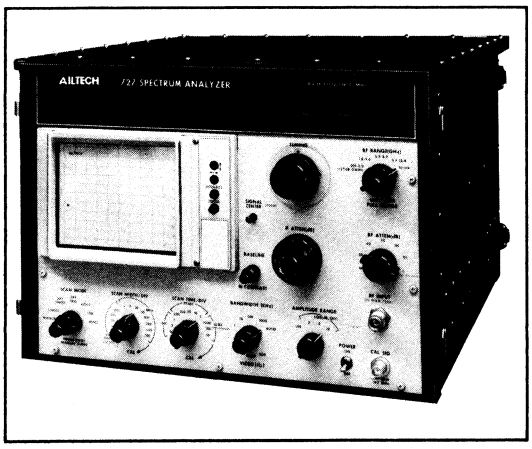
Spectral Purity

a. Residual FM, same as Spectrum Analyzer, unstabilized.
b. Spurious Responses.

10 kHz-2 GHz	>25 dBc
2 GHz-12.4 GHz	0 dBc

systematically planned spectrum analyzers





Systems designers around the world have selected the AILTECH Spectrum Analyzers as ideal test equipment for their Systems. They are presently serving satellite and general communications...radar...surveillance...automatic test of Aerospace vehicles...and many more applications.

The reason why is basically quite simple. AILTECH Analyzers provides everything systems designers need in one package. Standard features of cataloged laboratory instruments include: High sensitivity • YIG preselector • Variable persistence display with 100 dB on-screen capability • Frequency range to 22 GHz • Digital frequency readout • 10 kHz to 10 GHz scan width • Intermodulation distortion performance to 120 dB down • Automatic operation-filter selection, phase-lock, gain adjustment. Also...use as prescribed down converter—to 22 GHz.

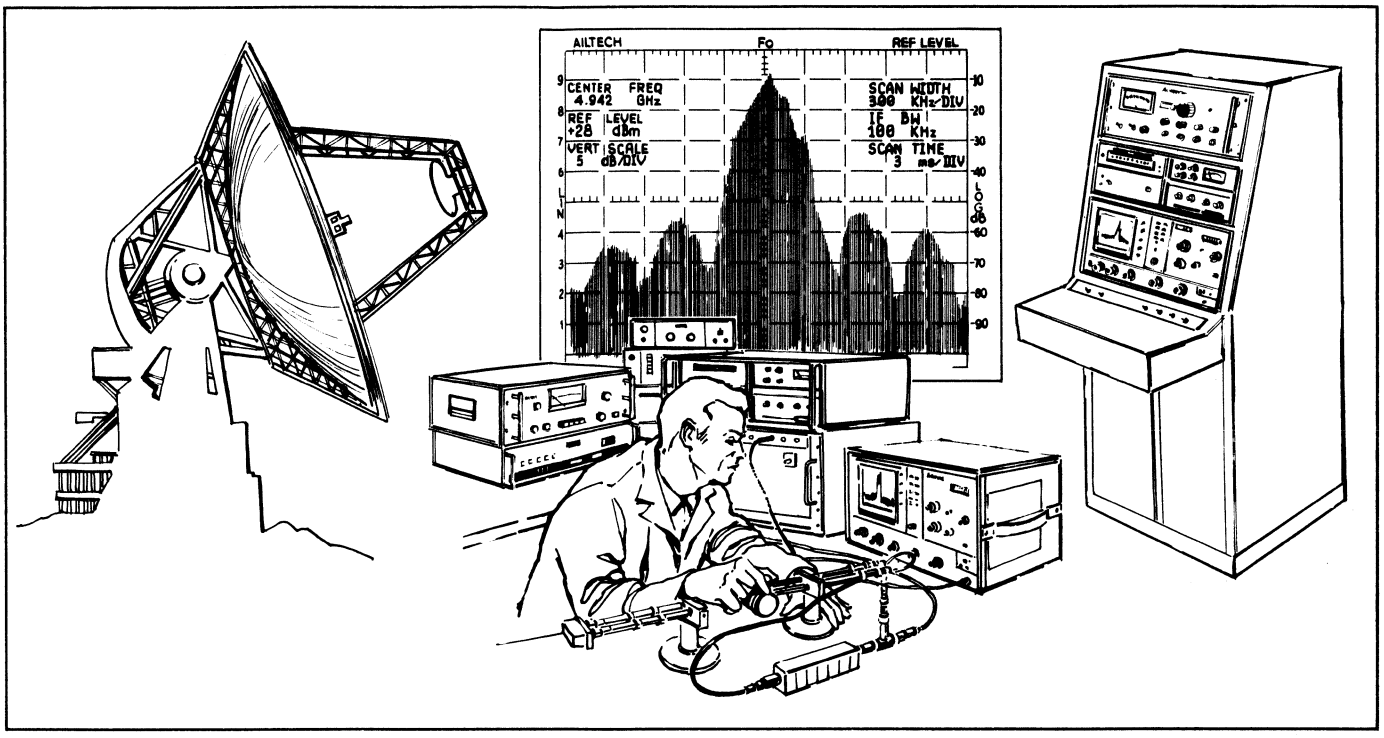
You can select an AILTECH Spectrum Analyzer to meet your system's requirement whether the emphasis is on cost-saving or on improved performance.

Does your application require...

- Wider IF bandwidths?...up to 8 MHz?
- Particular intermediate outputs?
- Increased IF gain?
- Custom modification of RF ranges for system need or economy?
- Special knobs, panels or paint colors?
- 400 Hz power?

AILTECH will make these, or other modifications of your choice, to help meet your need—exactly...and still retain the simplicity of operation which is the by-word of all AILTECH instruments. Call or write for a specific proposal and quotation to meet your requirements.

Notes: Spectrum Analysis



GENERAL CONSIDERATIONS

We feel that the most important point to consider in the design and use of a Spectrum Analyzer, or any other equipment, is YOU, the user.

It's your knowledge and skill that ultimately solves the problem. The test instrument should serve you easily, quickly and faithfully. You should expect and demand only the best.

In selecting a Spectrum Analyzer:

Look For...Ease of Use

- Uncluttered Panel and Controls
- Automatic Features
- Built-In Digital Storage Display
- Built-in Preselection

Demand...An Instrument Virtually **Free of Errors**

- Low Intermod Distortion Products
- Reduced Residual Spurs
- Narrow IF Selectivity
- The Elimination of LO Reradiation

and Be Assured...of **Superior Performance**

- 100 dB on-Screen Dynamic Range
- 10 GHz Wide Band Coverage
- 1 kHz/division Resolution
- −125 dBm/kHz Sensitivity

You can have the best...and it need not cost more.

We have prepared this section as a guide for engineers and technicians who have requirements for signal analysis in the frequency domain. We believe we have presented the key points to consider when specifying and using a Spectrum Analyzer. The questions we are most often asked are answered in sufficient detail to enable you to obtain maximum performance from an analyzer. Several practical applications are also presented for your general understanding.

We trust that this section will be helpful to you in your work.

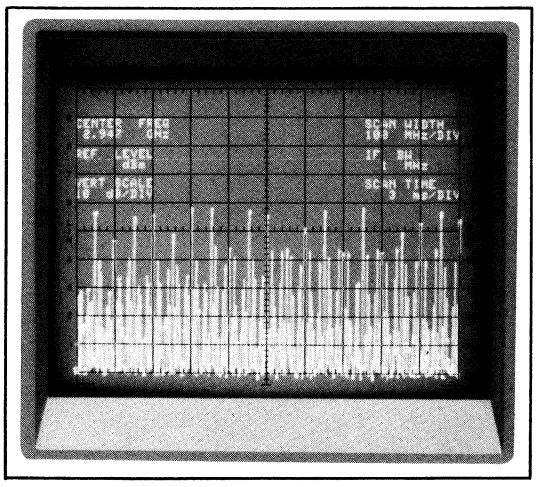


Figure 1
Analyzer Performance Without Preselector

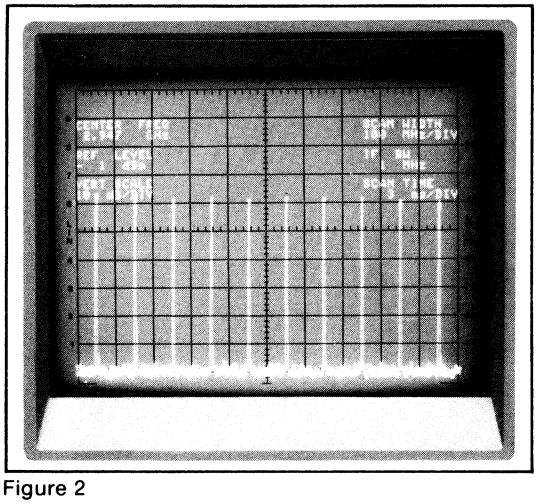
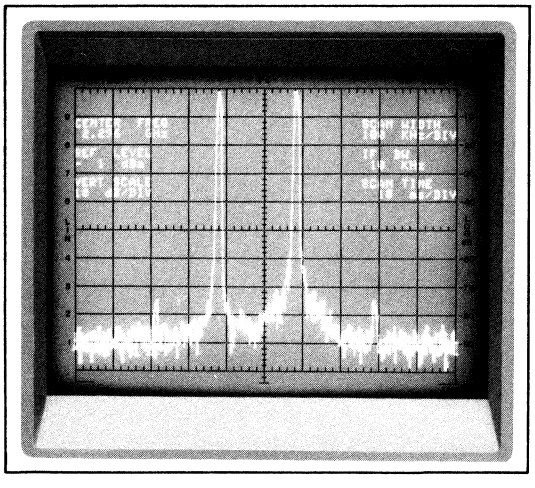


Figure 2
Analyzer Performance With Preselector

spectrum analysis

Figure 3
3rd and 5th Order Intermods



Specific Points to Consider Regarding Spectrum Analyzers

PRESELECTION

What is a Preselector?

The Preselector is a tracking bandpass filter, synchronized to the swept LO signal. It acts as a moveable window through which the input signals must pass.

Should a Preselector be a part of my analyzer?

A Preselector greatly enhances the performance of the analyzer. For optimum use of the instrument a preselector should be considered mandatory.

How does it enhance the performance of the analyzer?

The Preselector virtually eliminates the false responses that are present in all heterodyning processes...images, harmonic responses, intermodulation products and other non-linear responses.

The amount of LO emission from the input connector is also substantially reduced.

Including a preselector is a big step toward taking the Spectrum Analyzer out of the "experts only" class and making it useful for the average person.

Where is the Preselector located?

It can be housed in an external case, or built-in as an integral part of the analyzer.

Which is best?

The advantages of the built-in approach are many and they far outweigh the external arrangement. For example:

1. The LO of the analyzer and the Preselector are both YIG devices and as such are somewhat temperature sensitive. By locating both units close together in the same thermal environment tracking problems are substantially reduced.
2. The insertion loss of the preselector and its matching networks do not come as a "surprise" to the user since they are included in the analyzer's sensitivity specifications.
3. The RF attenuator of the analyzer is situated ahead of the preselector, thereby eliminating input VSWR problems and preventing damage to the preselector.
4. No separate calibration is required.
5. No special interconnection cables are required.

INTERMODS

What are intermods?

When two strong signals impinge upon a non-linear device such as a mixer, the signals and their harmonics interact with each other and produce distortion products which have the appearance of real signals. These are called intermods.

Does the preselector get rid of IM's?

Yes, but only when the fundamental signals are separated by more than the bandwidth of the preselector.

Which IM products are particularly troublesome?

IM products are defined by their order number (n + m). For example, the fundamental (n = 1) of one signal mixing with the second harmonic of the other (m = 2) produces a 3rd (n + m) order product.

In most cases the lower, odd order products are the most troublesome, since they occur near the fundamental frequency and are generally strong in amplitude.

How can you tell if they originate in the external system or within the analyzer itself?

Using the RF attentuator, decrease the signals amplitude by 10 dB. If the IM's are from the external system, they will also decrease by 10 dB. If they are caused by the analyzer itself, they will go down (n + m) times the fundamental.

How can my analyzer be tested for its intermod performance?

The test circuit shown in Figure 4 is recommended but care must be taken to isolate the test signals so they will not produce distortion products within themselves.

Adjust the amplitude of each signal generator to −10 dBm. Observe the signals on the Spectrum Analyzer. Performance can be predicted at any other input level by reducing the 3rd order IM by 30 dB for each 10 dB reduction of the input signal. For example, if the 3rd order IM is 40 dB down (−50 dBm) from the −10 dBm input signals, it will be 60 dB down (−80 dBm) from two −20 dBm signals and 80 dB down (−110 dBm) from two −30 dBm signals.

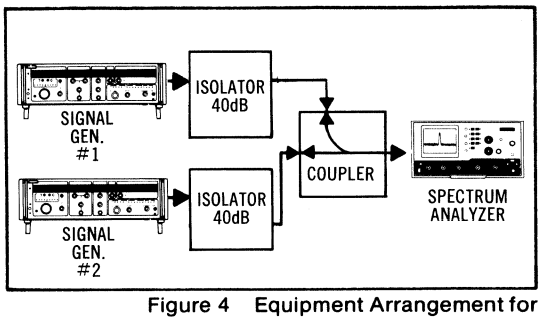


Figure 4 Equipment Arrangement for Intermod Performance Test

spectrum analysis

DIGITAL FREQUENCY READOUT

How is the frequency of the input signal displayed?

There are two generally accepted ways:

1. A mechanical, slide rule type of indicator.
2. An electronic, digital display.

Which is best?

The electronic, digital display is greatly preferred because:

1. It is more accurate.
2. It is more reliable and easier to service.
3. It provides a resolution of ±1 MHz.
4. It can be observed more easily from a distance.

FREQUENCY DISPERSION

What factors are important regarding frequency dispersion?

A good, general purpose Spectrum Analyzer will provide you with wideband coverage for ELINT useage, EMI measurements and harmonic analysis. It will also give you narrow band capability to look in close for detailed analysis.

How wide and how narrow a scan is practical?

With the AILTECH analyzers, you can view a full 10 GHz spectrum, the widest available from any supplier.

We also provide superior resolution by offering a scan width as narrow as 1 kHz/division.

PHASE LOCK

What does the term "phase-lock" mean?

The term refers to a common means of reducing the frequency instability of an oscillator by comparing its output to a stable reference, such as a crystal.

What is the advantage of this feature?

All the frequency jitter caused by the first LO is removed permitting the frequency stability of the input signal to be easily and accurately measured.

Can the analyzer be tuned in this mode?

For optimum use, it should be possible. With the AILTECH analyzer you can use both fine and coarse tuning. On some other units, the signal will disappear if the coarse control is touched.

IF FILTERS

What should the user be concerned with regarding IF filters?

In general the following points should be considered:

1. Bandwidth
2. Shape factor
3. Method of selection

What BW filter should be used?

Your selection depends upon your use. If you need to separate signals that are spaced close together, say 100 kHz, then a narrow filter is required...10 kHz would be a good choice. However, if your need is more in the area of broadband surveillance, a wide filter will let you scan rapidly without encountering distortion.

Experience has shown that most microwave signal analyses can be accomplished with filters having a 3 dB bandwidth between 1 kHz and 1 MHz.

What are the dangers of using filters narrower than 1 KHz?

While there is an occasional need to use smaller bandwidths, the following points should be kept in mind:

1. Most microwave signals are not stable enough to remain within a narrow filter. If the user doesn't recognize this fact, he could get distorted measurements.
2. The narrower the filter, the slower the required scan time. As a result, higher cost storage displays are always required.
3. Minimum scan widths should be of the same order of magnitude as the filter bandwidths. This adds cost and complexity.
4. Thermal drifts make a narrow filter extremely difficult to use until the entire analyzer is completely warmed up.

What is meant by Shape Factor?

Shape Factor is defined as the ratio of the filter width at 60 dB to the width at 3 dB.

What is considered a good shape factor?

Generally, the smaller the better—5:1 is presently the best available.

What is the advantage of a small shape factor?

It minimizes the possibility of overlooking a weak signal in the presence of a strong one.

With a large shape factor you must constantly search by switching to a narrower filter and readjusting the scan time to remain calibrated.

Why is the means of filter selection important?

Any means of choosing the filter that supplies the user with the information he desires is adequate. However, if the selection is **automatic,** as with AILTECH Analyzers, the operator is free to concentrate on his problem, not on the use of his test equipment.

A manual override is an advantage for occasional special applications.

What is meant by Automatic Selection?

For every combination of Scan Width and Scan Time that is set, the narrowest IF filter will be selected that does not distort the signal.

What function do the Video Filters provide?

Video filters are low pass devices which are generally used to adjust the noise content in the demodulated signal.

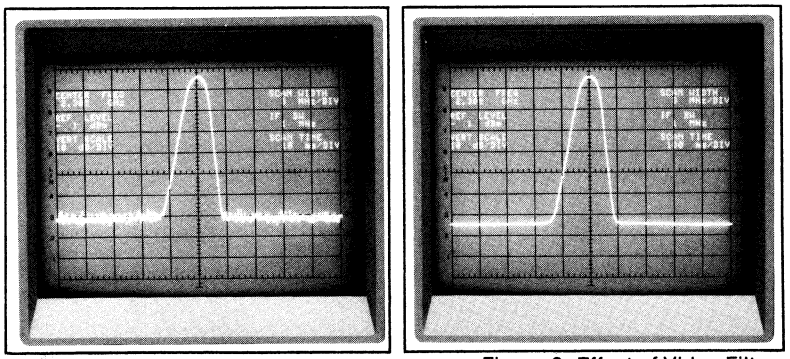
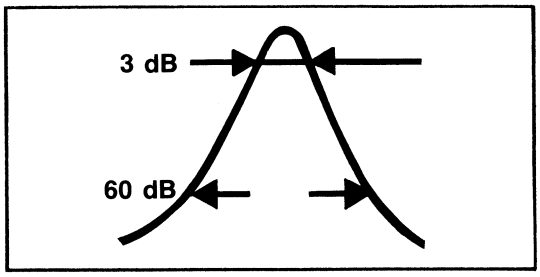


Figure 9 Effect of Video Filters

Figure 7
Filter Shape Factor



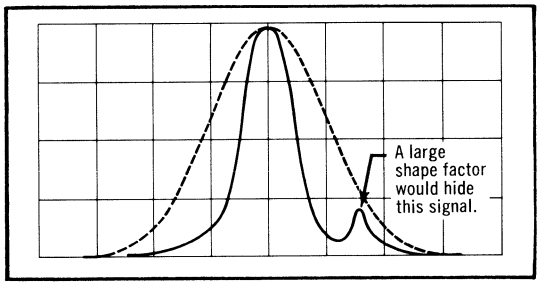
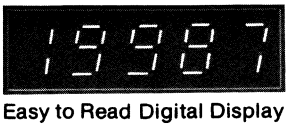


Figure 8
Comparison of Small and
Large Shape Factors

spectrum analysis

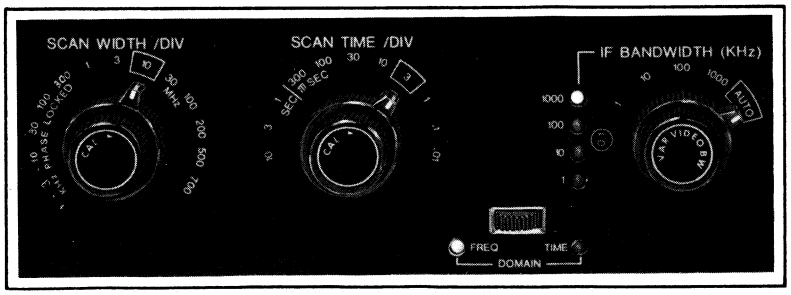
EATON has you in mind with...

- All Electronic, Digital Frequency Display
- 10 GHz Wide Dispersion and 1 kHz Resolution
- Automatic Phase Lock
- Automatic Selection of Filter Bandwidth
- Filter Shape Factors of < 5:1



Easy to Read Digital Display

Figure 10
Phase Lock and
Filters—Automatic Selection



spectrum analysis

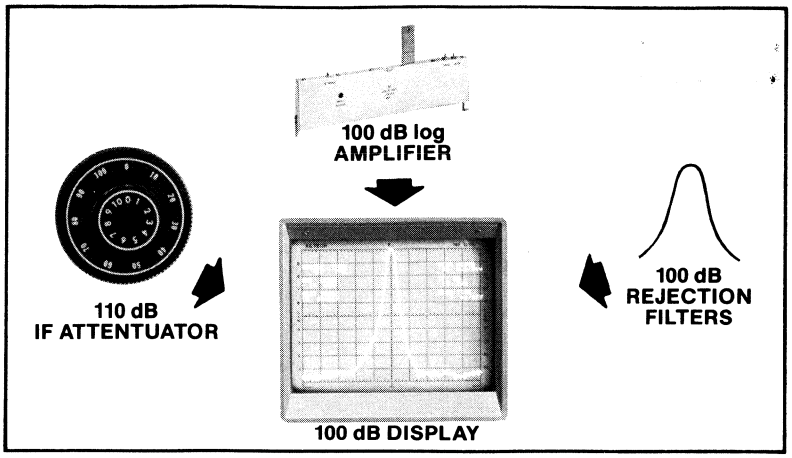


Figure 11
Total 100 dB Performance

DYNAMIC RANGE

What is meant by "Dynamic Range"?

In general, the dynamic range of an intstrument is the ratio between the largest and smallest signals that can be accurately measured.

However, a more practical definition limits the maximum and minimum levels to those that can be simultaneously observed. For Spectrum Analyzers, this is generally termed **"on-screen dynamic range".**

What is the best available on-screen dynamic range?

AILTECH analyzers provide a full 100 dB display range, the best available.

Can you give an example of how this range could be useful?

EMC and ELINT requirements can be more easily and thoroughly satisfied since multiple signals differing in amplitude, by more than one billion-to-one, can be observed.

In addition, low level noise and spurious signals originating in oscillators, amplifiers, receiving systems, etc. can be viewed simultaneously with their high power fundamental output. Consequently, the effect of changes can readily be observed on both the high and low power outputs.

What limits the total dynamic range?

The sensitivity of the analyzer limits the low end, and the **"burn-out"** specification of the analyzer limits the high end.

Is "burn-out" a typical problem with spectrum anaylzers?

Unfortunately, yes. It is quite easy for a user to be so engrossed in a measurement that he momentarily forgets to adjust the RF attentuator for a high power signal.

What is the maximum power level an analyzer can withstand when the RF attentuator is set to 0?

Most units specify a +13 dBm power level as maximum. AILTECH units, however, can accept +20 dBm without damage ...a 5:1 safety improvement.

If an analyzer does get damaged by high power, is it easily repairable?

There is no stock answer to this question. A potential buyer should investigate this for himself.

At EATON we have made "MAINTAINABILITY" one of our original design concepts. The result is that all microwave components are mounted on a hinged deck and are accessible within a few moments. The video processing circuits are mounted on plug-in PC cards with sockets for all the integrated circuit components. Furthermore, the display is a modular unit which can be either repaired externally or replaced in its entirety.

SENSITIVITY

How is the sensitivity of a Spectrum Analyzer specified?

It is the average power level of the internally generated noise in a 1 kHz bandwidth.

Is this level the same as the minimum discernable signal?

If the analyzer contains a built-in preselector, the insertion and matching losses are included in the sensitivity specification. For this configuration the answer is yes, the level is essentially the same.

If, however, an external preselector is used, a reduction of about 8 dB must be made for its insertion loss. Furthermore, the mismatch between the preselector and the analyzer will degrade the frequency response unless some additional attenuation is used. The over-all result could be a decrease of 15 to 20 dB in actual sensitivity to the user.

What is the result of changing the IF bandwidth?

The sensitivity will increase by 10 dB for every 10:1 decrease in bandwidth.

Is this also true for the Video filters?

No. The Video filters are low pass devices that average the noise in the demodulated signal.

Can Video filters improve sensitivity?

Video filters cannot increase the absolute sensitivity, but additional noise filtering does enhance the signal visibility.

What is meant when the term "noise figure" is used in reference to a Spectrum Analyzer?

It is merely another way of specifying the analyzer's sensitivity. Noise figure is defined as the ratio (difference in dB), between the average noise power level of the analyzer and the average noise power level of an ideal network.

For example:

Ideal	$P_I = kTB =$	-144 dBm/1 kHz
Analyzer	$P_A =$	-110 dBm/1 kHz
	N.F. =	34 dB

Can the noise figure be improved?

Yes, by placing a preamplifier ahead of the analyzer. The over-all noise figure is then computed by reflecting the noise figure of the analyzer to the input of the preamplifier and summing it with the noise figure of the preamplifier, as shown below.

$$NF_{TOT} = NF_1 + \frac{NF_2 - 1}{G_1} \qquad \text{(typically} < 10 \text{ dB)}$$

where subscript 1 refers to the preamplifier and 2 to the analyzer.

spectrum analysis

Figure 12
Arrangement for
Reduction of Noise Figure

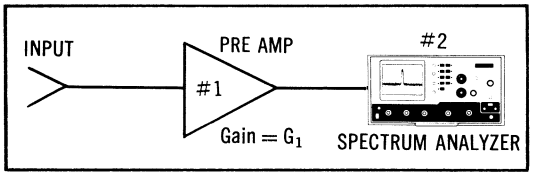
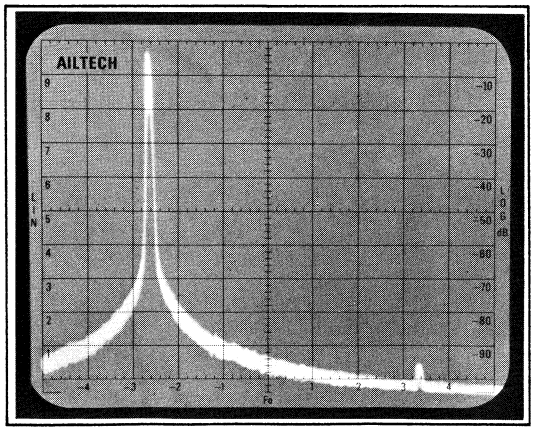


Figure 13 High Sensitivity
With 100 dB Dynamic Range



spectrum analysis

Does this offer any unique advantages?

EATON makes its IF available as an output on the rear panel. Therefore, the improved sensitivity converts the analyzer into a useful broadband receiver having the stability of a crystal oscillator over the entire frequency range of .001 to 20 GHz.

Application Notes

The basic theoretical analysis of CW, AM, FM and pulse signals in the frequency domain is discussed at length in many other texts. The following notes are presented to give the user a guide to more practical measurement techniques that are easily attainable with a Spectrum Analyzer.

COMPONENT PERFORMANCE VS. INPUT POWER

The test arrangement shown in Figure 14 provides a permanent graphic record of a component's characteristics as a function of input power.

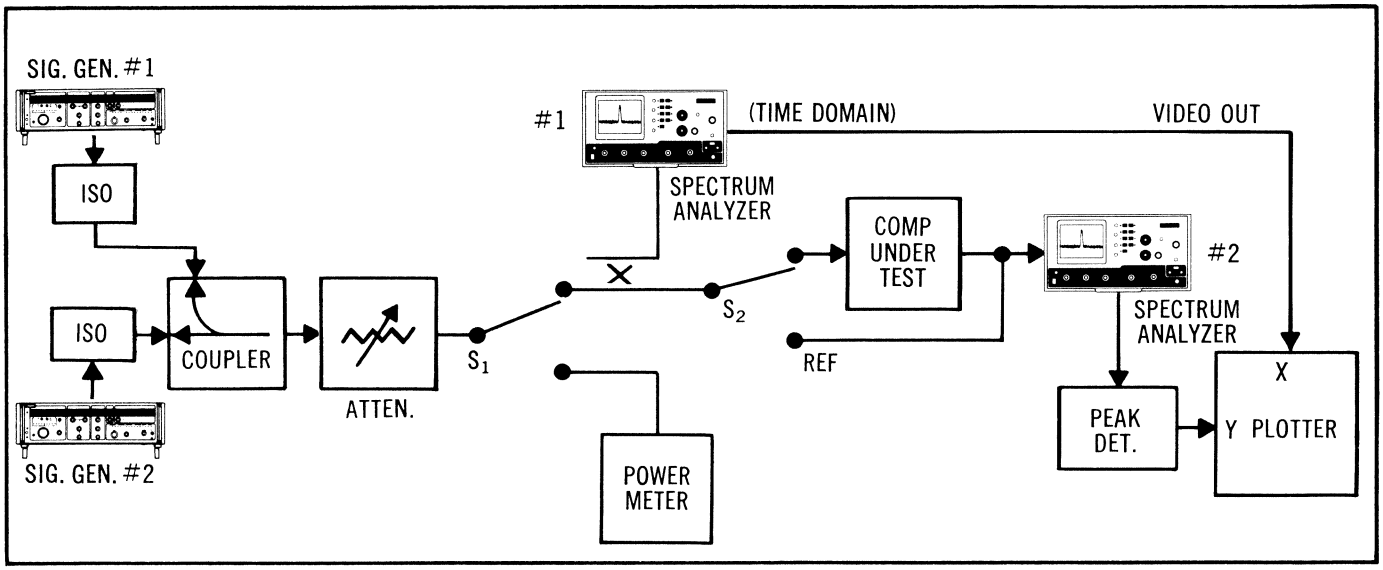


Figure 14
Equipment Arrangement for Evaluation of Component Performance vs Input Power

The basic concepts which make this arrangement so useful is the capability of the Spectrum Analyzer to isolate a discrete frequency, and the use of a peak detector to provide a continuous driving signal proportional to the strength of the isolated signal.

A simple detector, such as the one shown schematically in Figure 15, is sufficient to drive most X-Y plotters. The discharge time of capacitor C should be long with respect to the sweep time of the analyzer, but short relative to the change in the strength of the test signal.

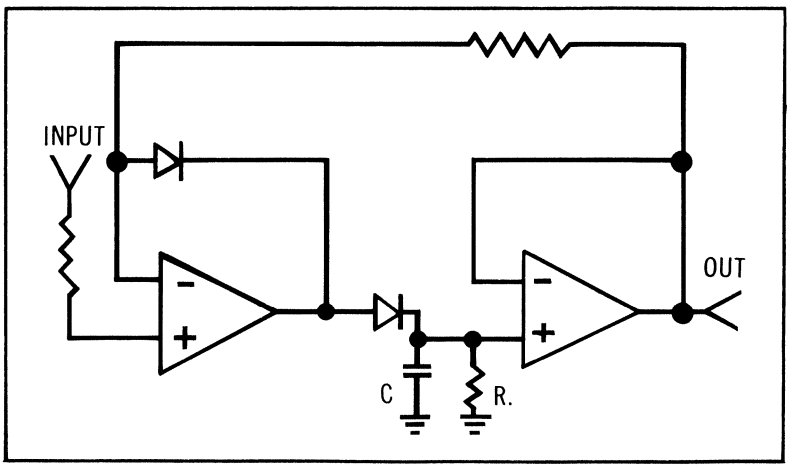


Figure 15
Peak Detector

The characteristics of a mixer as defined by this test arrangement are shown graphically in Figure 16. These results were obtained as follows:

1. Spectrum Analyzer #1, used in the time domain, measured the input test power and generated a signal to drive the horizontal axis. Spectrum Analyzer #2 measured the output of the mixer and generated a signal to drive the vertical axis.

2. A power reference was established using S1 and the power meter.

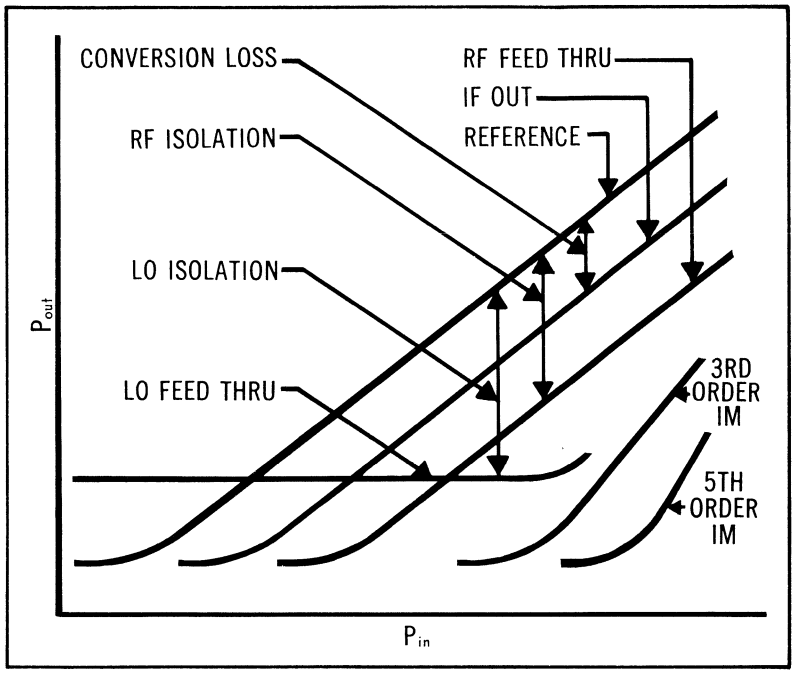


Figure 16
Mixer Characteristics

3. The calibration plot was taken with S2 in the REF position. Amplitude adjustments of the video outputs were made using the attenuator of the spectrum analyzer.

4. The second signal generator was required to measure the intermodulation distortion performance.

COMPONENT PERFORMANCE VS. INPUT FREQUENCY

There are several ways of determining the frequency response of a device using a spectrum analyzer.

A. For frequencies below 12 GHz, a Tracking Generator will supply a test signal that is synchronized to the analyzer. When used, as illustrated in Figure 17, the frequency response of the unit under test will be displayed on the screen of the CRT.

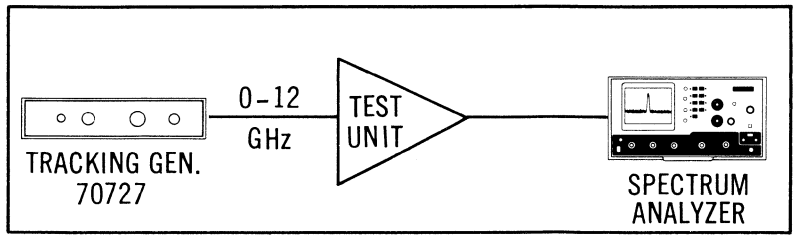


Figure 17 Frequency Response Measurement Simplified by Use of Tracking Generator

B. For frequencies above 12 GHz a sweep generator may be substituted for the track generator. Compatibility problems with the analyzer can be avoided by adjusting the sweep rate of the generator to be about one tenth that of the analyzer.

Time photography or the built-in digital memory could be used in place of storage.

C. A third approach utilizes the peak detector described in Figure 15 and generates the frequency response on an X-Y plotter. Figure 18 diagrams the configuration required for manual operation.

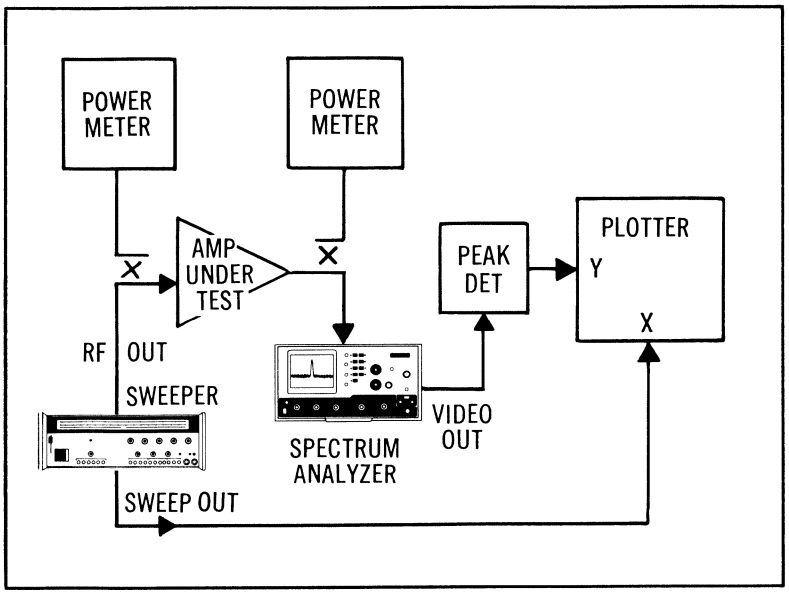


Figure 18 Wide Range Frequency Response Test

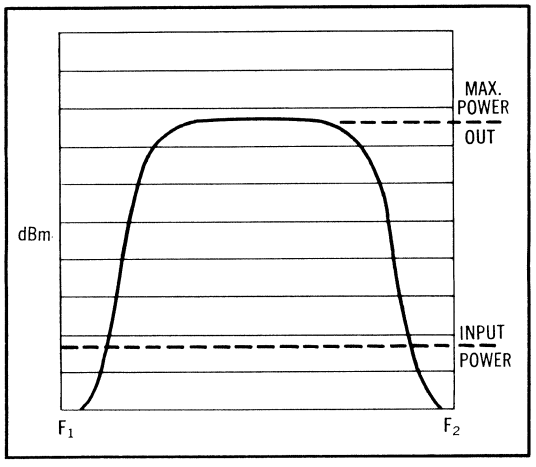


Figure 19
X-Y Plot from Wide Range Test

The operator manually sweeps the frequency of a levelled source and tunes the spectrum analyzer just enough to keep the response on screen. The results are shown in Figure 19.

THE SPECTRUM ANALYZER AS A WIDE-RANGE RECEIVER

Modern receivers are generally required to operate over wide bandwidths and furnish information in a clear, unambiguous manner. The AILTECH analyzers are unique in that they are designed to provide this type of operation. Scan widths from 10 kHz to 10 GHz are available with ultrawide IF bandwidths up to 8 MHz. Bandwidths as narrow as 100 Hz can also be selected for optimum sensitivity. Due to the built-in preselector and high level mixing, virtually all spurious responses are eliminated.

A linear 21.4 MHz IF signal is always provided at the rear panel. This output follows the front panel selectable filters and the IF attenuator. It is readily available for external demodulation. The first IF of 227 MHz is also available with a 10 MHz bandwidth as Option 002. By operating the analyzer in the phase-lock mode, any signal from 10 kHz to 20 GHz can be converted to the 227 MHz IF with a stability better than a few Hz.

An example of using the 757 as a receiver is shown above in Figure 20. This set-up was chosen because it also presents a simple technique for making wide-band, swept noise figure measurements.

Let us assume that the preamplifier is designed to operate from 1 to 4 GHz, has a typical noise figure of 7 dB and a minimum gain of 33 dB. Using an AILTECH analyzer, the high sensitivity of Band 1 permits a plot of noise figure vs. frequency to be obtained from 1 to 2 GHz without any correction for "second stage" effects. Even in the frequency range from 2 to 4 GHz, a correction of only 1 dB is required to compensate for the noise

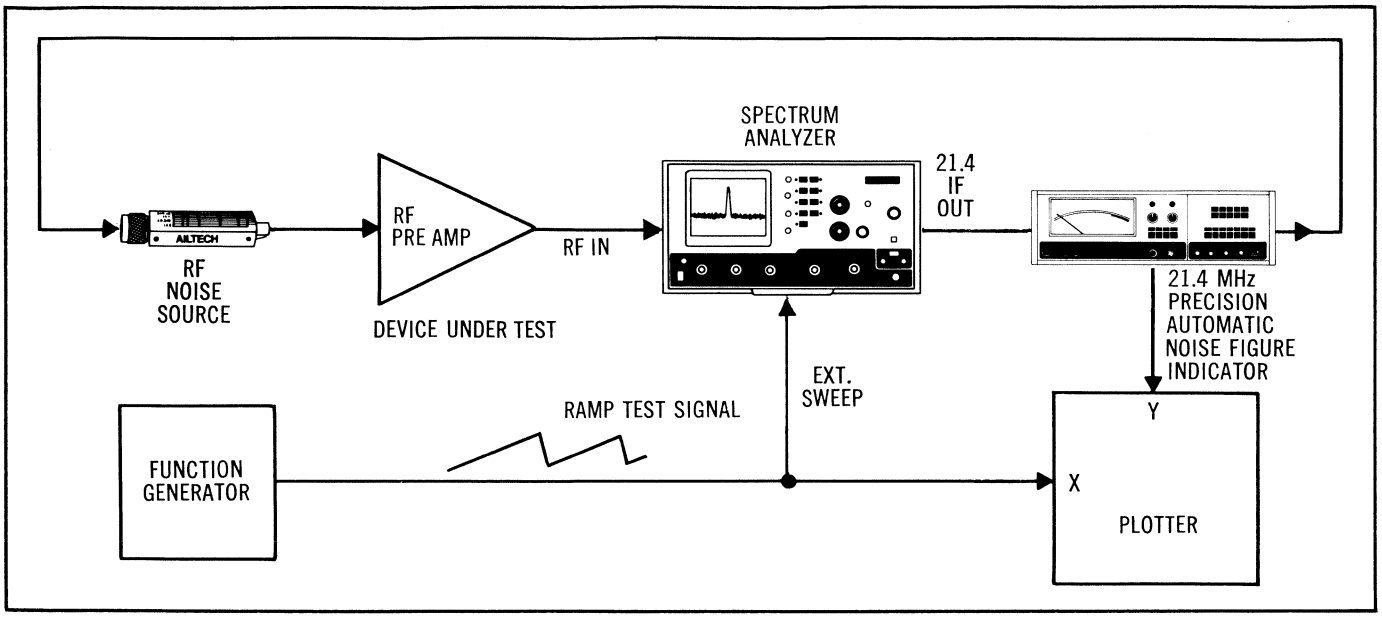


Figure 20 Use of Analyzer as a Receiver in Swept Noise Figure Test

figure of the Spectrum Analyzer. The correction factor is calculated as follows:

$$F_m = F_1 + \frac{F_2 - 1}{G_1}$$

$$F_m = 5 + \frac{2500 - 1}{2000}$$

$$F_m = 6.25 \text{ or } 8 \text{ dB}$$

$$F_m - F_1 = 1 \text{ dB}$$

where,

F_m = Measured Noise Figure
F_1 = Preamplifier Noise Figure = 7 dB = 5
F_2 = Spectrum Analyzer Noise Figure = 34 dB = 2500
G = 33 dB = 2000

This adjustment could easily be calibrated out of the final data with the AILTECH Type 75 or Type 7300 Precision Automatic Noise Figure Meter.

ACCURATE FREQUENCY MEASUREMENTS

The digital frequency readout of the AILTECH analyzers is quite accurate: Typically, it is three to four times more accurate than the mechanical, slide rule readout. However, a considerable improvement can be achieved when the LO output is used with a frequency counter.

The analyzer's main local oscillator is brought to an output port on the rear panel, at a power level of approximately +5 dBm. An improvement in frequency measurement accuracy of several orders of magnitude is possible due to the precise correspondence that exists between this frequency and the input signal.

The chief advantage of this method is its ability to measure low level signals in the presence of strong fundamental signals. Sidebands, spurs, etc., can be located very accurately, as long as the signal can be separated by the analyzer's IF filters and is above the threshold of noise.

spectrum analysis

To make the measurement in Band 1 proceed as follows:

1. Connect a frequency counter to the LO output port.
2. Tune the Zero Beat to the center of the screen.
3. Set the Scan Width switch to 1 MHz/division.
4. Set the IF Bandwidth to 10 kHz.
5. Set the Domain switch to Time.
6. Adjust the Fine Tuning control until the signal is centered in the filter. Some signal instability will be noted due to frequency modulation of the LO.
7. Read this frequency on the counter.
8. Reset the Domain switch to Freq.
9. Adjust the Tuning Control until desired signal is centered on the screen.
10. Repeat steps 5, 6, and 7 above.
11. The difference in the two readings is the desired frequency. The accuracy of this measurement will be about ±20 kHz.

In Bands 2 and above, simply measure the LO frequency at the signal of interest only, it is not necessary to measure the Zero Beat. The frequency of the input signal is then given by

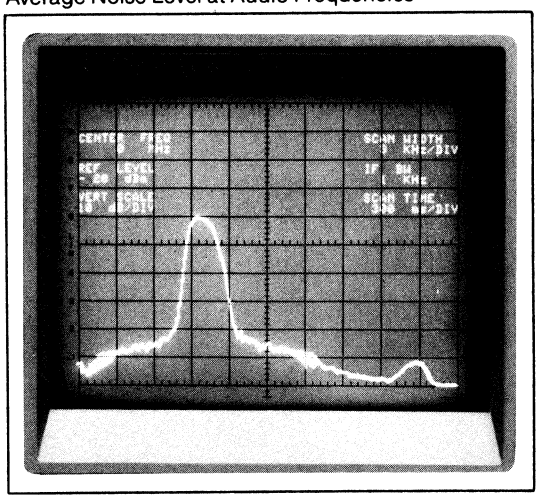
$$F_{RF} = NF_{LO} - 227 \text{ MHz}$$

where

N = 1 for Band 2
N = 2 for Band 3
N = 3 for Band 4
N = 5 for Band 5

An accuracy of ±500 kHz can be expected in these ranges.

Figure 21
Average Noise Level at Audio Frequencies



LOW FREQUENCY ANALYSIS

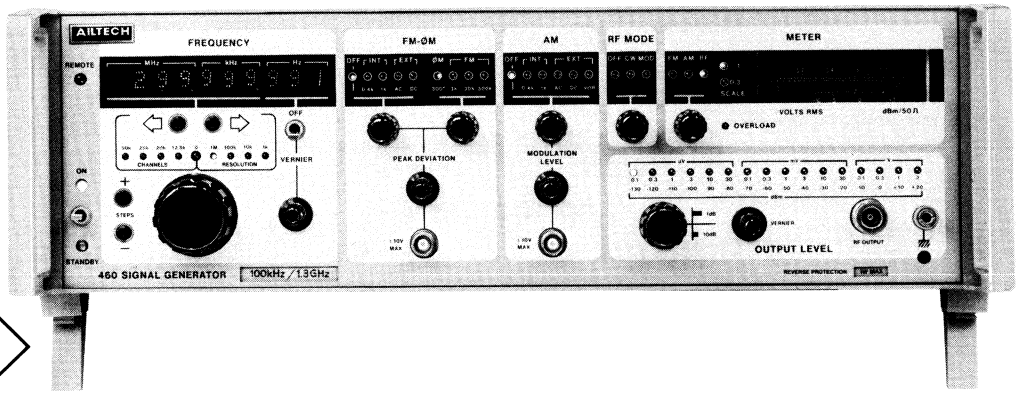
AILTECH analyzers are unique microwave instruments since they can also provide useful measurement capability down into the audio range. These low frequency signals are located by making use of the fact that the analyzers have a response when the frequency of the LO signal is the same as the intermediate frequency. This response represents "O" input frequency, and is generally known as a "zero beat." When used as a marker the "zero beat," together with the calibrated Scan Width switch, will allow any signal below 1 MHz to be accurately positioned.

Figure 21 illustrates the average noise level obtainable when the zero marker is situated at the left edge of the screen and a narrow Scan Width is selected.

AILTECH

Synthesized Signal Generators

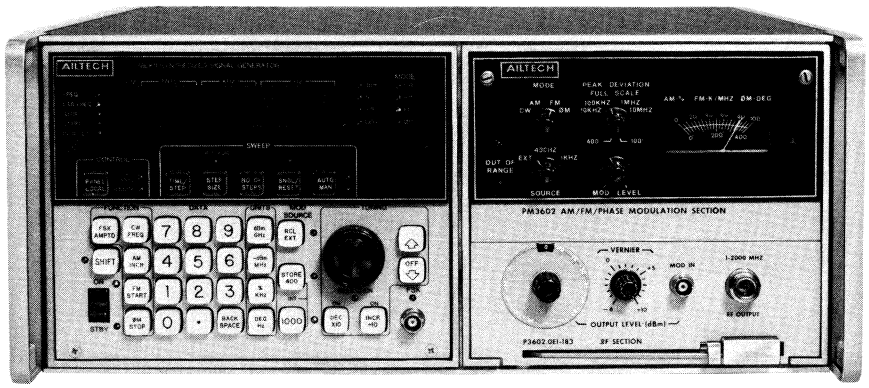
Select the Bus Compatible Synthesized/Signal Generator that meets your requirements



488 GPIB

Model 460 AM/FM/ϕM Programmable Control With Ultra-Low-Noise

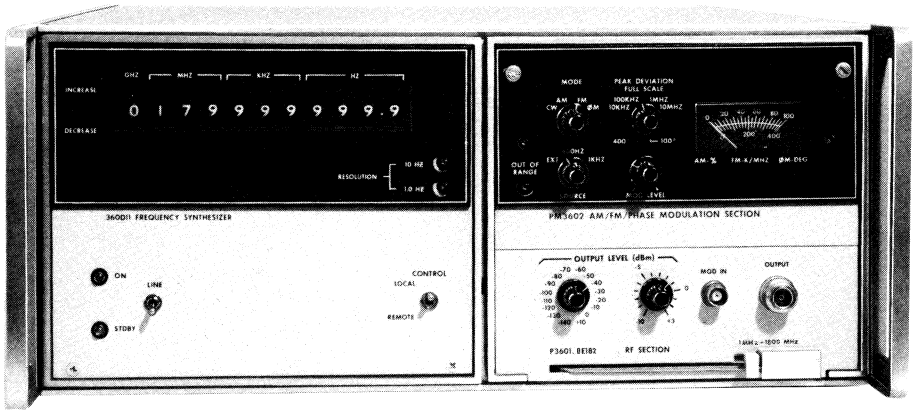
The 460 delivers higher Spectral Purity than cavity tuned generators, unusually high accuracy, broad frequency range, stability, high dynamic range and programmability of synthesis. The generator is controlled by a microprocessor in both the manual and programming mode.



488 GPIB

Model 380 Microprocessor—Keyboard Control With High Speed

The new 380 Synthesized Signal Generator offers keyboard/microprocessor control allowing frequency sweeps, storage capability and complete ease of use. 20 μsec switching time and up to 2000 MHz frequency range is standard. Options are available to increase the range to 4000 MHz.



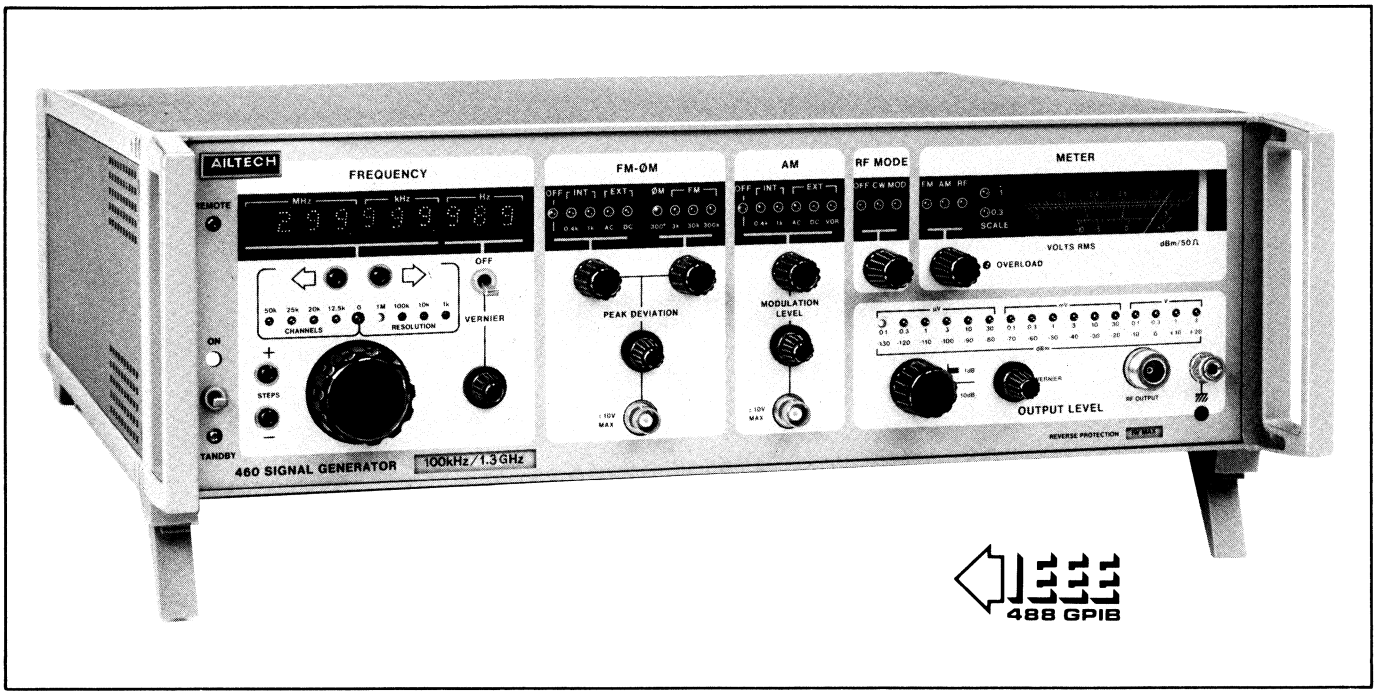
488 GPIB

Model 360 Thumbwheel Control of Frequency With High Speed

The 360 Synthesized Signal Generator offers 20 μsec switching time over the frequency range to 2000 MHz. Control of frequency is provided by thumbwheel on the face of the instrument.

The Ultra-Low-Noise 460 Synthesized/Signal Generator

Outstanding Low Noise Performance • Programmable AM/FM/ΦM • 0.1-1300 MHz with Option



Indispensable for Laboratories and Manufacturing Plants Producing:

- Avionics Instruments
- Radio Telephones
- Walkie Talkies and Beepers
- Multi-Channel Communications Equipment
- Quality Control Lines Utilizing Automatic Test Equipment
- Measurements Requiring Cavity Tuned Generators
- Telecommunications Receivers

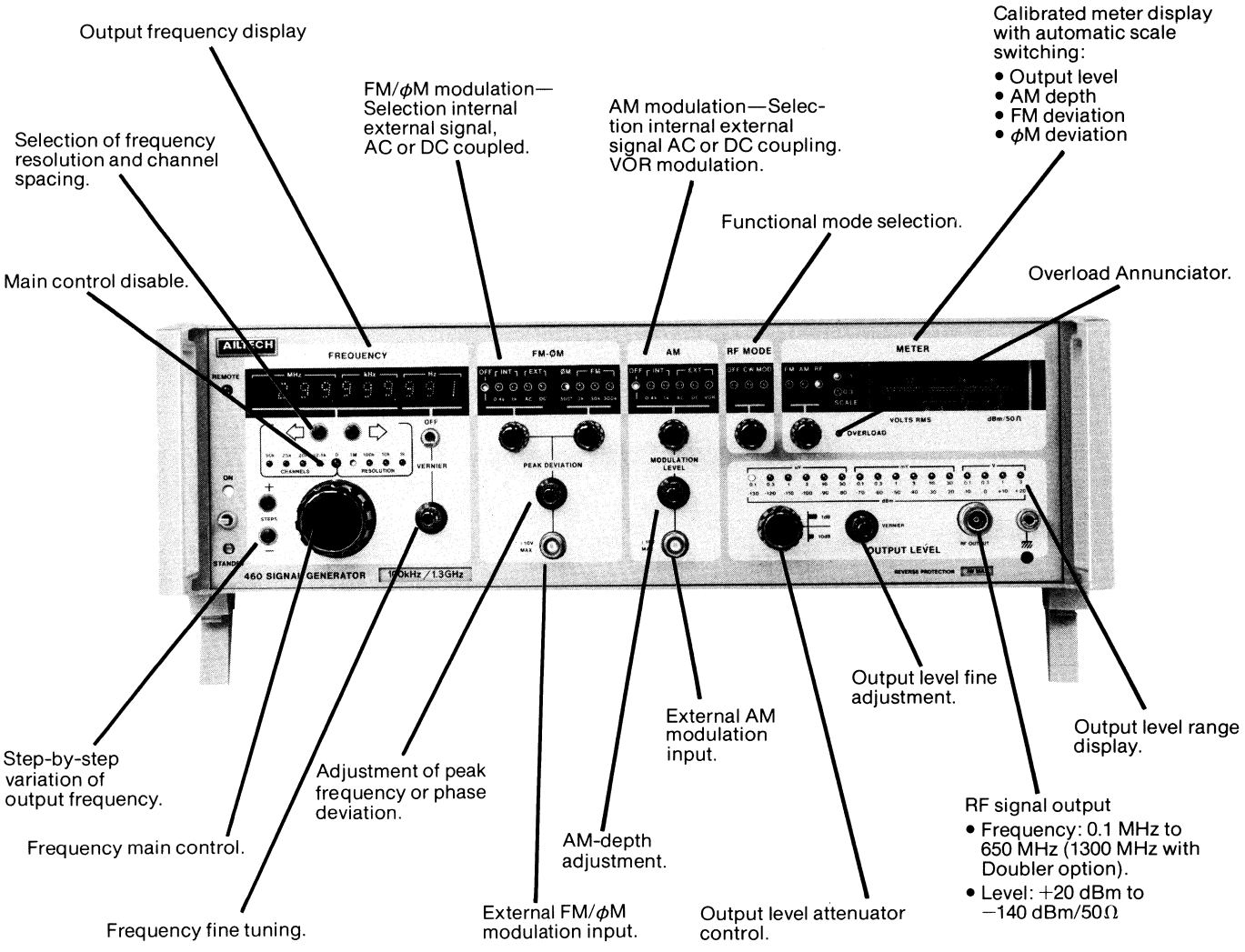
Features:

- Higher Spectral Purity—than Cavity Tuned Generators —145 dBc/Hz noise floor, —135 dB/Hz at 10 kHz
- Exceptional Accuracy and Stability $\pm 1 \times 10^8$/24 hours
- GPIB Programming Capability—bus compatibility allows use with ATE devices.
- High Dynamic Range +20 dBm to —140 dBm, programmable to 0.1 dB resolution
- Microprocessor Control—in both manual and programming mode
- Low Spurious Signals—to —100 dBc
- Wide Frequency Range— 0.1 MHz to 1300 MHz with 002 option
- Fast Pulse Modulation
- Calibrated and Programmable AM, FM, ϕM Modulation
- Resolution—1.0 kHz, 1.0 Hz with vernier
- Flatness—$\pm$0.5 dB
- Portability—light weight 51 lb., 5 inch high instrument
- Extreme Ease of Use—an AILTECH product line standard
- Spinwheel Tuning—tunes like a Signal Generator, performs like a Frequency Synthesizer
- LED Frequency Readout

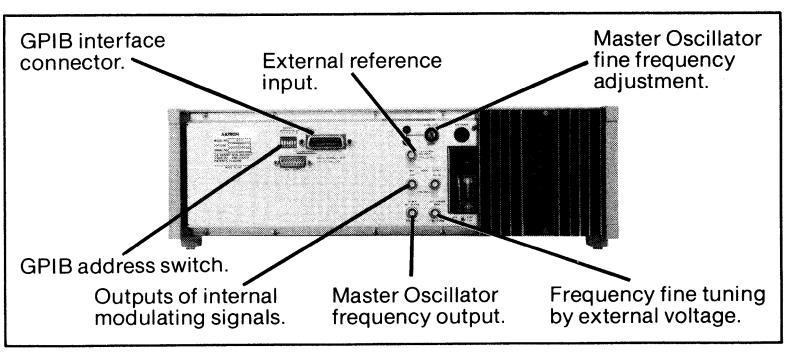
synthesized signal generator

This unique 460 Signal Generator is now part of the AILTECH family of Synthesizers. Following the standards of excellence set by all AILTECH products, the 460 is one of the best instruments of its kind available in the world. The 460 delivers higher Spectral Purity than cavity tuned generators, unusually high accuracy, stability, programmability of synthesis, and offers many features for extreme ease of use.

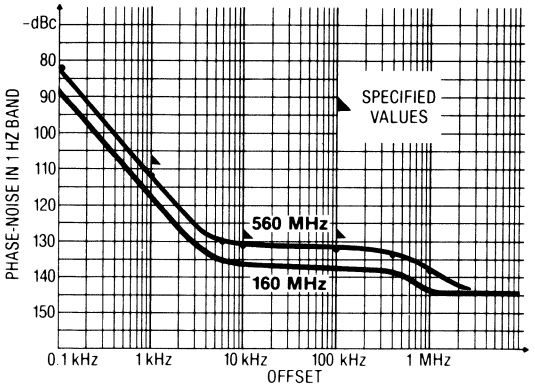
Controlled by a microprocessor providing ease of operation in manual setting as well as in remote programming, this instrument features all the characteristics of a high-performance signal generator: broad frequency range, AM/FM/ϕM, and pulse modulation, calibrated output level with high dynamic range.



AILTECH 460



AILTECH 460... Produces Pure Signals



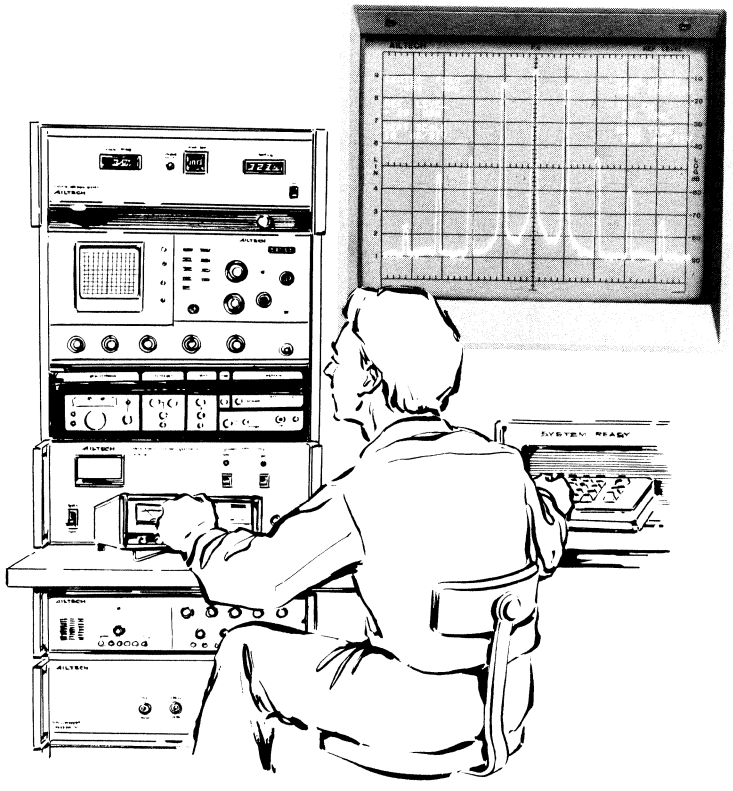
LOW NOISE

For precision measurements of high performance receivers, LOW NOISE is a must. Adjacent channel selectivity measurements require noise levels previously attainable only with mechanically tuned cavity type signal generators. The 460 delivers cavity noise performance with synthesizer accuracy and stability. Phase noise at a typical channel spacing offset of 10 kHz is -130 dBc/Hz. For image and IF rejection tests, low spurious is required and the non-harmonic spurious of the 460 is -100 dBc.

OUTSTANDING AMPLITUDE MODULATION

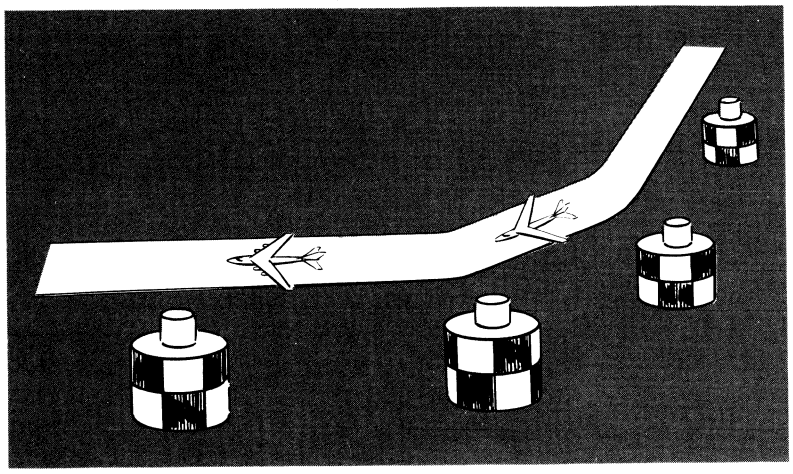
Few Signal Generators can match the performance shown on the Spectrum Analyzer. The 460 was set for a carrier power of +13 dBm (20 mw), the amplitude modulating frequency 100 kHz, and the modulating level 100%. The harmonic distortion as indicated by the second and third harmonics (>30 dB) is less than 3.5%. With this type of performance, the 460 can be used to test avionics receivers at high modulation levels with very low levels of distortion.

frequency synthesizers



PROGRAMMABLE

All functions of the 460 are programmable, making it the ideal generator for ATE consoles. Frequency can be programmed to within 1.0 Hz, level to a resolution of 0.1 dB, and AM, FM or ϕM to 1% resolution and lower. The 460 is the solution to the mechanically tuned cavity generator, surpassing its performance in a small lightweight programmable package.



VOR-ILS MODULATION

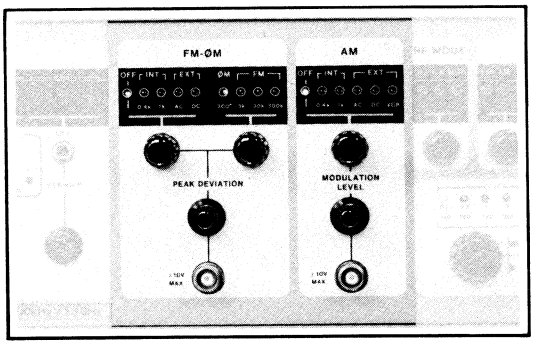
Checking the accuracy of air navigational systems requires a linear amplitude modulator with extremely low phase shift. The composite VOR modulating signal applied to the 460 AM input consists of a frequency modulated 9960 Hz AM subcarrier and a 30 Hz amplitude modulated sinewave, which simulates the rotating VOR antenna pattern. Since bearing is derived from the relative phases of the detected signal in the VOR receiver, the accuracy is affected by unwanted phase shifts in the simulated test signal. Using the 460, the phase shift from the modulator input to the RF envelope at 30 Hz is typically 0.06°

This performance, together with the synthesizer accuracy and stability, provides the test signals required for calibration and checkout of air navigational equipment.

frequency synthesizers

AM, FM, PHASE AND PULSE MODULATION

The 460 offers the most useful forms of modulation, AM, FM ϕM and fast rise-time pulse modulation (006 option). Since the modulators are separate, simultaneous modulation modes are available. AM-FM, AM-ϕM, AM-Pulse, AM-FM-Pulse, AM-ϕM-Pulse, FM-Pulse, ϕM-Pulse. This modulation capability makes the 460 very well suited for use in simulation of many types of ECM signals.



All combinations of modulation available at the front panel

HIGH POWER/WIDE DYNAMICS RANGE

Measuring intermodulation products of high power mixers and amplifiers requires high power signal generators. The 460 provides 100 milliwatts. The set-up shown uses three 460s to provide the high power LO, and the two high power interfering signals, required to test a high level mixer. High power is also useful for driving a frequency multiplier to obtain low noise signals in the microwave bands.

frequency synthesizers

Specifications Model Series 460

Frequency

Frequency Range: 0.1 MHz to 650 MHz. (1300 MHz with doubler option).

Resolution: 1.0 kHz with main tuning control, 1.0 Hz with vernier.

Selection: Spinwheel tuning provides 100 steps per turn, with step values selectable between 1 kHz, 10 kHz, 100 kHz and 1 MHz. Vernier control provides continuous fine tuning over a 1 kHz range. Up/Down frequency pushbuttons provide 1 kHz—10 kHz—100 kHz—1 MHz steps and 12.5 kHz—20 kHz—25 kHz—50 kHz steps. External voltage fine tuning, ±3 kHz for ±3 V.

Display: Indicates to a 1 kHz resolution (1 Hz with vernier on) on a 9 digit LED display. (10 digit with doubler option).

Accuracy and Stability: With Vernier OFF, determined by reference oscillator ($\pm 1 \times 10^{-8}$/24 hrs.). With Vernier ON, stability slightly degraded (±1 Hz/10 min after 30 minute warm-up), however display counts actual output frequency using the reference oscillator as the time base.

Reference Oscillator: Internal: 10 MHz oven stabilized, $\pm 1 \times 10^{-8}$/24 hours. Frequency adjustable by ten-turn potentiometer $\pm 1 \times 10^{-6}$.
External: Any sub-harmonic of 10 MHz down to 1 MHz, at level of 0.2 V rms to 1 V rms/50 Ω, will phase lock internal oscillator.

Reference Output: Rear panel BNC connector provides 10 MHz at 0.5 V rms/50 Ω.

Frequency Switching Speed: To be within 1 kHz, < 500 ms.
(GPIB Programming, Option 003)

Spectral Purity

Harmonics: 1.0 to 650 MHz, < −30 dBc in CW mode at +13 dBm into 50 Ω; 650 to 1300 MHz, <−25 dBc at +10 dBm.
Sub-Harmonics: 1.0 to 650 MHz, N/A
650 to 1300 MHz, <−25 dBc.
Spurious Signals: Non-Harmonic: 300 kHz to 80 MHz, <—80 dBc, except for fixed spurious at 400 MHz <—75 dBc, 80 MHz to 650 MHz, <—100 dBc, except for fixed spurious at 80 MHz <—85 dBc, 650 to 1300 MHz, <—94 dBc.

Sidebands at ±1 kHz: <—70 dBc.

Power-Line Related: Line Frequency, <—50 dBc, 2 X Line Frequency, <—60 dBc.

Single-Sideband Phase Noise: Guaranteed SSB Phase Noise in a 1 Hz BW, including EFFECT OF INTERNAL STANDARD.

Output Frequency	Phase Noise At Offset Frequency			
MHz	1 kHz dBc/Hz	10 kHz dBc/Hz	100 kHz dBc/Hz	2 MHz dBc/Hz
0.1-80	−107	−127	−127	−138
80-160	−119	−139	−139	−140
160-320	−113	−133	−133	−140
320-650	−107	−127	−127	−140
650-1300	−101	−121	−121	−134

Output

Output Level: 0.1 to 650, +20 to —140 dBm (2 V to 0.023 μV into 50 Ω), 650 to 1300 MHz, +10 to −140 dBm.

Resolution: 10 dB and 1 dB steps, Vernier ±1.5 dB (with 005 programming option 0.1 dB).

Specifications subject to change without notice.

Accuracy: Measured at 0 dBm to 50 Ω.

	Accuracy	
Output Level	**0.3-650 MHz**	**650-1300 MHz**
+20 to +10 dBm	±2.0 dB	—
+10 to 0 dBm	±2.0 dB	±3.5 dB
0 to −50 dBm	±1.5 dB	±3.0 dB
−50 to −110 dBm	±2.0 dB	±3.5 dB
−110 to −140 dBm	±3.0 dB	±4.5 dB

Flatness: Measured at 0 dBm.
±0.5 dB, 1 MHz to 650 MHz; ±1.5 dB, 650 to 1300 MHz.

Display: LED indicators and meter calibrated in volts and dBm into 50 Ω.

VSWR:	**0.1-650 MHz**	**650-1300 MHz**
	<2.0 above 0 dBm	<2.5 above 0 dBm.
	<1.3 below 0 dBm	<1.7 below 0 dBm

Amplitude Modulation

Depth: 0.1-650 MHz, 0 to 100% at output levels up to +14 dBm. AM performance degraded above +14 dBm. 650 to 1300 MHz, 0 to 100% at output levels up to +4 dBm.

Internal Modulation Frequencies: 400 Hz and 1000 Hz.

External Modulation 3 dB Bandwidth: 0 to 100 kHz for DC coupling, 30 Hz to 100 kHz for AC coupling.

Input Sensitivity: 0.2 V rms for 100% modulation.

Distortion: Measured using the internal 1000 Hz oscillator, output levels up to +14 dBm.

Depth	**Distortion**
0 to 30%	1.2%
30 to 50%	2.0%
50 to 80%	3.0%

Incidental Phase Modulation: <0.1 radians for 50% modulation.

VOR Modulation: AM phase shift <0.2° for a 30 Hz modulating signal.

Indicated Accuracy: ±2% of full scale, or ±5% of reading, whichever is greater (measured from 0 to 90% at a 1 kHz modulation rate).

Modulation Signal Output: Internal modulating signal available on rear panel at a level of 2.5 V rms into 50 ohms.

Frequency Modulation

Rate: External DC coupled, DC to 150 kHz.
External AC coupled, 30 Hz to 150 kHz.

Internal Modulating Signals: 400 or 1000 Hz.

Maximum Peak Deviation

Rates	**DC Coupling**	**AC Coupling**
DC-30 Hz	300 kHz	—
30-100 Hz	300 kHz	3000 x f_{mod} (kHz)
100 Hz-100 kHz	300 kHz	
100 kHz-150 kHz	$\frac{30{,}000}{f_{mod}}$ (kHz)	

FM Center Frequency Long Term Stability: DC COUPLED: ±1 Hz/10 min after 30 min warmup. Center frequency shift indicated on Frequency Display.
AC COUPLED: Same as in CW mode.

FM Distortion: <1% up to 30 kHz deviation, <3% up to 100 kHz deviation.

Incidental AM: <1% for a 1 kHz modulating signal with 75 kHz deviation, 1 MHz to 650 MHz.

Specifications are continued on the following page.

frequency synthesizers

Model 460 Signal Generator Specifications—continued.

Input Sensitivity: 1 Vrms/600 ohms for 1 kHz, 10 kHz or 100 kHz ranges.

Deviation Control: Vernier control, calibrated meter display with automatic range switching.

Indicated Accuracy: ±7% of full scale.

Full Scale Ranges: 0 to 3, 30, 300 kHz with automatically switched sub-ranges 0 to 1, 10, 100 kHz.

Phase Modulation

Rate: DC coupled, DC to 50 kHz. AC coupled, 30 Hz to 50 kHz.

Maximum Peak Deviation: 300°.

Internal Modulating Signals: 400 or 1000 Hz.

Indicated Accuracy: ±10% of full scale.

Input Sensitivity: 1 Vrms/600 ohms for 100° deviation.

Pulse Modulation (Option 006)

RF Frequency: 10 MHz to 650 MHz, 10 MHz to 1300 MHz with Option 002.

Modulating Signal: external rear panel BNC.

Impedance: 600 ohms, DC Coupled.

Pulse Repetition Rate: 10 Hz to 200 kHz (2.5 MHz with uncalibrated output level).

Pulse Duration: 200 ns minimum.

Pulse Amplitude Required: Nominally >+0.3 V (5 V max) pulse, return to zero.

Rise and Fall Times: <30 nano sec. typical with a modulating pulse having a 20 ns rise and fall time.

On/Off Ratio: 10 MHz to 200 MHz, >70 dB.
200 MHz to 500 MHz, >60 dB.
500 MHz to 650 MHz, >50 dB.
650 MHz to 1300 MHz, >90 dB.

ALC Response Time: 2 seconds.

Output Level Flatness: ±1.0 dB, 10 MHz to 650 MHz, ±1.3 dB, 650 MHz to 1300 MHz.

Simultaneous Modulation: AM-Pulse, FM-Pulse, ϕM-Pulse, AM-FM-Pulse, AM-ϕM-Pulse.

General

Operating Temperature Range: 0°C to 45°C.

Power: 115 or 230 V, ±15%, 100 W, 48 to 66 Hz.

Dimensions: 132 mm H x 440 mm W x 452 mm D (5.2" x 17.35" x 17.8").

Weight: Net 23 kg (51 lb.).

Options

001 Protective Fuse: Reverse power protection up to 50 W. Output accuracy degraded 1.0 dB, 0.1 to 650 MHz; 2.0 dB, 650 to 1300 MHz. VSWR degraded 0.5 from 0.1 to 650 MHz; 0.8 from 650 to 1300 MHz.

002 Frequency Doubler: 650 to 1300 MHz.

003 GPIB Programming Interface: Compatible with IEEE STD 488-1975. Allows programming of output frequency to 1 Hz resolution, level to 0.1 dB resolution, operating mode, modulating signals, AM level with 1% resolution, FM and ϕM levels with 1/300 of full scale resolution.

004 Rack Mounting Adapter

005 48-420 Hz Power Line

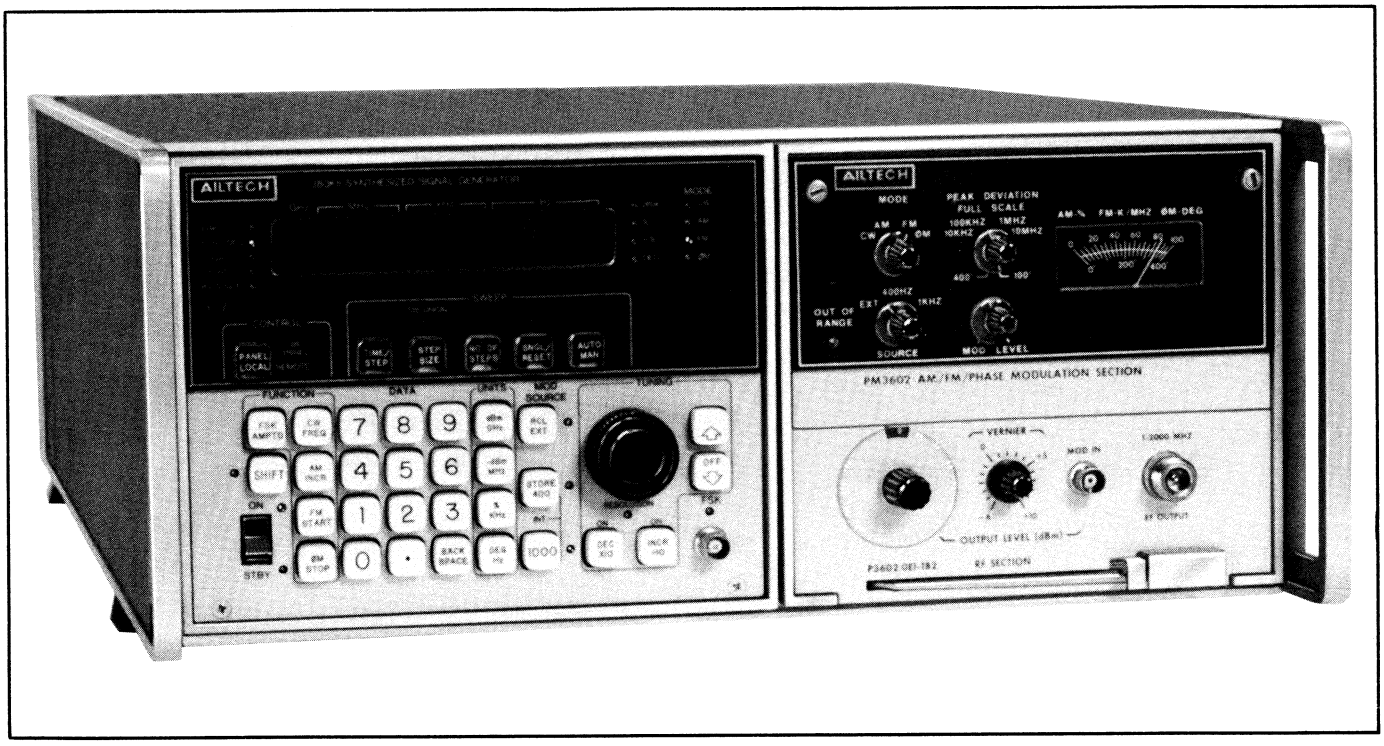
006 Pulse Modulation

297610 47 Pin Card Extender

Specifications subject to change without notice.

Model 380 Direct Synthesized Signal Generator

Featuring Microprocessor-Keyboard Control



Who Needs the AILTECH 380 Signal Generator?

Development Engineers

- Essential to Remain Technologically Competitive.
- Reduce Development Time Using High Speed Calculator Control.
- Improve Accuracy of Measurements.
- Minimize Signal Generator Inventory—One Instrument Covers Multiple Ranges.
- Check Out Your CAD Designs Quickly and Accurately.

Systems Designers

- Frequency Agility Ideal for Radar, ECM and Secure Communications Systems.
- Quick, Multi-channel Capability for Communications Systems.
- Provides Stimulus for Avionics Shop and Flight Line Equipment.

Manufacturing Operations

- Avoid Obsolescence—Invest in GPIB Capable Instrumentation.
- Improve Quality of Product by Reducing Production Test Errors.
- Reduce Labor Costs and Elapsed Production Test Time.
- Automatic Operation Allows Semi-skilled Operators.
- Use the Same Equipment in Production That Was Used in Development.
- Obtain Hard Copy Test Results Using GPIB Instruments.

Standards and Calibration Laboratories

- Improve Throughout and Obtain Hard Copy Test Data.
- Increase Calibration Accuracy with High Speed Repeatable Measurements.
- Reliability of Direct Synthesis Assures Reduced Maintenance Time

The 380 Total Capability System

Fast Switching

- Direct Synthesis
- 10 KHz to 2000 MHz
- Options to 4000 MHz
- Fast Switching, $<20\ \mu s$
- Fail Safe Operation (No Loops to Unlock).

Low Noise

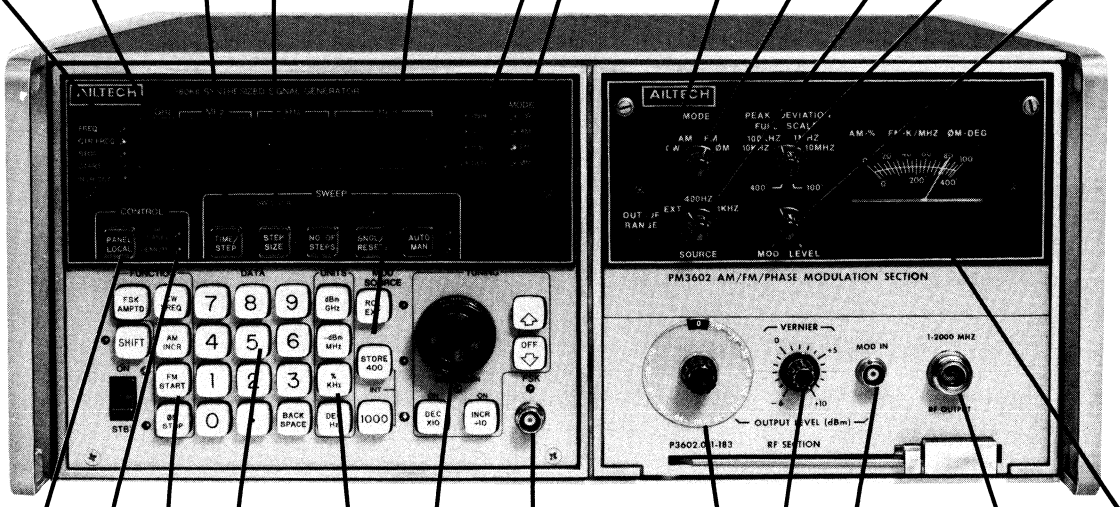
- SSB Phase Noise <-135 dBc/Hz at 10 KHz Offset (fc=35 MHz)
- Broadband Noise Floor <-130 dBc
- Spurious <-100 dBc at 80 MHz
  <-74 dBc at 2000 MHz

Microprocessor Control

Keyboard Control of all functions

- Digital Sweep
- Knob-Tuning of all functions
- Function Incrementing
- Frequency Shift Keying
- AM-FM-Phase Modulation
- Store/Recall
- GPIB Programming of all functions & levels

synthesized signal generator



SW Uncal Lamp.

LED Indicates When an Out of the Range Frequency Has Been Selected.

Mode Lamps, Modulation on RF Output.

Sweep Function Keys; Sweep Speed, Step Size, No. of Steps and Single, Auto, or Manual Sweep.

CW, AM, FM or ϕM Mode Switch.

Unit Lamps; Degrees, Percent, dBm and msec.

Modulation Source Selector Switch.

Frequency, Output Level, Amplitude Display Indexes, and Parameters.

Store and Recall Keys 9 Configurations.

Peak Deviation Switch.

Function Lamps.

Mod Level Control.

RF and Modulation Panel Key.

Modulation Meter.

REMOTE Lamp Indicates Instrument Under Bus Control.

FSK Input Accepts TTL Logic Input.

RF Output Connector: 10 kHz to 180 MHz for the 380, 1 MHz to 2000 MHz for the 382.

Stepping Controls, a Knob and Stepping Keys.

External Modulation Signal Input (PM3602 Modulation Module Shown).

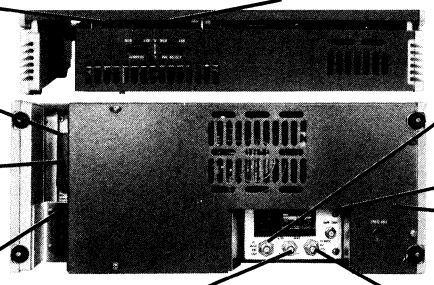
Frequency, Start & Stop Frequency, Output Level, CW, AM, FM, ϕM, Sweep, Increment Set, and FSK Function Keys.

Units Keys, Frequency, Output Level, and Modulation Index.

Calibrated Controls Provide Continuous Control of Output Level When Enabled From Keyboard. The 181/183 Options Provide—136 to +10 dBm Output Power.

Data Keys, Enter Values of Selected Function.

Rear Panel



GPIB Address Switches, 0 to 30.

Parallel Poll Select Switches, 1 through 8.

Buffered 10 MHz Reference Signal at 0 to +6 dBm, If Reference Input is 5 or 10 MHz, Used To Slave Other Instruments.

High-Speed Frequency Programmability Connector.

Sweep Output Voltage Staircase, 0 to +2.0V. 1000 Steps Maximum.

Remote Programming; Output Level, Modulation Connector.

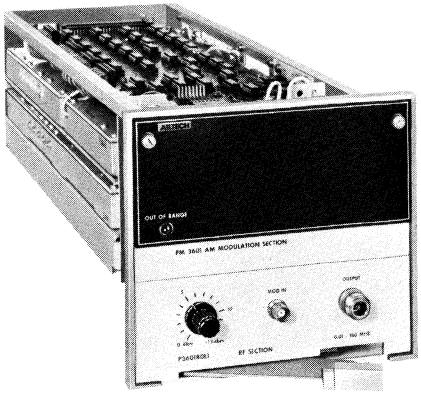
Optional Crystal-Controlled, Oven-Stabilized, Oscillator, 10 MHz Reference.

IEEE-488 Remote Control.

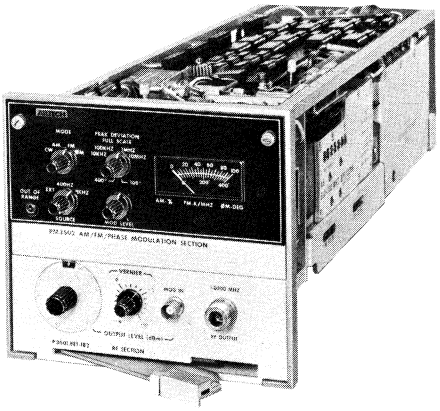
Reference Input Connector, 5 or 10 MHz Reference Signal at 0 to +3 dBm.

Reference Output Connector, Internal 10 MHz Oscillator Signal (If Option Is Installed) At 0 to +3 dBm.

AILTECH 380



180 MHz with AM Modulator



2000 MHz, with
AM/FM/ϕM Modulator

Directly Synthesized Signal Generator

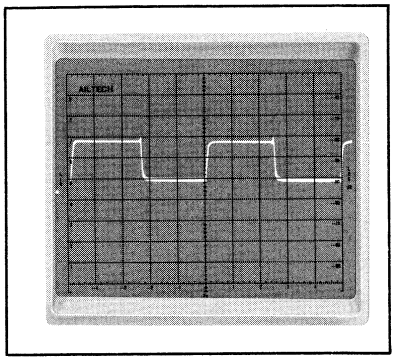
10 KHz to 2000 MHz— Options to 4000MHz

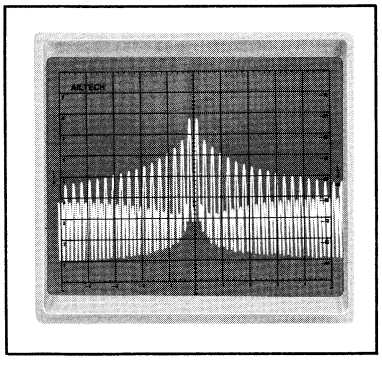
The 380 Series Synthesized Signal Generator is a modular plug-in system with a choice of RF plug-ins covering 10KHz to 2000 MHz. Doubler options are available extending the directly synthesized frequency to 4000 MHz.

AM/FM/ϕ Modulation

Fully programmable AM/FM/ϕM is available with PM3602 modulator, which is included in models with an M suffix (i.e. 380M). Modulation is settable either by the conventional modulation controls on the modulator panel, or by a simple keyboard entry. Under keyboard control, percent AM, FM and Phase deviation are indicated by the digital display. AM bandwidths to 100KHz, and FM and ϕM bandwidths to 300KHz are provided. In the FM mode, the center frequency remains synthesized, eliminating troublesome carrier drift.

Internal 400 Hz or 1000 Hz modulation signals, or external modulation is selectable. In external modulation, a 1 VRMS input signal is required for accurate calibration.





FSK/PSK Modulation

The 380 Series can be used to generate an FSK signal by entering Center Frequency and Deviation directly into the Keyboard. The speed of direct synthesis provides fully synthesized chirp-free keying not possible with indirect synthesis. The keying signal is a TTL level applied to the FSK input. Maximum speed is 7 kHz or 14 kBITS/sec.

PSK capability is provided using the Phase Modulation mode of operation. The keying waveform with a 1.0 volt peak amplitude is supplied to the External Modulation input, and the desired phase deviation is entered into the Keyboard.
(M-suffix units only).

The advantages of direct synthesis are:

- Fast switching—<20 μs across the entire range.
- Fail Safe—no phase loops to unlock—giving an erroneous output.
- Easily maintained—less adjustments than phase locks.

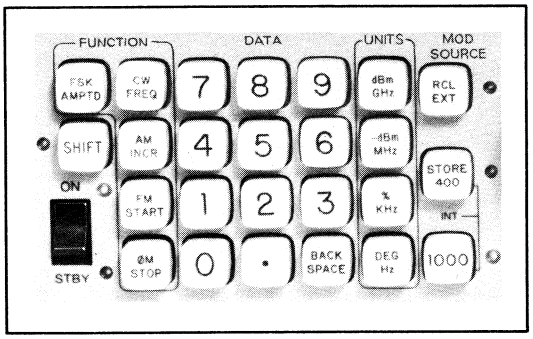


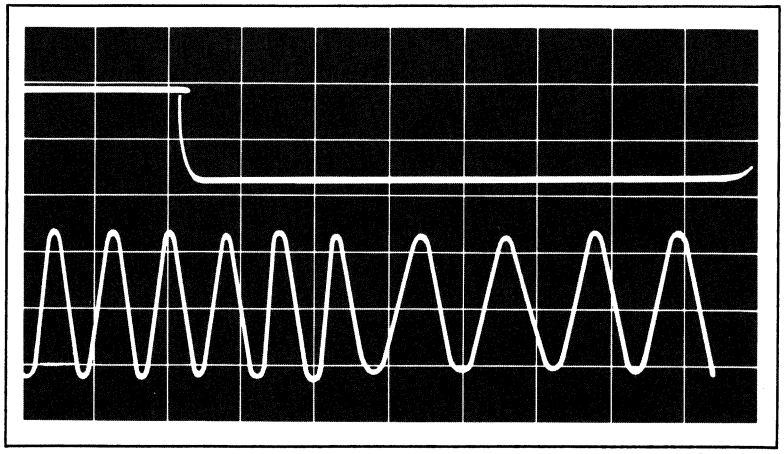
PHOTO LEFT: Demodulated FSK signal at 1.7 GHz, ±50 kHz, at a 4 kHz rate. Analyzer adjusted for slope detection in zero scan mode, 50 μsec/division. Switching speed approximately 10 μsec.

PHOTO RIGHT: BPSK Modulation at 1.7 GHz, ±90° at a 10 kHz rate. Carrier null greater than 50 dB.

frequency synthesizers

Calibrated Output +13 dBm to −150 dBm

The 380 series with the optional output attenuator provides calibrated output power +13 to −150 dBm for the 180 MHz plug-in, and +10 dBm to −136 dBm for the higher frequency plug-in. The output level is controllable with the 180 series attenuator options by using either the conventional 10 dB switch and output level vernier, or by keyboard entry. Resolution is infinite under vernier control and 0.5 dB under keyboard or GPIB control.



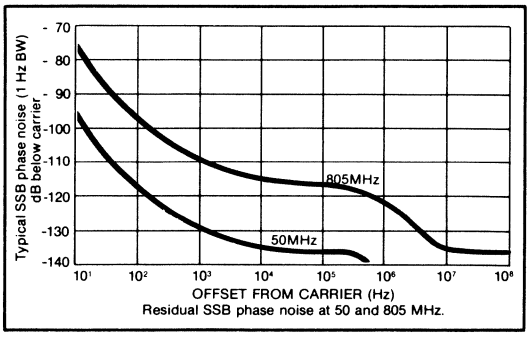
2 μs/cm.
UPPER TRACE—Frequency Switching command.
LOWER TRACE—AILTECH 380 RF output switching between 200 kHz and 300 kHz.

Outstanding Speed and Spectral Purity

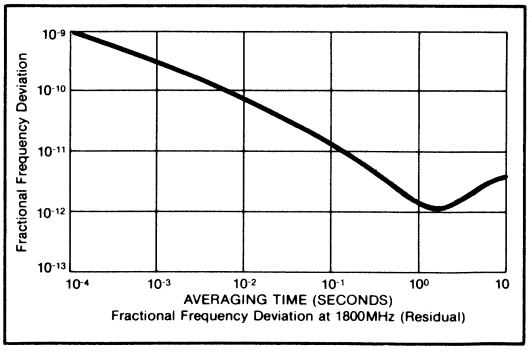
Direct Synthesis and Switching Speed

Fast switching between frequencies can be just as important in an ATE system, where time is money, as in an Intelligence Collection System where high speed local oscillator switching means less information lost. To capitalize on the inherent fast switching of the patented AILTECH Direct Synthesis, programming can by-pass the IEEE-488 bus and a parallel BCD input can be used. In this mode, speeds faster than 20 μs are attained. (Up to 500 times faster than the typical indirect synthesizer.) If the IEEE-488 bus is to be used, a fast learn mode is provided which allows switching an unlimited number of frequencies at speeds of 100 μsec.

Either way the 380 is the fastest production synthesizer with coverage to 4000 MHz, available today.



Residual SSB phase noise at 50 and 805 MHz.



Fractional Frequency Deviation at 1800MHz (Residual)

Spectral Purity

The 100 dB spurious performance of the 380 series is achieved by a well designed frequency plan, which reduces the number of fixed frequencies required for synthesis, together with a well shielded construction employing cast aluminum modules with RFI cover gaskets.

In critical applications such as testing channelized receivers, the 380 provides the necessary spurious free output preventing generation of false alarms.

Phase Noise

Noise on the output of a signal results in a limitation of the sensitivity of the system, and the 380 has been designed to provide an exceptionally clean signal for wide band local oscillator use. In addition to the low noise performance close to the carrier, the 380 provides wideband noise floors of less than −130 dBc per Hz all the way to 2000 MHz. This together with the fast switching low spurious performance makes the 380 useful in fast scan and frequency agile local oscillator applications.

RF Specifications Model Series 380

Frequency Characteristics

	380	382		
Frequency Range	.01 - 179.999999 MHz	1.0 - 1999.99999 MHz		
Frequency Resolution	1 Hz 0.1 Hz with Main Frame Option 001	Output Frequency <60 MHz >60 MHz	Standard 1 Hz 10 Hz	Mainframe Option 001 0.1 Hz 1.0 Hz
Frequency Accuracy and Stability	Same as reference oscillator (±3 x 10^{-8}/24 hours with mainframe option 002, ±1 x 10^{-9}/24 hours with mainframe option 003)			
Harmonics	<—30 dBc, 1.0 to 180 MHz	<—20 dBc, CF >3 MHz(3) <—15 dBc, CF <3 MHz(3)		
Sub Harmonics & Multiples (f/2, 3f/2, etc.)	N/A	<1000 MHz, N/A >1000 MHz, <20 dBc		
Signal To AM Noise(2)	>84 dB	>70 dB		

	Programming Mode	μP Time	Settling Time	Total Switching Time
Frequency Switching Time to be within 0.01 radians of final phase for 11-digits of frequency change	BCD Parallel	0	20 μs	20 μs(1)
	GPIB	19.9 ms	20 μs	20 ms
	Fast Learn	84 μs	20 μs(1)	104 μs

1. For 1800 MHz & 2000 MHz units, switching time is< 80 microseconds for a frequency step from above 10 MHz to below 10 MHz.
2. Measured in a ±15 KHz band, excluding a ±0.5 Hz band centered on the carrier.
3. For output levels below +5 dBm with 182/183 attenuator options.

Spectral Purity: Guaranteed SSB Phase Noise in a 1 Hz BW, including effects of internal standard; options 002 or 003.

Output Frequency		Spurious Signals	Phase Noise at Offset Frequency		
380 MHz	382 MHz	dBc	1 kHz dBc/Hz	10 kHz dBc/Hz	100 kHz dBc/Hz
.01 - 60	1 - 60	—100	—121	—126	—131
—	60-100	—98	—119	—124	—129
60 - 180	100-200	—95	—113	—118	—123
—	200-400	—86	—107	—112	—117
—	400-1000	—80(1)	—101	—106	—111
—	1000-2000	—74(2)	—95	—100	—105

(1) For 950-1999.99...MHz, a spurious could appear from 1050-1150 MHz, <—60 dBc.

(2) For 1600-1680 MHz, a spurious could appear from 1470-1550 MHz, <—55 dBc. For 1900-1999.99...MHz, a spurious could appear from 1700-1950 MHz, <—60 dBc. For 1800-1999.99...MHz, a spurious could appear 610 ±1 MHz below the carrier, <—55 dBc.

Output Characteristics

	380	382
Level Range	Std, +13 to 0 dBm 181 opt, +13 to —150 dBm	Std, +10 to 0 dBm 183 opt, +10 to —136 dBm
Level Accuracy	Std, ±1.0 dB 181 opt, ±1.5 dB	Std, ±2.5 dB 183 opt, ±3 dB, +10 to —50 dBm ±3.5 dB, —50 to —136 dBm
Leveling	Std, ±0.5 dB, f >1 MHz ±1 dB, f <1 MHz 181 opt, ±1.0 dB, f >1 MHz ±1.5 dB, f <1 MHz	Std, ±2.0 dB 183 opt, ±2.5 dB
Programming Resolution	Std. N/A 181 opt, 0.5 dB	Std. N/A 183 opt, 0.5 dB
Impedance	50 Ω	50 Ω
VSWR	Std <2.6 181 opt, <2.6 above 0 dBm <1.4 below 0 dBm	Std <2.6 183 opt, <2.6 above —6 dBm <1.4 below —6 dBm

Output Characteristics — continued

	Programming Mode	μP Time	Settling Time	Total Switching Time
Output Level Switching Time	BCD Parallel	0	10 ms	10 ms
(180 series options only)	GPIB	20 ms	10 ms	30 ms

Amplitude Modulation

PM3601 or PM3602 Modulators	**380, 380 M .01 - 180 MHz**	**382, 382 M 1 - 2000 MHz**
Modulation Depth	0 - 95%(1)	0 - 90%(2)
Indicated AM Accuracy at 400 and 1000 Hz Rates (M - suffix only)	±5% of Full Scale (100%)	±5% of Full Scale (100%)
AM Distortion, THD. 400 and 1000 Hz Rates		
30% AM	1.0%	1%(3)
90% AM	3.0%(1)	5%(3)
AM 3 dB Bandwidth		
0 - 70%	DC - 200 Hz, Cf < 0.4 MHz DC - 10 kHz, 0.4 ≤ CF < 4 MHz DC - 100 kHz, CF > 4 MHz	DC - 10 kHz, 2 MHz < CF < 10 MHz(4) DC - 80 kHz, CF ≥ 10 MHz
0 - 90%	DC - 100 Hz, CF < 0.4 MHz DC - 5 kHz, 0.4 ≤ CF 4 MHz DC - 50 kHz, CF ≥ 4 MHz	DC - 5 kHz, 2 MHz < CF < 10 MHz(2) DC - 50 kHz, CF ≥ 10 MHz(2)
Internal Oscillator (M - suffix only)	400 and 1000 Hz	400 and 1000 Hz
Remote Programming (M - suffix only)	Fully programmable, external modulation input level is 1.0 VRMS for full scale.	
Programming Resolution (M - suffix only)	0.5% Increments	

1. For input levels below + 9 dBm. With 181 ATTENUATOR OPTIONS, for levels below +7 dBm.
2. For output levels below +7 dBm. With 182/183 ATTENUATOR OPTIONS, for levels below +3 dBm.
3. For output levels between +0 and +7 dBm. With 182/183 OPTIONS, for Vernier level settings between —4 and +3 dBm.
4. For output levels between +2 and +7 dBm. With 182/183 OPTIONS, for levels between 0 and +5 dBm.

Frequency Modulation

PM 3602 Modulation Section	**380 M .01 - 180 MHz**	**382 M 1 - 2000 MHz**
Rate	20 Hz to 300 KHz	
FM Center Frequency Long Term Stability	Same as in CW Mode	
Maximum Peak Deviation	1 MHz	1 MHz, CF < 400 MHz 10 MHz, CF ≥ 400 MHz
Incidential AM	< —70 dB with 75 KHz peak deviation at a 1 KHz rate	
FM Distortion (Internal Oscillator)	< 2% up to 100 KHz dev.	< 2% up to 100 KHz dev. for CF < 320 MHz < 2% up to 1 MHz dev. for CF ≥ 320 MHz
Internal Oscillator	400 and 1000 Hz	
Full Scale Ranges	0 - 10 KHz, 0 - 100 KHz, 0 - 1 MHz, 0 - 10 MHz	
Indicated FM Accuracy (up to 20KHz rates)	±5% of Full Scale Range	
Remote Programming	Modes, range, and level. External modulation input level is 1.0 VRMS for full scale.	
Programming Resolution	0.5% of Selected Range	

Phase Modulation

PM 3602 Modulation Section	380 M .01 - 180 MHz	382 M 1 - 2000 MHz
Rate	DC to 300 kHz	
Maximum Peak Deviation	100°, CF < 60 MHz 200°, CF ≥ 60 MHz	100°, CF < 100 MHz 200°, 100 to 200 MHz 400°, CF > 200 MHz
ϕM Distortion (Internal Oscillator)	< 5%	
Internal Oscillator	400 and 1000 Hz	
Full Scale Ranges	0 - 100°, 0 - 400°	
Indicated Accuracy	±5% of Full Scale Range	
Remote Programming	Mode, range and level. External modulation input level is 1.0 vrms for full scale.	
Programming Resolution	0.5% of Selected Range	

Pulse Modulation

PM 3601 or PM 3602	380, 380 M .01 - 180 MHz	382, 382 M 1 - 2000 MHz
Rise/Fall Time	< 5 μs	
On/Off Ratio	> 70 dB	> 30 dB
Input Level Required	0 to +5V under keyboard or remote control 0 to −5V under modulator panel control	

Digital Sweep

Sweep Functions

Start-Stop Sweep: Sweeps between two selected frequencies.

Step Size: Choice of 100 or 1000 points per sweep, or may be set to any value within the frequency resolution of the instrument up to 10,000 points.

Sweep Speed: Internal, 1, 10, 100 ms/step. External, 500μs/step maximum.

Sweep Output: 0 to 2 V nominal stepped ramp, 1000 points maximum. BNC connection on rear panel. SW UNCAL LED indicates when sweep uses over 1000 points.

Sweep Modes

Auto: Sweep repeats automatically.

Single: Single sweep activated by front panel keyboard.

Manual: Sweep controlled by front panel knob, or up/down keys.

Remote Programming

Interface: IEEE Standard 488 OR PARALLEL TTL (BCD for Frequency and Level).

Functions Controlled: All functions except the line switch are controlled and are programmable with the same accuracy and resolution as in keyboard mode. Output level is programmable only with 180 series attenuator options. Modulation is programmable only with M suffix models. (Includes PM 3602 modulator).

Mating Connector Types: (Not Supplied).

Fast Switching Parallel TTL:

Frequency: AMP CHAMP 229974-1.

Modulation and Level: AMP CHAMP 552284-1.

IEEE-488 Bus Cable: Amphenol Part Numbers
408-30111-301 (1 Meter Length).
408-30111-302 (2 Meter Length).
408-30111-304 (4 Meter Length).

Operating Temperature Range: 0° to +50°C

Power Requirements: 115 or 230 V ±10%, 48 to 66 Hz, 280 VA

Size: 178 mm H x 426 mm W x 648 mm D (7" x 16¾" x 25½")

Weight: Net: 41 kg (91 lb.)
Shipping: 52 kg (115 lb.)

frequency synthesizers

Options

001: Increased Resolution

002: Frequency Standard 3 x 10^{-8}/day

003: Frequency Standard 1 x 10^{-9}/day

004: 50-400 Hz Power Line

005: IEEE 488 (GPIB) Adapter
(Not Required for 380 Series)

006: Rack Mounting Adapter

007: Slide Mounting Adapter

181: Attenuator 180 MHz

183: Attenuator 2.0 GHz

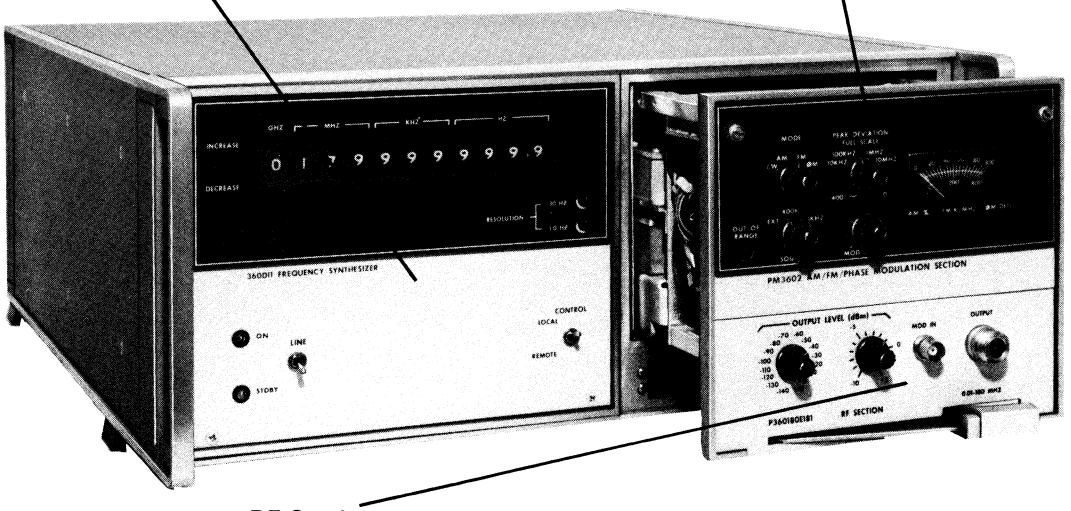
299252: Service Kit

The 360 Direct Synthesis System

Modular Frequency Synthesis System

Mainframe
The Mainframe contains the basic synthesizer modules, frequency standard (optional), power supplies, and manual control circuits. The unit illustrated provides 11 decade switches for fast, convenient, manual frequency selection.

Modulation Section
A module of the PM3600 Series must be installed in the RF Section for proper operation of the synthesizer. The unit shown (P/N PM3602) provides for amplitude, frequency and phase modulation.



RF Section
This plug-in contains the circuitry which determines the frequency range of the synthesizer. Present units operate over the broad range of 10 kHz to 180 MHz and 1 MHz to 1800 MHz. Remote frequency programming is simplified through the use of BCD parallel, positive true, TTL compatible logic.

Laboratory Signal Generation:

- Frequency Response
- Dynamic Range
- Linearity
- Sensitivity
- Distortion

Computer Controlled Test Systems:

- EMI/EMC
- General ATE
- Auto-scan Receivers

OEM:

- Frequency-agile system
- Spectrum management systems
- Electronic Intelligence
- Communications Systems

Model 360—Thumbwheel Control of Frequency
The AILTECH 360/380 Synthesized Signal Generator Systems offer a choice of two main frames, the 360 series thumbwheel frequency control, or the 380 series microprocessor controlled keyboard version.

The 360 Total Capability System

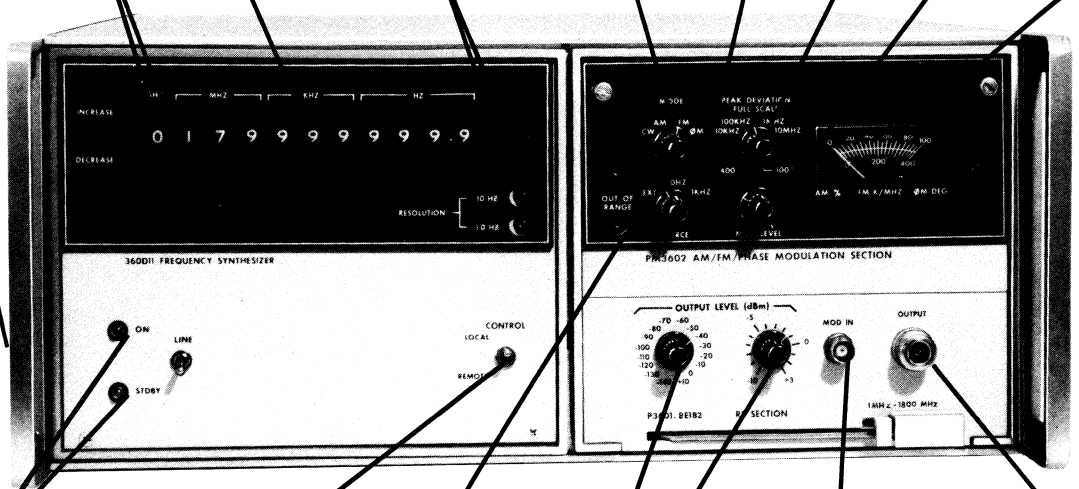
AILTECH's 360 Frequency Synthesizer is a modular, plug-in system that provides a simplified, economical solution to the general need for stable, precise signal generation. Offering state-of-the-art performance in spectral purity and switching time, the 360 becomes a valuable element in high-performance systems such as scanning receivers, frequency-agile radars, communication systems, etc. and, the addition of features such as modulation and programmable output attenuation through its modular design, makes the 360 a precision instrument for laboratory use and in automatic test systems.

The 360 is a "no compromise" synthesizer. Other units may compare in one or more features, but none provide the combined excellence of the 360 in all major performance characteristics—including price.

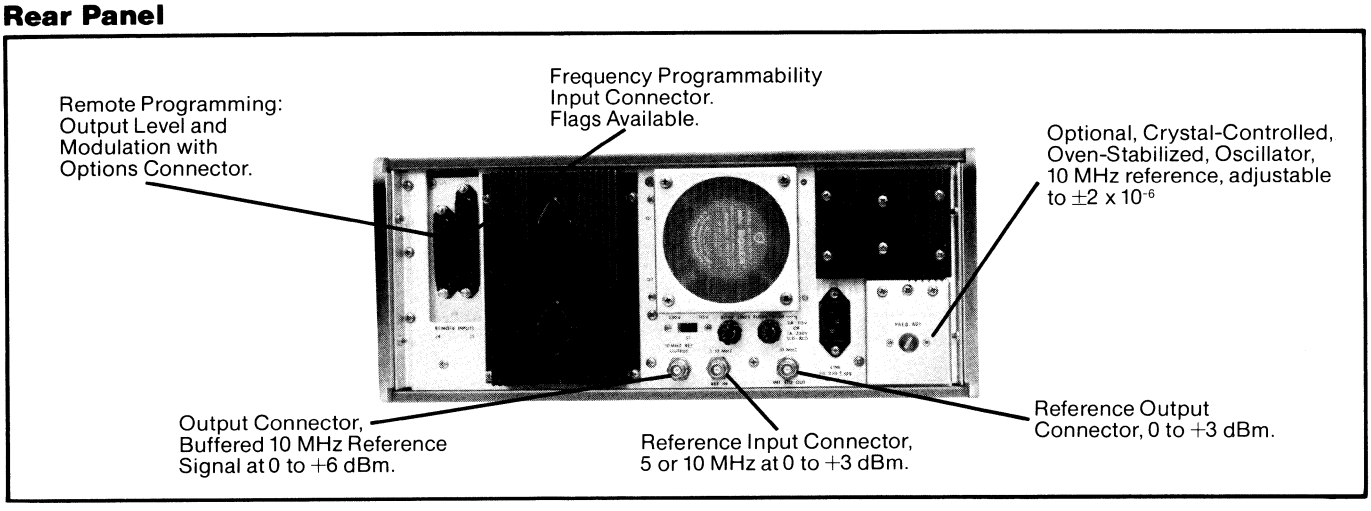
Features

- **Low Noise:** —138 dBc/Hz Floor
- **Low Spurious:** —100 dBc
- **High Speed Programmability:** 20 μsec switching
- **Versatile:** Plug-in modularity
- **Signal Generator Features:** Modulation, programmable output, attenuator options, etc.
- **Ease of Programming:** BCD parallel, GPIB

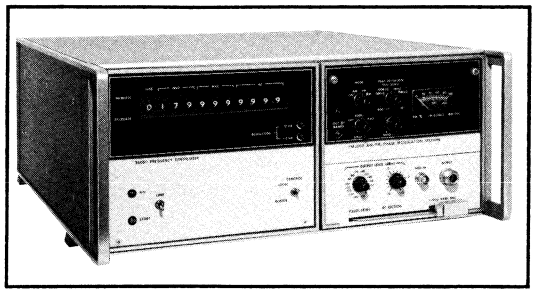
synthesized signal generator



Rear Panel



AILTECH 360



MAINFRAME OPTIONS

-001 Increased resolution.

-002 Internal, 10 MHz reference oscillator, oven-stabilized.
Aging rate: $\pm 3 \times 10^{-8}$/24 hours.
Adjustment range: $\pm 2 \times 10^{-6}$ minimum.

-003 High stability, internal, 10 MHz reference oscillator, oven-stabilized.
Aging rate: $\pm 1 \times 10^{-9}$/24 hours.
Adjustment range: $\pm 2 \times 10^{-6}$ minimum.

-004 50, 60, 400 Hz line frequency operation.

-005 GPIB ADAPTER compatible with IEE STD. 488-1975

-006 Rack Mounting Adapter.

-007 Slide Mounting Adapter.

frequency synthesizers

THE AILTECH 360 SYSTEM MODULAR DESIGN ENSURES EASE OF APPLICATION FOR OEM OR GENERAL LABORATORY USERS.

GENERAL DESCRIPTION

Each AILTECH Direct Frequency Synthesizer consists of a main frame, a plug-in RF Section, a modulation module and a frequency extender which is installed in the lower section of the main frame.

The modular design simplifies application to specific system situations without necessitating expensive redesign of the over-all instrument. For example: the RF Section can be easily removed and replaced with a plug-in, operating only over a particular band of frequencies, including microwave bands. These same design principles permit expanding the unit's capabilities for general laboratory use with additional modules.

MAINFRAME DESCRIPTION

The Mainframe comprises the upper left side of the package and is made up of a fixed-frequency generator, all synthesis decades smaller than 100 kHz and the power supplies. Mounting provision is provided for an optional reference oscillator. While the frequency stability is set at 3×10^{-8}/24 hours—higher stability is also available.

The decades in the Mainframe utilize AILTECH's patented, BCD synthesis technique which provides high-speed operation without sacrifice of spurious-free performance. The output of the Mainframe is a synthesized 35 to 36 MHz signal which is applied to the Frequency Extender (P/N 3600E1) for additional processing.

For convenience in setting the output signal manually, reversible pushbuttons are provided for each frequency decade. Large, easy-to-read numerals, mechanically ganged to the decade switches provide a clean display of the selected frequency. Frequency may also be selected by means of the programming input at the rear of the RF Section simply be setting the LOCAL-REMOTE switch to REMOTE position. Status flags, indicating the positions of the POWER and LOCAL-REMOTE switches, are available at the programming connector.

Optional brackets can be provided to simplify rack-mounting. However, additional support is required.

MAINFRAME P/N 360D11

TECHNICAL CHARACTERISTICS

FREQUENCY SELECTION: 11 Digits selected by push button, or remotely programmable via RF Section rear connector (TTL compatible, BCD parallel).

FREQUENCY RESOLUTION: Dependent upon RF section installed.

REFERENCE OSCILLATOR:
Internal: See options.
External: 5 or 10 MHz, 0 dBm, 50 ohms, BNC rear panel input.

REFERENCE OUTPUT: Rear panel BNC connector provides 10 MHz reference output at +3 dBm nominal, 50 ohms.

DISPLAY: Frequency selection pushbuttons provide mechanical display of frequency.

OPERATING TEMPERATURE RANGE: 0 to 55° C.

POWER: 115 or 230 volts, ±10%, 48 to 66 Hz, approximately 130 watts including typical RF Section, Frequency Extender, and Modulation Section.

SIZE: 16¾ inches wide x 7 inches high x 22⅜ inches deep (426 x 178 x 568 mm).

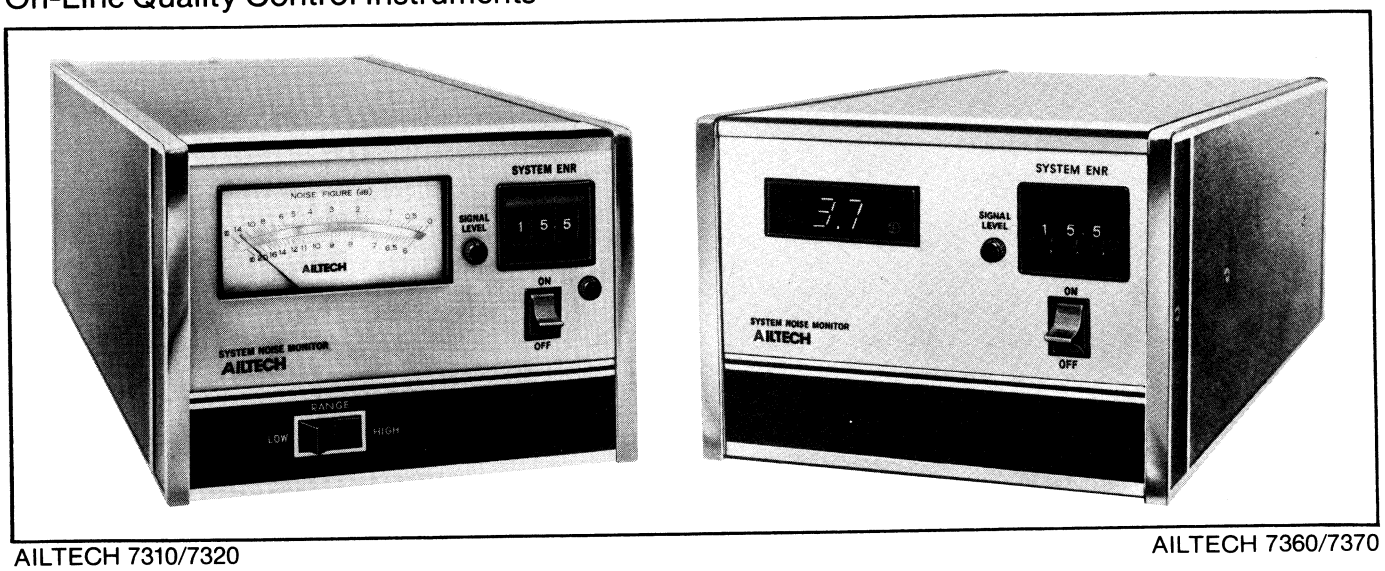
WEIGHT: Mainframe only. Net: 48 lbs. (21.6 kg), Shipped: 60 lbs. (27.3 kg)

Note: With the exception of the Mainframe module (above) and the thumbwheel controls, the 360 Direct Synthesized Signal Generator is the same as the Model 380.

Please see pages 41 through 47 for performance features and specifications.

Series 7300 System Noise Monitors

On-Line Quality Control Instruments



AILTECH 7310/7320

AILTECH 7360/7370

The AILTECH 7300 Series of System Noise Monitors are designed to satisfy those field and production applications that demand *Simplicity* and *Economy* in their instrumentation.

With over 20 years of experience in the noise instrumentation market, AILTECH has always been the leader in this field. We provide the most accurate and versatile—

LABORATORY INSTRUMENTS

- Type 75 Precision Automatic Noise Figure Indicator
- Type 136 Precision Test Receiver
- Type 7009 Hot-Cold Body Noise Standard

BROADEST RANGE OF NOISE SOURCES

- Both gas discharge and solid state types as well as several types of secondary noise standards

Exclusive from Eaton Corporation, Electronic Instrumentation Division

INSTRUMENTATION FOR NBS TRACEABLE CALIBRATION

- Type 82 Microwave Noise Temperature Calibrator

However, the need for this type of instrumentation extends beyond the laboratory. Production testing of components, subsystems, etc. and field monitoring of system performance is essential if original equipment goals are to be maintained.

The Production testing for Noise Figure of various components (e.g. transistors, amplifiers, etc.) is becoming more necessary in today's drive for large quantities of inexpensive communication components and equipments. The 7300 System Noise Monitor is specifically designed for today's production testing needs, from high speed computer controlled test equipment operations down to the more economical manual test set ups.

Long term system degradation is usually a prelude to failure but during that period it can mean to the user such things as:

- higher bit-error rates
- obscured targets
- reduced range
- loss of communication

Monitoring of system performance during actual field operation will alert the operator to anticipate and correct these errors before they occur.

As opposed to laboratory type of instrumentation, the need in production and field applications is for simpler, easier to use, smaller and less expensive products. It is to satisfy these goals that the 7300 series is dedicated.

- Accurate
- Versatile
- Economical
- Simple Calibration
- Convenient Sizes
- Simultaneous Noise Figure and Gain

And IEEE-STD-488 Interface Compatability

system
noise
monitoring

system noise monitoring

Applications

NOISE FIGURE MEASUREMENT

• Transistors • Amplifiers • Mixers • Receivers

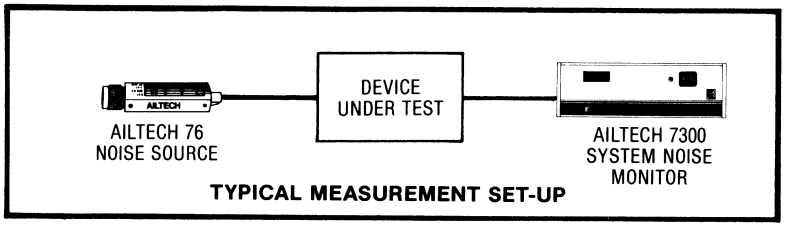


Figure 1

Figure 1 shows a typical setup for measurement of noise figure. The System Noise Monitor (SNM) furnishes modulated low level DC power to the noise source which in turn provides a noise on-noise off period to the receiver under test. The IF of the receiver is then injected into the SNM which detects, measures and indicates Noise Figure or Noise Temperature directly. Other than a control for initial calibration of ENR, no other controls are contained in the basic SNM making it function as a simple go-no-go production instrument.

Both analog and digital models are available. In digital versions, a BCD output is provided at the rear panel, and some configurations are available with the Standard Bus Interface where computer control is required.

AUTOMATED PRODUCTION TEST

• Transistors • FETs • Amplifiers • Mixer-amplifiers

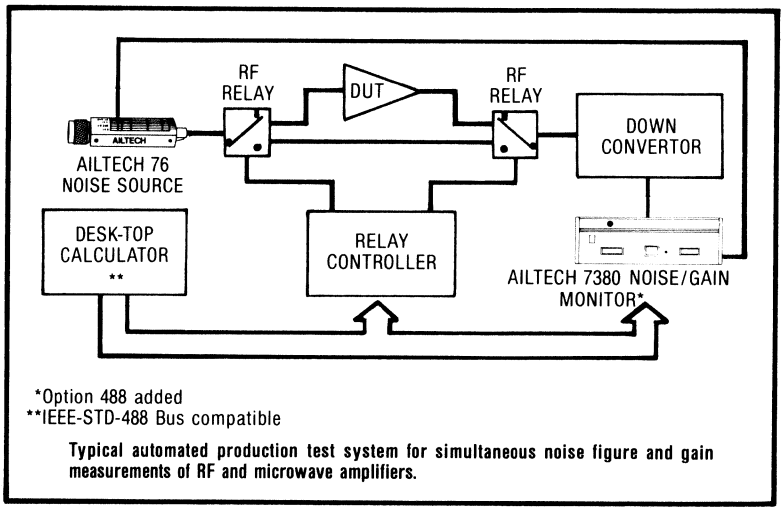


Figure 2

The optional bus interface for the 7370 and 7380 provides a low-cost means of adding noise figure and, simultaneously, gain to the growing list of automated measurements. The benefits to be gained include greater throughput, improved measurement consistency, more thorough testing, and less potential for error in the measurement results.

All these factors add up to less testing cost—and with the 7380 Noise/Gain Monitor costs can be even further reduced. This unique instrument determines the gain of the DUT from its noise parameters, thus providing two critical performance criteria with one set-up.

A unique capability when under calculator control is the ability to extract true DUT noise figure from the overall measured noise figure of the set-up using the gain and stored second-stage noise figure. Figure 2 illustrates the typical set-up.

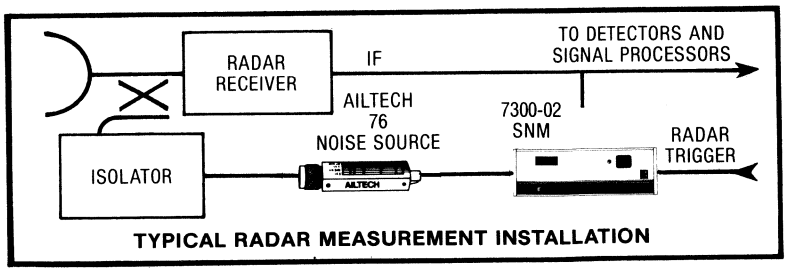


Figure 3

Figure 3 is a simplified block diagram of a typical radar installation. Although the basic measurement technique is the same, the noise source must be injected through an appropriately rated isolator and directional coupler. This is necessary so that the system performance is not degraded as well as protecting the noise source from high power radar signals. Typical couplers present decoupling values of from 15 to 25 dB. This necessitates that the noise source power (ENR) be increased to assure adequate noise be injected into the system. AILTECH not only furnishes such high level sources but can also calibrate the ENR at the output of the coupler to eliminate this component as another source of error.

In simple operation, it is necessary to perform this measurement while the radar receiver is in the stand-by position (transmitter off). However, AILTECH can also provide a standard option that permits the measurement to be made during normal radar operation. In this mode, the SNM receives a trigger from the radar and turns the noise source on only during the radar dead time. The SNM then performs the measurement using sample and hold techniques. In this manner completely synchronous operation is achieved.

COMMUNICATIONS SYSTEMS

Conventional noise measurement techniques have also been applied to monitor the performance of satellite communication receiver systems. Using simple adaptation, the operator can measure the noise introduced by the receiving system itself, its antenna, the satellite transponder or radio stars that are used for G/T measurements.

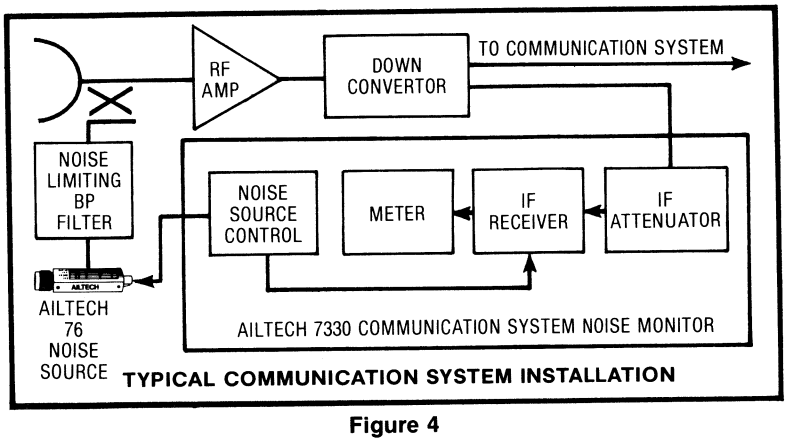
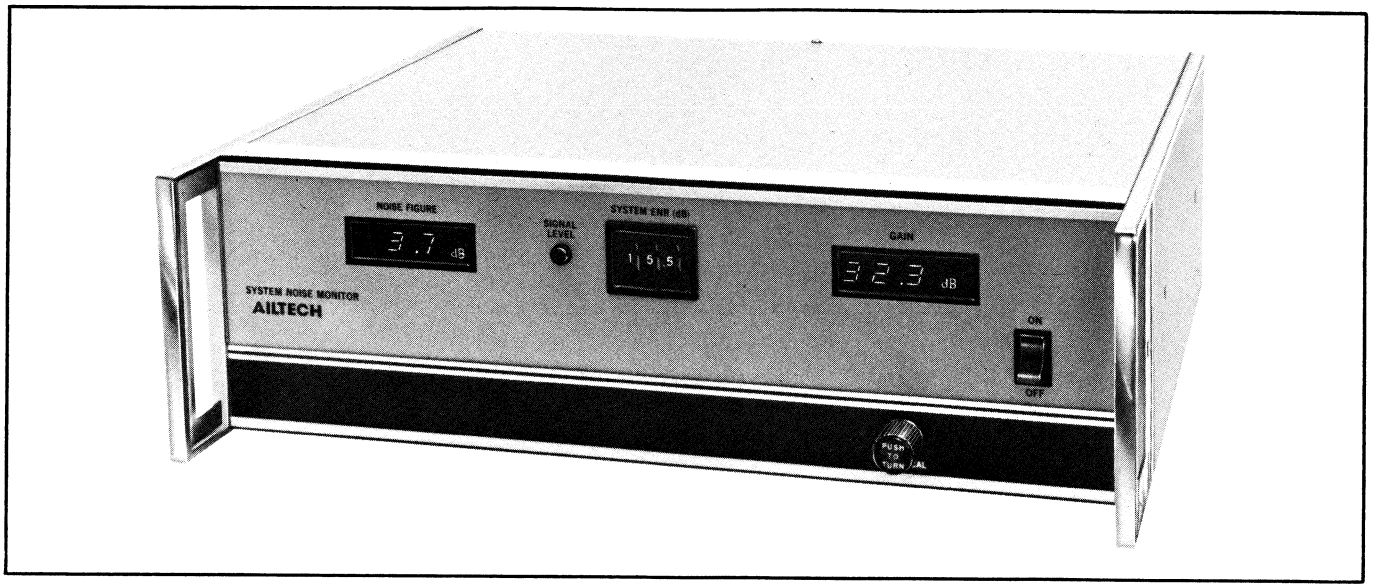


Figure 4

To perform these measurements only two instruments are required. A Model 7330 Communication System Noise Monitor and a calibrated noise source coupled to the RF input line of the communication ground station. *Figure 4* presents a block diagram of the measurement system. (Note: Paper "Measurements of Noise and G/T in Satellite Communications Systems" available on request.)

system noise monitoring

7380* Noise Figure/Gain Monitor



IEEE 488 GPIB

system noise monitoring

The AILTECH 7380 Noise Figure/Gain Monitor is ideal for making rapid, accurate noise figure and gain measurements on semiconductors, amplifiers, receivers, mixers, etc. BCD outputs of noise figure and gain, as well as an optional GPIB interface, if computer control or digital interface is necessary.

Noise figure using solid-state noise sources, and the data are presented on a 3-digit LED display. Gain is measured simultaneously by monitoring DUT noise levels, and is continuously displayed on a separate 3-digit LED readout.

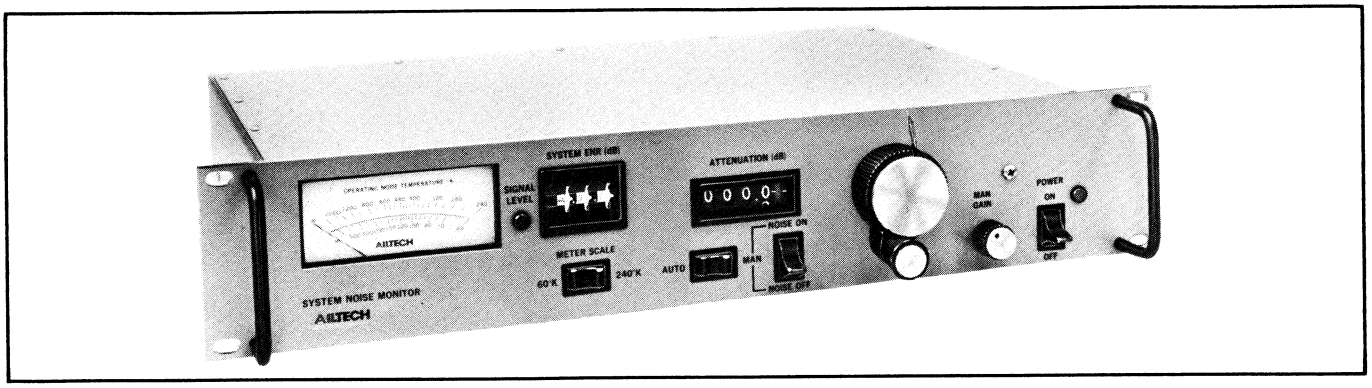
Specifications for the AILTECH 7300

Input Frequency Range	10.7, 21.4, 30, 36, 45, 60, or 70 MHz
Bandwidth	10% (nominal)
Sensitivity	-100 dBm (nominal)
Input Signal Level Range	40 dB
Input Impedance	50 ohms
ACCURACY (See note)	
Noise Figure	
0 to 6 dB	±0.25 dB
6 to 12 dB	±0.5 dB
GAIN	
0 to 40 dB (at constant temperature)	±1.0 dB
RESOLUTION FOR NOISE FIGURE AND GAIN	0.1 dB (3 digit display)
ENR CALIBRATION RANGE	6 to 15.9 dB in 0.1 dB steps
NOISE GENERATOR GATE OUTPUT (REAR PANEL)	BNC, female. "Noise On," +28.00 Volts "Noise Off," 0.25 Volts
IF INPUT (REAR PANEL)	BNC, female
AUXILIARY OUTPUTS (Rear panel Cinch 57-30240)	Analog Recorder: 7.5 volts nominal for 0 dB noise figure Signal Level Monitor: uncalibrated Noise Figure/Gain: BCD parallel, TTL, positive logic (requires a control pulse to select Noise Figure or Gain outputs)
INPUT POWER	115/230 VAC±15%, 50-400 Hz, 15 watts
OPERATING TEMPERATURE	5 to 50°C
SIZE	5¼"H. x 17⅛"W. x 13¼"D. (13.3 x 43.5 x 33.7 cm)
WEIGHT	18 lbs. Net (8.2 kg), 22 lbs. Ship (10 kg)

Note: Accuracy in the Automatic mode is specified as related to a manual measurement at a fixed frequency.

***Available with GP-IB Interface**

7330 Communication System Noise Monitor



The AILTECH 7330 Communication System Noise Monitor is designed to provide operating noise temperature monitoring of communication and microwave receivers. It also provides the capability of performing measurements of system sensitivity. The AILTECH 7330 has practical applications to satellite communication systems as well as receivers operating in microwave links.

The AILTECH 7330's high accuracy and ease of operation makes it ideally suited for permanent installation in satellite communication systems.

system noise monitoring

Specifications for the AILTECH 7330

Input Frequency	30 or 70 MHz
Bandwidth	10% (nominal)
Sensitivity with attenuator at 0 dB	−52 dBm (minimum)
Input Impedance	75 ohms (nominal); 70 MHz IF 50 ohms (nominal); 30 MHz IF
AUTOMATIC MODE	
Input Signal Level Range	40 dB
ACCURACY	
Full Scale to Half Scale	±5.0% (in Kelvins)
Half Scale to Three Quarter Scale	±8.0% (in Kelvins)
FULL SCALE READING	
Lower Scale	60 K (Kelvins) with 5K Resolution
Top Scale	240 K (Kelvins) with 20K Resolution
Calibration Range	System ENR of −4.9 dB to +4.9 dB
MANUAL MODE	
Attenuation Range	100 dB (Ailtech 32 Precision IF attenuator)
Y-Factor measurement error	±0.005 dB/10 dB step +0.03 dB
REAR PANEL INPUT AND OUTPUT CONNECTORS	
Noise Generator Gate Output	BNC, female +28.00 VDC for "Noise On," 0 Volts for "Noise Off."
Recorder Output	Nominal 1.0 volt for full-scale meter deflection
IF Input	BNC, female
Video, Recorder and all Optional Outputs	Cinch 57-30240 with mating connector
Input Power	115/230 VAC ±15%, 50-400 Hz, 10 watts
Operating Temperature	5 to 50° C
Size	3½"H. x 19"W. x 12¼"D. (8.9 x 48.3 x 31.1 cm)
Weight	10 lbs. (4.5 kg) Net. 14 lbs. (6.3 kg) Ship

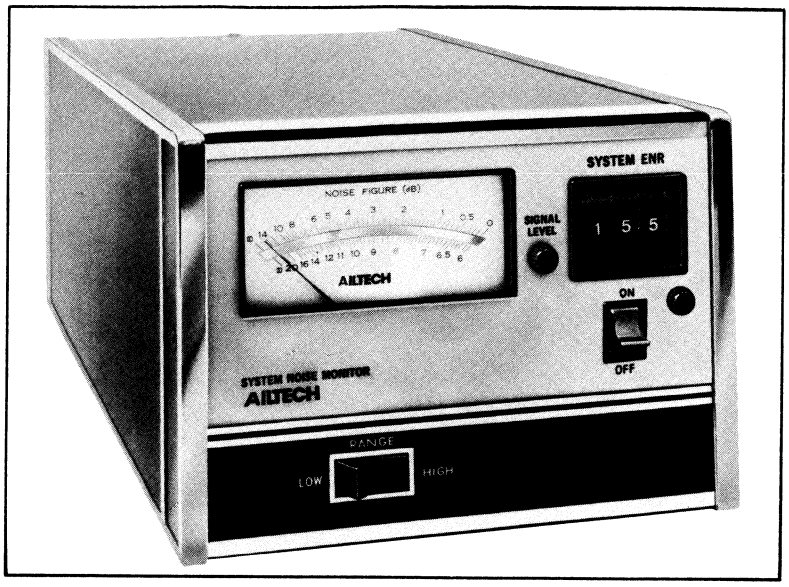
HOW TO ORDER YOUR SYSTEM NOISE MONITOR

There are only four steps to take to completely specify your specific model from the 7300 series.

1. Choose the basic model desired from the six units available (7310, 7320, 7330, 7360, 7370 or 7380).
2. Specify your center frequency.
3. Noise figure scales will normally be provided. Should you require noise temperature scales, a T in the complete part number will specify this.
4. Add suffix numbers for your desired options (see pp. 7-10).

Example: P/N 7310-(30) T-03-10 specifies an analog, half rack, 30 MHz unit with temperature scales, including alarm and front panel manual control options.

system noise monitoring



7310 System Noise Monitor

The AILTECH 7310 System Noise Monitor is a fully automatic instrument that provides a continuous indication of the noise performance of a microwave receiver. Its high accuracy, ease of operation and small size make it ideally suited for permanent installation in receiver systems.

The AILTECH 7310 is an analog, bench-type System Noise Monitor. It provides a fixed IF (see specs for available choices) with either Noise Figure or Noise Temperature indication.

GENERAL SPECIFICATIONS FOR THE AILTECH 7300 SERIES SNM

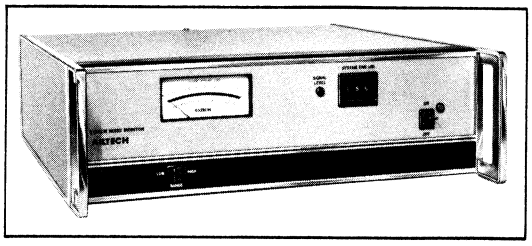
INDICATOR	
Input Frequency Range	10.7, 21.4, 30, 36, 45, 60, or 70 MHz
Bandwidth	10% of center frequency (nominal)
Sensitivity	−70 dBm (minimum)
Signal Level Range	40 dB
Input Impedance	50 ohms (75 ohms can be provided if specified at time of order)
ACCURACY (See Note)	
Analog Units	
Full Scale to Half Scale	±0.25 dB for Noise Figure ±5.0% (in Kelvins) for Noise Temperature
Half Scale to Quarter Scale	±0.5 dB for Noise Figure ±8.0% (in Kelvins) for Noise Temperature
Digital Units - 0 to 6 dB	±0.25 dB
6 to 12 dB	±0.5 dB
Scale Indications	
Noise Figure	0 and 6 dB Full Scale
Noise Temperature (Analog Units Only)	60 and 240K Full Scale (available if specified at time of order)
ENR Calibration Range	6 to 15.9 dB (in 0.1 dB steps)
Noise Generator Gate Output	BNC, female. +28.00 Volts for "Noise On," 0 Volts for "Noise Off"
Recorder Output (Rear Panel)	1.0 volt across 1K ohms for full scale meter deflection (7310, 7320) 7.5 volts nominal across 1K ohms for 0 dB indication (7360, 7370)

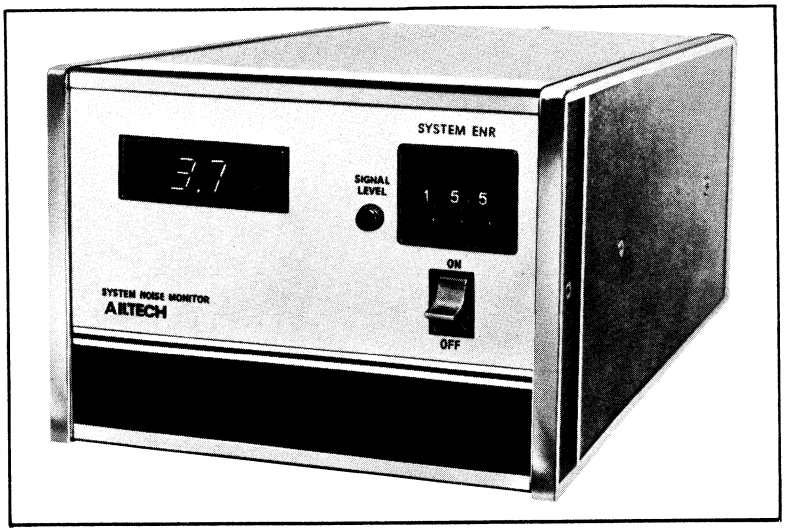
OPTIONS AVAILABLE (See page 59 for descriptions)

7310: 03, 06, 10, 12

7320: 02, 03, 04, 06, 07, 09, 10, 11, 12, 13, 15

The AILTECH 7320 System Noise Monitor is the Full Rack version of the AILTECH 7310.





7360 System Noise Monitor

system noise monitoring

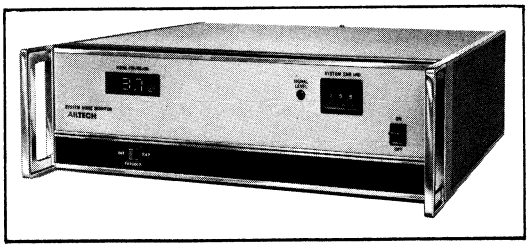
Today the trend in instrumentation for monitoring the condition and performance of operating systems is toward unattended, automated operation under control of, or interfacing with, a computer. This is where the AILTECH 7360 Digital System Noise Monitor comes in—measuring noise figure—Fast, Accurately and Automatically.

The AILTECH 7360 is the digital, bench type, System Noise Monitor. The 7360 has a fixed IF (see specs for available choices) with Noise Figure indication. Noise temperature indication is available in analog units only.

IF Input (Rear Panel)	BNC, female
Video, Recorder and all Optional Outputs (Rear Panel)	Amphenol 57-20240-1
Input Power	115/230 VAC ±15%, 50-400 Hz, 10 watts
Operating Temperature	5 to 50° C
Size	
7310	5¼"H. x 7 7/16"W. x 13¼"D (13.3 x 18.9 x 34.3 cm)
7320	5¼"H. x 17⅛"W. x 13¼"D. (13.3 x 43.5 x 33.7 cm)
7360	5¼"H. x 7 7/16"W. x 13¼"D. (13.3 x 18.9 x 34.3 cm)
7370	5¼"H. x 7⅛"W. x 13¼"D. (13.3 x 43.5 x 34.3 cm)
Weight	
7310	10 lbs. Net (4.5 kg) 14 lbs. Ship (6.3 kg)
7320	15 lbs. Net (6.8 kg) 19 lbs. Ship (8.6 kg)
7360	10 lbs. Net (4.5 kg) 14 lbs. Ship (6.3 kg)
7370	15 lbs. Net (6.8 kg) 19 lbs. Ship (8.6 kg)

Note: Accuracy in the Automatic mode is specified as related to a manual measurement at a fixed frequency and includes effects of tracking error and temperature variations. Higher accuracy and resolution is obtainable under most operating conditions.

*The AILTECH 7370 System Noise Monitor is the Full Rack version of the AILTECH 7360.



OPTIONS AVAILABLE (See page 59 for descriptions)

*Available with GP-1B Interface

system
noise
monitoring

Options for the 7300 Series System Noise Monitors

IEEE-STD-488 INTERFACE OPTION

The AILTECH 7370 and 7380 System Noise Monitors can now be remotely controlled by means of the IEEE-488-1975 Standard Interface Bus Noise figure and gain measurements, as well as several auxiliary set-up functions, can be programmed and monitored using a calculator or computer with IEEE 488 I/O Bus compatibility.

This option provides a low cost means of adding noise figure (and simultaneously, gain*) to the growing list of automated measurements. In the past, noise figure has usually required a separate setup 1, necessitating removal of the device-under-test (DUT) from a test station, thus adding time, cost, inconvenience, and a greater potential for error to the performance verification of the DUT—either in the design/development or production phase.

With the exception of the added functions noted, the option-equipped instruments are identical in features and performance to the standard units, for example, BCD parallel and analog outputs proportional to noise figure and signal level are available on the rear panel.

TO ORDER: Add -488 to the 7370 or 7380 part number.

CONTROL FUNCTIONS AND OUTPUTS

Control Functions

Standby: The noise source can be enabled or disabled under bus control, thus becoming a passive termination while other tests are made.

Range: Available only on 7370's equipped with option 100 (order option 488B) Instruments so equipped have an added extended measurement range of 10 to 29.9 dB. The range—either normal (0 to 19.9 dB) or extended—can be selected via the bus.

Auxiliary: A user-defined, bus-controlled output on the interface board. This output can be used for such functions as input selection, external level control, etc.

Outputs

Noise Figure.

Gain (7380 only).

Signal Level: A fault indication. If the SNM Signal Level Light is extinguished for any reason, usually an indication of a fault in the IF amplifier chain, a noise figure of 00.0 dB will be placed on the bus data lines. This unique value can serve as a fault indicator to the controller.

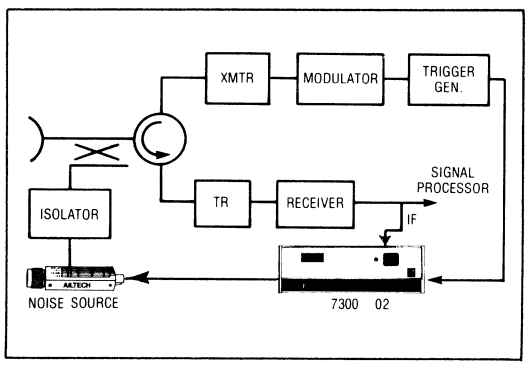
ON LINE RADAR NOISE FIGURE MONITOR (Option-02)

INTRODUCTION:

Option 02 offers the capability of continuous monitoring of the noise figure of a radar without interfering with its normal operation. Noise is injected into the radar front-end via a directional coupler in the main transmission line to the antenna during the dead time on every other repetition period of the radar. The noise monitor IF gate is opened on every period; thus, an automatic Y-factor measurement is implemented. The result is displayed as noise figure.

Continuous noise figure monitoring provides an indication of an impending front-end component failure before it occurs. TR devices with erratic or long recovery times, PIN switch instabilities, and general degradation of low noise amplifiers are typical of the conditions not observable by classic MDS measurements.

The block diagram shows a typical installation. The noise is injected through the directional coupler, typically 20 dB. The isolator is rated to prevent change to the noise source by the transmit pulse. Calibrated, high-level noise source/isolator assemblies can be provided (sold separately) for most applications such that the injected noise is within the "ENR Calibrate" range of the 7300.



Typical Installation

The synchronous radar option offers two modes of operation. In the non-delay mode, the radar provides a trigger at the start of or during the dead-time. This mode offers the most flexibility in terms of PRF stagger and range. If a dead-time trigger is not available, the modulator transmit trigger is used and a fixed delay occurs to set the measurement interval within the dead time. All units also incorporate an internal trigger for free-running operation. This mode is useful for alignment and testing of sub-assemblies on the bench or when the radar is out of service.

Option 02 is applicable to the 7320 and the 7370. It is especially useful for automated monitoring when used with a 7370 equipped with the optional 488 interface bus. Consult the factory for special application to bench-mount 7310.

ADDED PERFORMANCE WITH OPTIONAL FEATURES

INTRODUCTION:

In addition to the Standard Bus Interface and Synchronous Monitor options, AILTECH offers a line of low-cost options to enhance performance and simplify operation for specific applications. These options are described below while the chart on the opposite page is provided as an aid to illustrating applicability of specific options to the various models.

Option No. **Title and Description**

03 **Noise Figure Alarm:** A relay operates when the noise figure exceeds a variable, internally preset value. Relay contacts (SPDT) are brought out to the rear panel connector. The alarm DISABLE switch is mounted on the front panel.

04 **Frequency Converter:** A fixed frequency, internally mounted downconverter used to translate a specific input frequency to the basic SNM IF. Connection to the IF is via rear panel patch cable. The L.O. can be preset at the factory for any frequency between 180 and 265 MHz. Conversion loss is 6 dB nominal.

06 **Special Paint:** Upper front panel only painted per customer requirements (customer to supply paint).

07 **High Sensitivity:** A low-noise preamplifier is internally mounted to provide a nominal 20 dB improvement in sensitivity. IF input is via the preamplifier. Input noise figure is 3 dB, nominal. Typical sensitivity with this option for the 7320, 7370 is −100 dBm (−72 dBm for the 7330).

09 **RF Mixer:** A broadband mixer is mounted on the rear panel. The mixer will accept RF and LO inputs form 10 to 1000 MHz. Connection to the SNM IF input is via rear panel patch cable. Nominal conversion loss is 6 dB.

10 **Manual Front Panel Controls:** The AUTO-MANUAL mode switch, noise generator ON-OFF switch, and MANUAL GAIN control, used for manual Y-factor measurements are brought out to the front panel.

11 **Rack Mount Adaptors:** A pair of angle adaptors which bolt on to the 7320, 7370 and 7380 side frames to make these instruments suitable for standard 19 inch relay rack mounting (NOTE: the 7330 front panel is 19 inches wide and can be rack-mounted without these adaptors).

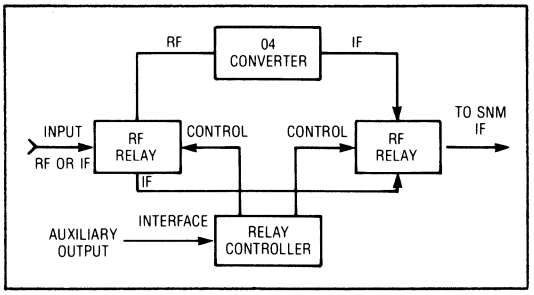
12 **10 Volt Recorder Ouput:** A second analog recorder output which provides 10 volts for full-scale deflection is added. The nominal 1.0 volt recorder output is retained, but the External Meter output is deleted.

13 **Front Panel Connectors:** The IF Input and Noise Source Output connectors are brought out to the front panel.

15 **Slide Mounting:** This option provides a pair of non-tilt slides mounted to the 7320, 7370, or 7380 side frames. Slide type is Zero. C300S-14. Requires −11 option.

100 **Range Extension, 29.9 dB:** Extends the noise figure measurement range of the digital units to 29.9 dB by means of a front panel RANGE switch. Can be bus-controlled if the 488 Option is installed. Accuracy in the extended range is ±0.5 dB for 10 to 15 dB indication, ±10 dB for 15 to 29.9 dB.

101 **Range Extension Output:** Provides a switch closure at the rear panel connector when the Extended Range is selected (-100 Option must be installed).



Typical Special Application

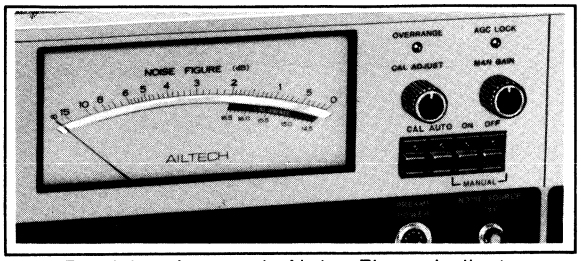
TO ORDER

1. Add -02 to the 7320 or 7370 part number.
2. Specify measurement gate width −20 microseconds minimum.
3. Specify nominal radar PRF.
4. Specify mode—Delay or Non-delay.
5. Specify required delay if applicable.
6. Provide trigger characteristics (amplitude, pulse width, etc).
7. Specify transmitter peak and average power at the coupled noise injection port (required for the separately sold noise source/isolator).

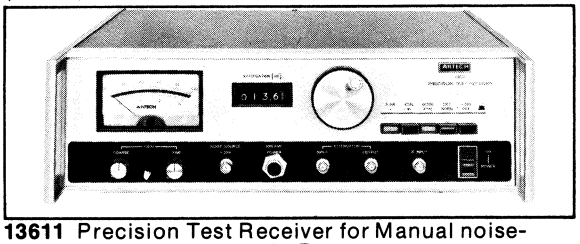
OPTION AVAILABILITY

SNM MODEL	7310	7320	7330	7360	7370	7380
OPTION						
02	SP	●			●	
03		●	SP	●	●	●
04	SP	●			●	●
06		●	●	●	●	●
07	SP	●	●		●	
09	SP	●		SP	●	●
10		●		●	●	●
11		●			●	●
12		●	●	●	●	●
13	SP	●	SP	SP	●	●
15		●			●	●
100				●	●	●
101				●	●	●
488					●	●

All options are not available on every model System Noise Monitor, as indicated above. Some options are only available on special order (SP).

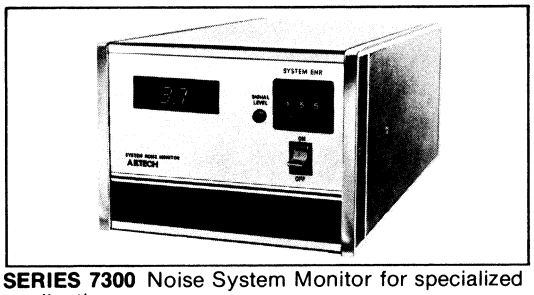


7514 Precision Automatic Noise Figure Indicator (PANFI).



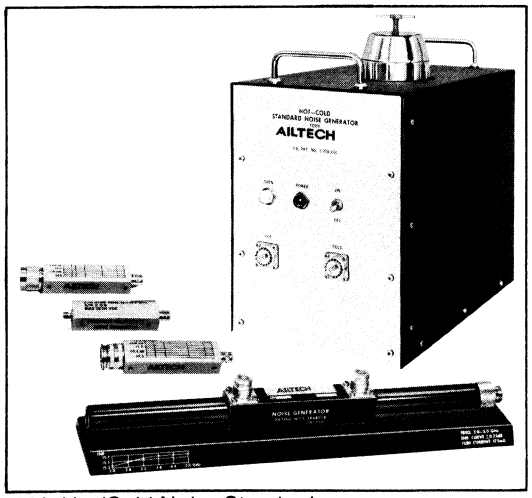
13611 Precision Test Receiver for Manual noise-figure measurements to 0.1 dB accuracy.

7175 Noise Generator Power Supply

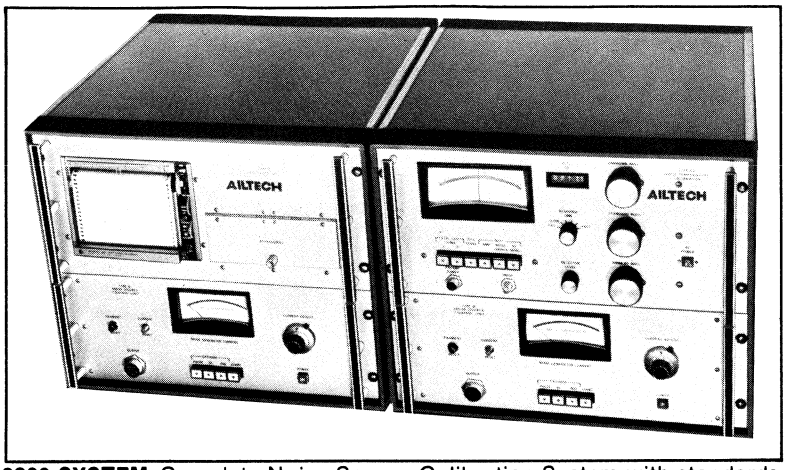


SERIES 7300 Noise System Monitor for specialized applications.

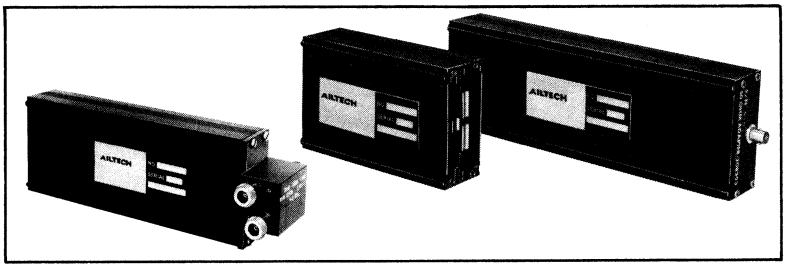
SERIES 32 Precision Attenuators: 30, 60 and 70 MHz.



7009 Hot/Cold Noise Standard.
SERIES 70 & 76 Complete offering of Solid-State & Gas-Discharge Noise Sources from 10 MHz to 40 GHz.



8200 SYSTEM Complete Noise-Source Calibration System with standards traceable to N.B.S.



SERIES 135 Coaxial & Waveguide Mixers from 10 MHz to 38 GHz.

Noise Figure Measurement and Calibration

- 10 MHz to 40 GHz
- ±0.1 dB measurement accuracy
- NBS — traceable calibration systems

An Introduction to Noise-Figure Measurement

Eaton Corporation Electronic Instrumentation Division has pioneered in the field of noise-figure measurement and calibration. We have available a complete line of precision noise-figure instrumentation and accessories which are described in this catalog.

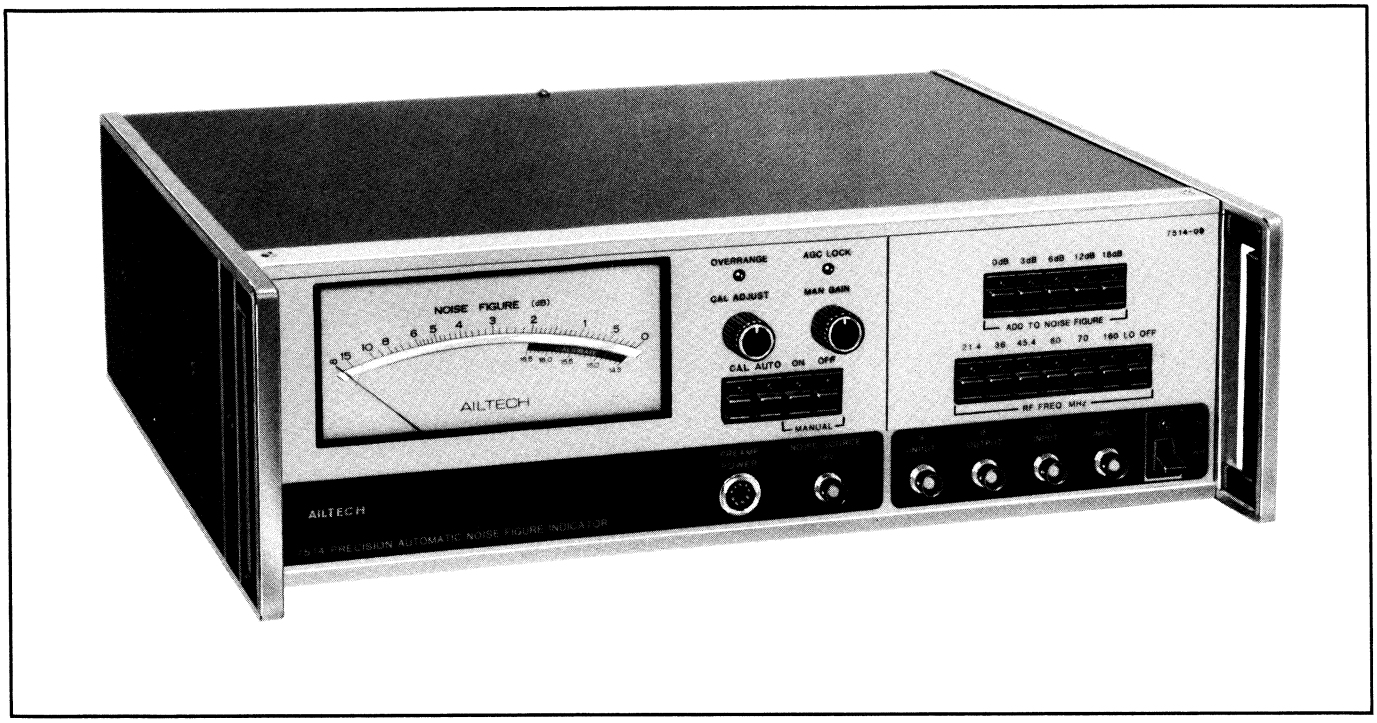
Basic Equipment Consideration

There are two basic methods of measuring noise parameters. These are known as "Automatic" and "Manual." The Manual measurement uses a series substitution technique to measure the Y-factor, and the operator calculates the noise figure from an equation (see page 67). The Automatic measurement requires a Precision Automatic Noise Figure Indicator (PANFI), which electronically makes the Y-factor measurement and displays the results directly in noise figure.

The selection of one method over the other is a simple, convenience-versus-accuracy trade-off. The Automatic method's ease-of-operation and measurement speed are of prime importance in production test where many measurements must be performed, or in a laboratory when extensive noise figure-versus-frequency characteristics are to be measured. Also, the direct-reading PANFI allows the operator to easily optimize noise figure by circuit adjustments.

When the greastest accuracy is required, the Manual method should be used. This method eliminates the small errors associated with tracking inaccuracies and non-linearities associated with the Automatic system.

7514 Precision Automatic Noise Figure Indicator (PANFI)



Features

- Accuracy as great as ±0.05 dB.
- Sensitivity of −76 dBm (−100 dBm with Preamplifier).
- Self-Calibration for 10 MHz to 40 GHz Noise Sources.
- Resolution of 0.02 dB for low noise figures.
- Front-panel, signal-strength indicator.
- Overrange indicator.
- Visual control status indicators.
- Compatible with all AILTECH Solid-State Noise Sources.
- Compatible with Gas-Discharge Sources when used with the 7175 Power Supply.
- SIMPLE operation.
- All Solid-State Design.

The AILTECH 7514 is the newest member of Eaton Corporation's line of highly accurate, laboratory noise figure instrumentation. Like its predecessors, the AILTECH 7511 and 7512, this new instrument provides the means to accurately and easily measure the noise figure of an amplifier or receiver. Its fast, direct-reading capability offers the user the means to immediately evaluate the effects of circuit adjustments on noise performance.

The 7514 PANFI has been engineered to simplify noise-figure measurements for the operator. After initial setup, only one pushbutton need be operated to read noise figure directly and automatically. A front-panel indicator provides assurance that sufficient signal is present for an accurate measurement.

A patented calibration system is incorporated to maintain the high accuracy of the 7514 PANFI regardless of which noise source is chosen. Thus, the basic ±0.05 dB accuracy (typical) holds for measurements from 10 MHz to 40 GHz, using either solid-state or gas-discharge noise sources (requires P/N 7175 Gas Noise Generator Power Supply). To further enhance system accuracy, the AILTECH 7514 is capable of Manual measurement of noise figure.

noise figure instrumentation

An expanded meter scale provides for indications of from 0 to 3 dB, spread over 3 inches of meter arc (one-half the meter scale), enabling resolution of a few hundredths of a dB. A unique range switching feature allows most noise-figure readings to fall within this expanded portion of the scale.

Specifications:

Frequency Range: 10 MHz to 40 GHz (Depends on the noise source and the availability of a 30 MHz output frequency from the device/system under test. For other output frequencies, see "Options" below).

Noise-Figure Range: Zero to 33 dB in 5 ranges

Accuracy: (Exclusive of Noise-Source Accuracy)

Typical: (At constant temperature & input level)
±0.05 dB + 0.05 dB per 3 dB increment.

Guaranteed: ±0.10 dB from 0 to 9 dB
±0.20 dB from 9 to 12 dB
±0.4 dB from 12 to 18 dB
±0.75 dB from 18 to 21 dB
±1.0 dB from 21 to 33 dB

Input Frequency: 30 MHz (see "Options" below)

Bandwidth: 5 MHz (minimum)

Sensitivity: −76 dBm (typical) at zero AGC level.

Control Ranges:

Automatic Gain (AGC): 65 dB (minimum)

Calibration: Calibrates PANFI to any Noise-Source ENR between 14.5 and 16.5 dB.

Signal-Strength Indicator: Front Panel light (labeled "AGC")

Overrange Indicator: Front-Panel light

Rear-Panel Outputs:

Auxiliary Power Supply: Powers AILTECH 13630, 13650, 13680 Preamplifiers.

Recorder: 50 mV DC, 5KΩ ungrounded output impedance.

Noise Source: Powers any AILTECH Solid-State Noise Source and Gas-Discharge Noise Generator Power Supply (P/N 7175) in both Automatic and Manual modes.

Meter Indications: Noise-Figure, Detector Level (Manual Operation), ENR

Line Power: 115/230V ±10%, 50 to 400 Hz, 40 Watts (nominal)

Size: 14-7/8" x 17" x 5-1/4" (37.8 x 43.2 x 13.3 cm)

Weight: 21 lbs. (9.5 kg) net, 30 lbs. (13.6 kg) shipping weight

Part Numbers and Options:

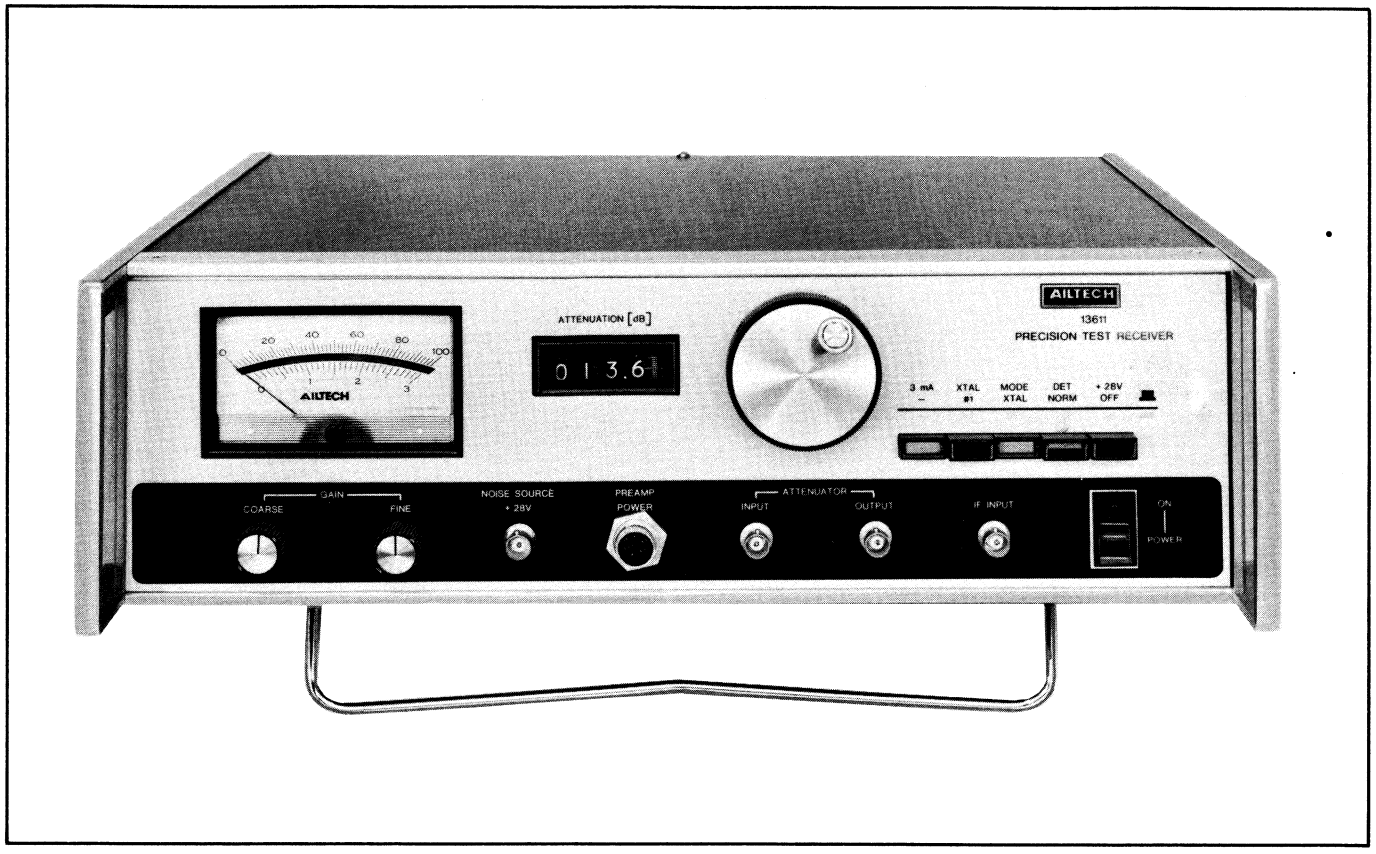
P/N 07514: For operation at 30 MHz with AILTECH 76 Series Solid-State Noise Sources (see P/N 7175 for operation of AILTECH 70 Gas-Discharge Noise Generators).

Option -09: For operation at 30 MHz, or at any one of six, preselected, front panel switch selected frequencies (21.4, 36, 45, 60, 70, 160 MHz), or 10 to 1000 MHz using an external local oscillator (+7 dBm L.O. power). Sensitivity: −72 dBm.

Option -11: 19" Rack mount brackets.

On special order, any fixed frequency between 21.4 and 70 MHz can be provided. Mixer-preamplifiers are available to extend the frequency range of noise-figure meaurement to 38 GHz (see Accessories).

13611 Precision Test Receiver



The AILTECH 13611 Precision Test Receiver is designed specifically for series-substitution measurements. In the series-substitution method, and RF signal is linearly down-converted to an intermediate frequency (IF). The IF of the AILTECH 13611 Receiver is 30 MHz. Any change in the RF power level is measured by adding, or removing, an equal amount of IF attenuation by means of the Precision Variable Attenuator within the Receiver.

Thus, the AILTECH 13611 Receiver provides a simple means of accurately measuring power level changes over a range of −90 to +30 dBm at 30 MHz, and −100 to −20 dBm from 10 MHz to 38 GHz using an external mixer-preamplifier (see Accessories section). The power supply for an external mixer-preamplifier is contained in the Precision Test Receiver.

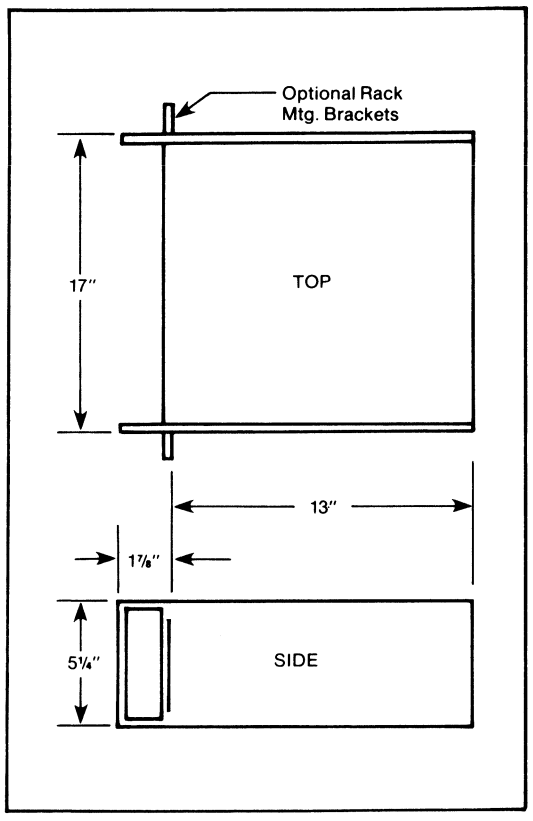
The AILTECH 13611 Receiver may be used to determine noise figure or noise temperature to an accuracy of better than ±0.1 dB by making a Manual Y-factor measurement (see block diagram on following page). A complete line of noise sources is available for this application.

The Receiver also features a regulated, +28 volt D.C. output that can be used to control a solid-state noise generator; thus, with the addition of an appropriate mixer-preamplifier and a noise generator, the instrument forms the nucleus of a virtually, self-contained, manual, noise performance (noise figure or effective input noise temperature) test set.

Other applications for the Precision Test Receiver include measurement of RF/IF attenuation, insertion loss/gain, and logging characteristics of amplifiers. Moreover, the addition of an SWR meter at the "Video Out" jack converts the AILTECH 13611 Receiver into a highly-sensitive (−100 dBm typical), frequency-selective voltmeter. The signal source must be amplitude modulated by a 1 KHz frequency in this application.

Features

- Measures Noise Figure to accuracies of better than ±0.1 dB.
- Measures 10 dB increments of gain/loss to 0.03 dB accuracy.
- Useful as a frequency-selective meter over 100 dB dynamic range.
- Useable from 10 MHz to 38 GHz with accessory mixer-preamps.
- High-level IF output for AFC and phase-lock applications.
- Regulated output power for AILTECH 76 Series Solid-State Noise Sources.



Outline Dimensions
13611 Precision Test Receiver

noise figure instrumentation

Specifications:

Center Frequency: 30 MHz

3-dB Bandwidth: 1 MHz (nominal)

Full-Scale Sensitivity: −90 dBm (minimum)

Attenuator:

Range: 0 to 100 dB

Accuracy: ±0.005 dB/10 dB +0.03 dB

Resolution: 0.01 dB/division

Gain-Control Range: 45 dB (minimum)

Input Impedance: 50 ohms (nominal)

Meter Indications: Mixer-crystal current and second-detector (normal and expanded scales).

Scale Resolution: Normal 0.05 dB, expanded 0.005 dB (1/2 minor scale division)

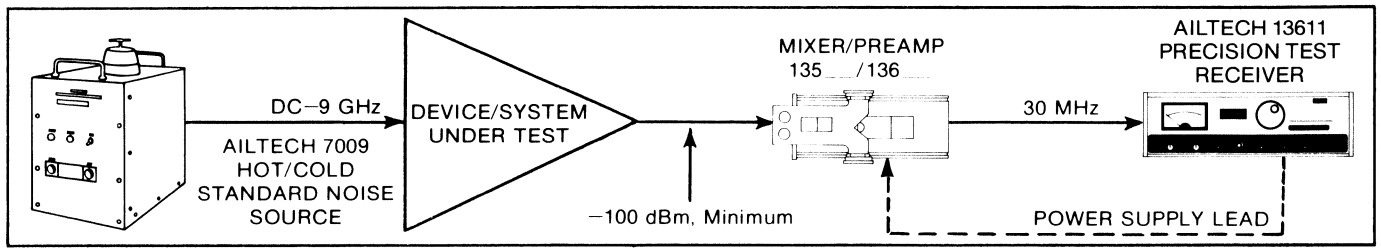
Line Power: 115/230V ±10%, 50 to 400 Hz, 20 Watts (nominal)

Size: 17" x 5-1/4" x 14-7/8" (43.2 x 13.3 x 38.1 cm)

Weight: 32 lbs. (14.5 kg) net, 40 lbs. (18.2 kg) shipping weight

Option -11: 19" Rack mount brackets

For the greatest accuracy in noise-figure measurement, the Manual method should be used. This method eliminates the errors associated with tracking inaccuracies and non-linearities associated with detection systems. When the 13611 Precision Test Receiver is used with the 7009 Hot/Cold Standard Noise Generator, it is possible to measure noise figure to accuracies of better than ±0.1 dB.



A typical manual set up is shown.

Device/system noise parameters are measured by means of the "Manual Y-factor technique." In this method two terminations, at known temperatures, are alternately connected to the input of the device/system under test. The change in the output noise-power level is noted (called the Y-factor). Effective, input noise temperature (T_e) or noise figure (F) is calculated from

$$T_e = \frac{T_2 - YT_1}{Y - 1} \text{ and}$$

$$F = \frac{\frac{T_2}{290} - Y\left(\frac{T_1}{290}\right)}{Y - 1} + 1$$

where T_2 and T_1 are the "hot" and "cold" source termination temperatures in Kelvins, respectively. The equation for noise figure assumes no "image" response in the device/system under test. For heterodyne systems, the result must be multiplied by the factor $\left(\frac{G_i}{G_s} + 1\right)$, where G_i is the image-channel gain and G_s, is the signal-channel gain. All terms are shown as ratios, not in decibels.

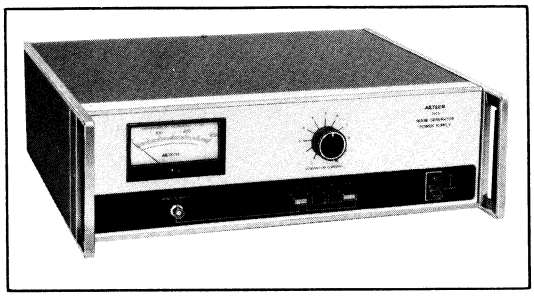
Specifications subject to change without notice.

7175 Gas Noise Generator Power Supply

This instrument provides the user with the means to perform both manual and automatic noise figure or noise temperature measurements using an AILTECH 70 Series Gas Discharge Noise Generator.

The 7175 Power Supply and a 70 Series Noise Generator can operate "stand-alone" for noise performance measurements by means of the manual Y-factor technique; however, the unit also offers a unique Remote mode of operation which permits triggering from 28 volt pulsed source normally used to drive solid-state noise sources.

The Remote feature provides the means for automatic noise figure measurements using microwave gas-discharge noise generators up to 40 GHz with direct-reading noise figure instrumentation such as the AILTECH 7514 Precision Automatic Noise Figure Indicator and the 7300 Series System Noise Monitors. These instruments normally operate only with solid-state noise generators up to 18 GHz (AILTECH 76 Series).



7175 Noise Generator Power Supply

noise figure instrumentation

Specifications:

Output: Capable of igniting and controlling all AILTECH 70 Series Gas-Discharge Noise Generators

Remote Input: On: +25 to +30 volts (pulsed or CW)
Off: 0 volts

Trigger Rate: 50 Hz to 2 kHz

Power Input: 115/220 VAC ±10%, 50/60 Hz, 120 watts

Size: 17 in. W x 16 in. L x 5-1/4 in. H
(43.2 x 40.6 x 13.3 cm)

Weight: 20 lbs. (9.1 kg) net
25 lbs. (11.4 kg) shipped

Option -11: 19" Rack mount brackets

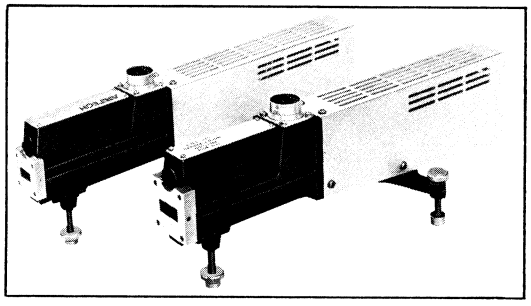
Precision Attenuators

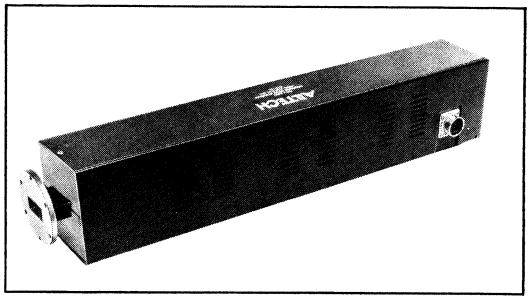
The AILTECH 32-series Precision Attenuators are identical to the attenuators incorporated in the 13610 Precision Test Receiver and 8210 Noise Temperature Calibrator. The Attenuators are used to make accurate, Manual, Y-factor measurements in conjunction with the AILTECH 75 PANFI. Moreover, the attenuators may be used as secondary-standards in attenuation calibration systems. They are continuously variable with .01 dB resolution, have a 100 dB range, an accuracy of ±0.005 dB per-10 dB-increment plus 0.03 dB uncertainty, a typical insertion loss of 18 dB, and a maximum power rating of 1 watt. Input and output impedances are 50 ohms, except for the 70 MHz—units which are 75 ohm-impedances. All Attenuators have a nominal SWR of 1.3, including the SWR of the TNC connectors.

Cased Precision Attenuator

Part No.	Freq. (MHz)	Mounting	Size	Weight
3230	30	Unmounted	8¾" x 3⅛" x 2⅛"	1¾ lbs.
3231	30	Rack	19" x 3¼" x 3 15/16"	3¼ lbs.
3232	30	Case	14¼" x 4½" x 4½"	4¼ lbs.
3260	60	Unmounted	22.2 x 7.9 x 5.4 cm	0.8 kg
3261	60	Rack	48.3 x 8.3 x 8.8 cm	1.5 kg
3262	60	Case	36.2 x 11.4 x 11.4 cm	1.5 kg
3270	70	Unmounted	8¾" x 3⅛" x 2⅛"	1¾ lbs.
3271	70	Rack	19" x 3¼" x 3 15/32"	3¼ lbs.
3272	70	Case	14¼" x 4½" x 4½"	4¼ lbs.

Noise Source Calibration System





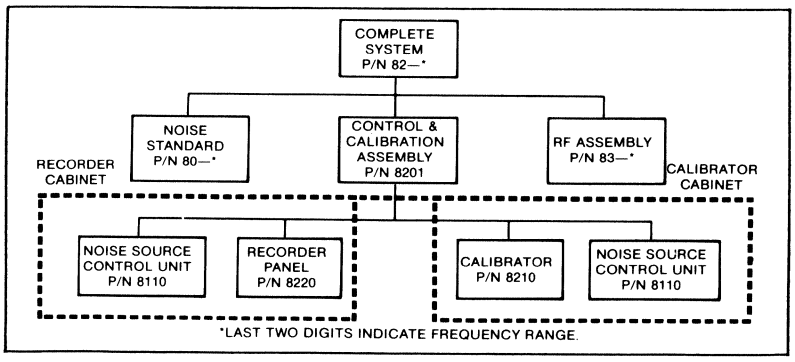
The AILTECH 82 System is the only, commercially available instrumentation designed specifically for the calibration of Noise Sources. With this system you can now provide your Standards Laboratory with the capability for calibrating Noise Sources, "in-house," at considerable savings.

As shown in the illustration below, a complete system operating in a specific frequency band is comprised of three major assemblies: A Noise Standard, an RF Assembly, and a Control and Calibration Assembly. To expand your existing system you need only acquire the appropriate Noise Standard and RF Assembly. Additional Preamplifiers (AILTECH 8230), normally part of the AILTECH 8210, may also be purchased to expedite changing frequency ranges.

The Control and Calibration Assembly includes a radiometric receiver, a recorder and two 8110 Control Units for supplying current-regulated power to gas-discharge Noise sources (AILTECH 70 and 80 Series).

The AILTECH 80 Noise Standards include both solid-state and gas-discharge types. Above 8.2 GHz, the Noise Standards are waveguide units using precision-ground, argon-gas tubes.

The AILTECH 83 RF Assemblies are coaxial up to 8 GHz, and waveguide above that frequency. Each Assembly above 1 GHz consists of a termination, tuner, isolator, mixer, and a mounting stand. Below 2 GHz, a low-noise preamplifier is also provided.



noise figure instrumentation

COMPLETE SYSTEM SPECIFICATIONS

System P/N	Frequency Range (GHz)	Standard P/N	RF Assembly P/N	Estimated* Uncertainty
8211A	0.01-1	8011	8310	**
8211	1-2	8011	8311	**
8212	2-4	8012	8312	±0.22 dB
8213	4-8	8013	8313	**
8252	8.2-12.4	8052	8352	±0.11 dB
8291	12.4-18	8091	8391	±0.11 dB

*Based on arithmetic sum of 8201 comparison accuracy with specified RF Assembly, and uncertainty of the Noise Standard (NBS) calibration where applicable. See NBS Special Publication 250, Section 7 for availability of NBS calibration services and fee schedule.
**Consult factory for estimated uncertainties in these bands.

RF ASSEMBLY SPECIFICATIONS

P/N	Frequency Range (GHz)	VSWR, Max (Using Tuner)	Input Connector	Comparison* Uncertainty	Mounting Base Length—in. (cm)	Weight—lbs. (kg)
8310	0.01-1	1.30	14 mm Precision	±0.20 dB	36 (92)	24 (10.9)
8311	1-2	1.10	14 mm Precision	±0.09 dB	36 (92)	30 (13.6)
8312	2-4	1.05	14 mm Precision	±0.06 dB	36 (92)	38 (17.3)
8313	4-8	1.05	14 mm Precision	±0.07 dB	36 (92)	38 (17.3)
8352	8.2-12.4	1.05	Cover Flange WR-90	±0.05 dB	36 (92)	40 (18.2)
8391	12.4-18	1.05	Cover Flange WR-62	±0.05 dB	36 (92)	38 (17.3)

*Uncertainty of the differential ENR measured on the 8201 when used with the specified front end, appropriate standard, and a noise generator for calibration with VSWR of < 1.2.

NOISE STANDARD SPECIFICATIONS

P/N	8011	8012	8013	8052	8091
Frequency Range (GHz)	0.01-2	2-4	4-8	8.2-12.4	12.4-18
Type	Solid-State	Gas-Discharge	Solid-State	Gas-Discharge	Gas-Discharge
VSWR (max)	1.15	1.15	1.2	1.15	1.15
ENR (dB)	15.5 ±0.5	15.0 ±0.5	15.5 ±0.5	15.5 ±0.5	15.5 ±0.5
ENR* Uncertainty (dB)	—	±0.16	—	±0.06	±0.06
Output Connector	Precision Type N Male	Precision 14 mm	Precision Type N Male	Cover Flange WR-90	Cover Flange WR-62
Power Required	28.00 VDC 10 mA	AILTECH 8110	28.00 VDC 10 mA	AILTECH 8110	AILTECH 8110
Size-in. (cm)					
length	4½ (11.4)	14½ (37)	4½ (11.4)	12 (30.5)	12 (30.5)
height	1 (2.5)	5 (12.7)	1 (2.5)	6 (15.3)	6 (15.3)
width	1 (2.5)	4 (10.2)	1 (2.5)	4 (10.2)	4 (10.2)
Weight—lbs. (kg)	7/16 (0.2)	15 (6.8)	7/16 (0.2)	6 (2.7)	6 (2.7)

*The physical and electrical characteristics of the Noise Standard are such that its Excess Noise Ratio (ENR) can be calibrated by the National Bureau of Standards to the stated maximum uncertainty.

noise generator calibration service

Facing budget problems?

If your present budget does not allow you to invest in the AILTECH Noise Temperature Calibration System, send us your equipment and we'll do the job for you. This unique service offered by Eaton Corporation provides excess noise ratio calibrations to an absolute accuracy of ±0.11 dB (at specific frequencies)—and in most cases the results are directly traceable to N.B.S.!

Your equipment will be checked with the highly-regarded AILTECH Noise Temperature Calibrator which can accommodate noise generators in several waveguide sizes as well as coaxial types from 10 MHz to 18 GHz. Calibrations performed at the frequencies shown are directly traceable to the National Bureau of Standards. The listed uncertainties apply to noise generators, calibrated at the frequencies shown, with VSWR's less than 1.2, and whose output connectors mate directly with the input connector specified for that brand. Other connectors and calibration at other frequencies within the bands listed can be accommodated at reduced accuracy. Noise generators can also be calibrated at frequency ranges not shown between, 10 MHz and 2.6 GHz and 3.9 GHz to 8.2 GHz with traceability to the AILTECH laboratory thermal standard.

Consult the factory for more information on this unique valuable offering.

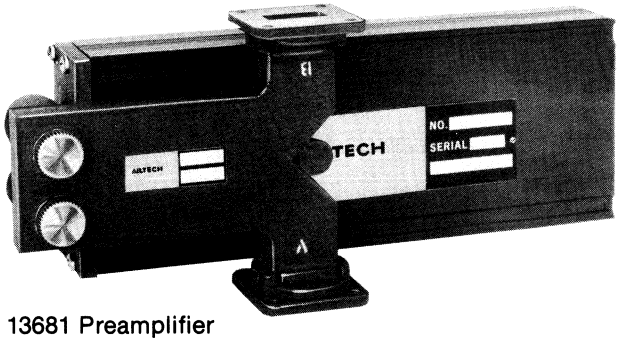
A. WR-62 Waveguide Noise Generators: 12.4 to 18 GHz.
Calibration Frequencies ..... 13.5, 15, 17 GHz
Calibration Uncertainty ..... ±0.11 dB
Input Connector UG-419/U

B. WR-90 Waveguide Noise Generators: 8.2 to 12.4 GHz.
Calibration Frequencies ..... 9.0, 9.8, 11.2 GHz
Calibration Uncertainty ..... ±0.11 dB
Input Connector UG-39/U

C. Coaxial Noise Generators: 1-18 GHz
Calibration Frequencies ..... 0.03, 0.3, 1.0, 2.0, 3.95, 8.0, 8.2, 9.8, 12.4, 15.0, 18.0 GHz
Calibration Uncertainty ..... ±0.25-3.0 dB
Input Connector ..... BNC Female

Specifications subject to change without notice.

Accessories—Noise Figure Instrumentation



13681 Preamplifier
with
Waveguide Mixer

13680 Preamplifier
with Converter

13680 Preamplifier
with
Coaxial Mixer

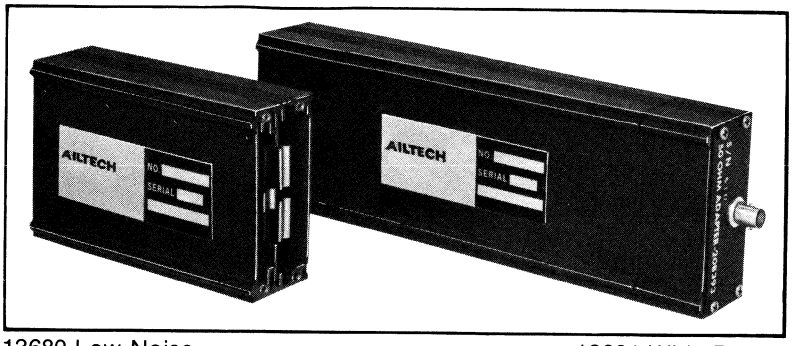
MIXERS AND FREQUENCY CONVERTERS

The AILTECH 135-series Mixers, and 13635 Frequency Converter, effectively extend the frequency range of the 75 PANFI and 13611 Precision Test Receiver to cover the entire 0.01-38 GHz spectrum. The individual Mixers and Converter plug directly into any of the AILTECH 136-series Preamplifiers. The combination of mixer-preamplifier, or converter-preamplifier, converts an entire RF band into the high-level, 30 MHz-output necessary to drive the AILTECH 7514 or 13611. Typical noise figures range from 7.5 dB for the AILTECH 13635/13680 combination, to 15 dB for the 13596/13681 combination.

Part Number	Frequency Range (GHz)	Connector Type	L.O. Level (nominal)
13635	0.04-0.15	Type N	Internal, tuneable L.O.
13508	0.01-1	TNC	5mw (+7 dBm)
13504	1-2	TNC	5 mw
13505	2-4	Type N	1 mw (0 dBm)
13506	4-8	Type N	1 mw
13507	7-11	Type N	1 mw
13509	3.6-4.2	Type N	1 mw
13546	8.2-12.4	WR-90	1 mw
13547	12.4-18.0	WR-62	1 mw
13553	18.0-26.5	WR-42	1 mw
13596	26.5-40	WR-28	1 mw

Specifications subject to change without notice.

accessories – noise figure instrumentation



13680 Low-Noise Preamplifier

13681 Wide Range Preamplifier with 208393 Adapter Attached

PREAMPLIFIERS

AILTECH 136-series preamplifiers will accept any of the AILTECH 135-series "plug-in" Mixers, or 13635 Frequency Converter, or AILTECH 208-series Adapters. The Preamplifiers are powered directly by the 75 PANFI or 13611 Precision Test Receiver.

The AILTECH 13680 is the preferred choice when the noise figure of the Measurement System itself must be a minimum (e.g.: A typical noise figure of 10 dB can be expected when using the AILTECH 13680/135-series-Mixer combination.).

The AILTECH 13681 has a linear dynamic range in excess of 80 dB on CW signals and 70 dB on noise. In conjunction with the 13611 Precision Test Receiver, it is particularly well suited for measurement of large attenuation values. Moreover, the 13681 Preamplifier will not limit the 65-dB dynamic range of the AILTECH 75 PANFI.

Specifications

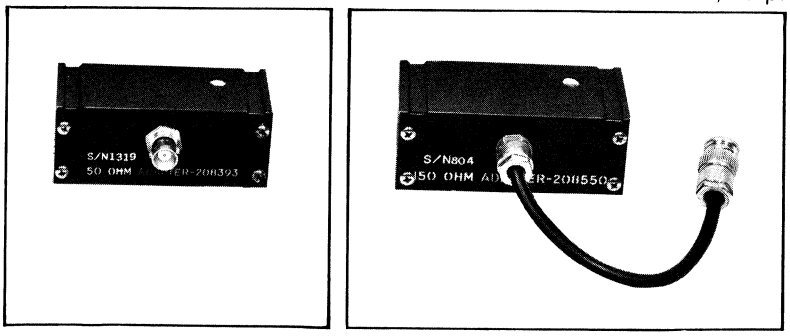
Part Number	**13680**	**13681**
Center Frequency	30 MHz	30 MHz
Bandwidth (minimum)	3 MHz	3 MHz
Gain (minimum)	45 dB	30 dB
Noise figure (nominal)	3.3 dB	6 dB
Maximum linear output (0.1 dB compression)	+17 dBm	+17 dBm
Maximum output power (nominal) (50 ohm load)	+27 dBm	+27 dBm
Power Required	20 vdc at 225 mA	20 vdc at 225 mA

IMPEDANCE ADAPTERS

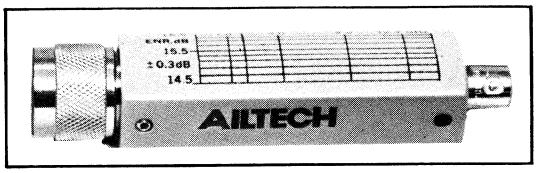
Plug-in Adapters are available to noise-match the 136-series Preamplifiers to source impedances of 50 ohms or 150 ohms—15 pf (a typical balanced-mixer output impedance).

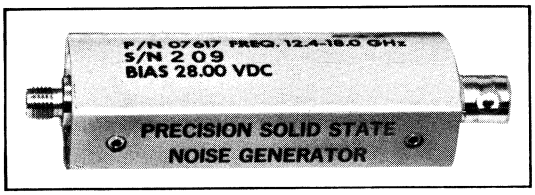
208393
50 OHMS

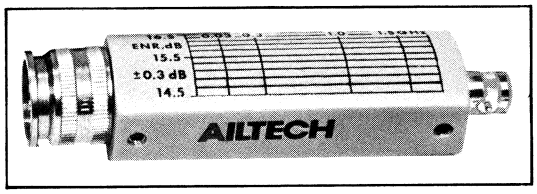
208550
150 OHMS, 15 pf



76 Series
Solid-State Noise Generators







Four AILTECH coaxial noise generators are offered (P/N's 7615, 7616, 7617 and 7618) to cover the frequency range from 10 MHz to 18 GHz.

In this group, the 7618 is unique in that it provides extremely broadband operation from 1 GHz to 18 GHz; thus, it offers the user unprecedented convenience if the application requires crossing traditional frequency bands.

These noise generators provide a calibrated, accurate, output (ENR) in the range from 14 to 16.5 dB; therefore, they are valuable tools for the measurement of amplifier and receiver noise performance in the laboratory (see the section on HIGH LEVEL NOISE SOURCES, P/N 7650/7660 for units applicable to systems).

Every source in this series is calibrated against a known noise standard that is traceable to the National Bureau of Standards where applicable. The noise generating element is isolated from the output by 12 to 20 dB; consequently, mismatch errors are minimized, and no destructive transients are present in the output.

Technical Specifications

Part Number	7615	7616	7617	7618
Frequency Range (GHz)	0.01-1.5	1-12.4	12.4-18	1-18
Excess Noise Ratio (nominal, dB)	15.5	15.5	15.5	15.0
Flatness vs. Frequency (dB)	±0.5	±0.5	±1	±1
Calibration Frequencies (GHz)	0.03, 0.3, 1.0, 1.5	1, 2, 3.95, 8.2, 9.8, 12.4	12.4, 15, 18	1, 2, 3.95, 8.2, 9.8, 12.4, 15, 18
Calibration Accuracy* (dB)	±0.3	±0.25 to ±0.3	±0.25	±0.25 to ±0.3
VSWR (maximum)	1.2	1.2	1.3	1.2, 1 to 12.4 GHz 1.3, 12.4 to 18 GHz
Input Connector	BNC Female	BNC Female	BNC Female	BNC Female
Output Connector	N Male	N Male	SMA Female	SMA Female
Input Power	+28 volts @ 20 ma. max.	+28 volts @ 20 ma. max.	+28 volts @ 20 ma. max.	+28 volts @ 20 ma. max.

*Accuracy of the ENR at the calibration frequencies. Accuracies vary slightly with frequency—actual accuracies listed in the instruction Manual. Calibration data is plotted on a graph on the body of the noise generator.

AILTECH 7650, 7660

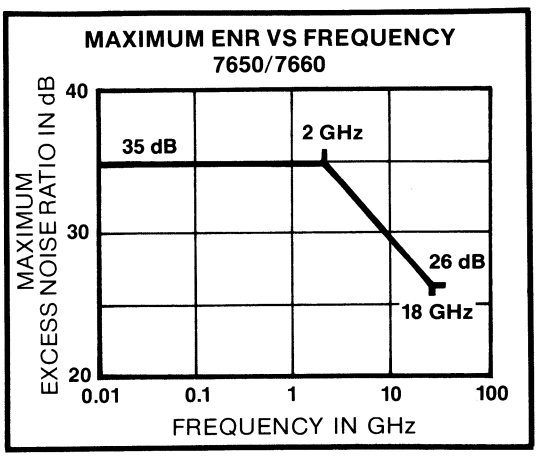
(The difference between these two units is in the type of output connector—7650 has a type N-male while 7660 has a 3mm-female.)

The convenience of solid-state, low-power requirements, small size and weight, plus the high-level output makes the AILTECH noise sources ideal for system noise monitoring applications. A high excess noise ratio permits the user to inject noise into a receiver system through a coupler and still attain a reasonably high, injected noise power in the system for measurement of noise figure or operating noise temperature. Use of high-value couplers reduces noise degradation of the receiver when the monitoring function is not active. Small size and the need for only a single coaxial power connection make antenna feed mounting particularly convenient.

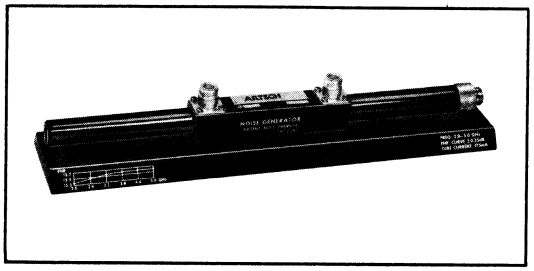
Operating up to 18 GHz with typically a 15-percent bandwidth, these devices can be provided with excess noise ratios as high as 37 dB.

AILTECH's experience in the manufacture, characterization, and calibration of noise measurement equipment permits specification of the ENR of a typical device to within ±0.5 dB. Isolators or couplers can be supplied at additional cost (or supplied by the customer), and the calibration can be performed at the output port, thus eliminating another source of system error.

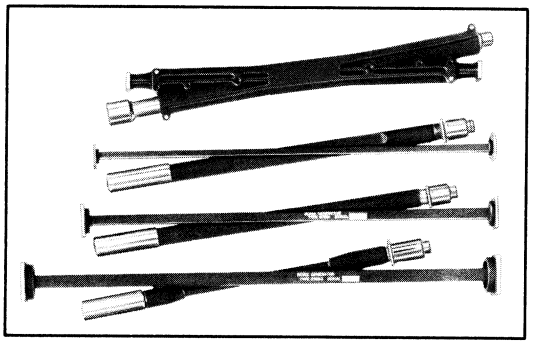
All units operate from +28 volts DC at less than 30 mA. This greatly simplifies operating the units at remote locations.



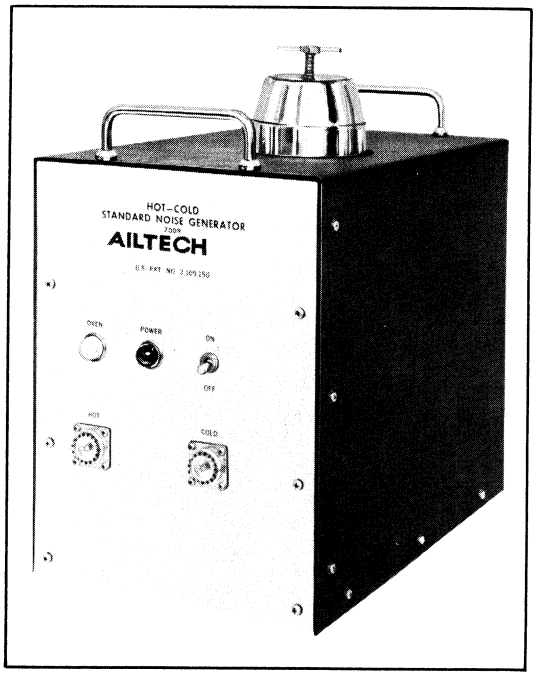
noise sources



Coaxial Gas-Discharge Noise Sources



Waveguide Gas-Discharge Noise Sources



7009 Hot/Cold Standard

Specifications

Part Number	7650-X[1]	7660-X[1]
Frequency Range	10 MHz to 18 GHz	10 MHz to 18 GHz
Bandwidth[2]	Up to 15 percent	Up to 15 percent
Maximum Excess Noise Ratio[2]	See graph	See graph
Typical VSWR[3]	4:1	4:1
Output Connector	Type N-male	3 mm-female
Input Connector	BNC-female	BNC-female
Power Required	28.0 V at 30 mA maximum	28.0 V at 30 mA maximum
Overall Dimensions (nominal)	1 x 1 x 4 in. (2.54 x 2.54 x 10.2 cm)	½ x ½ x 2½ in. (1.27 x 1.27 x 6.4 cm)
Weight	3.5 oz. (99 g)	2.7 oz. (76.5 g)

Notes:
[1]Last digit assigned to each specific noise source.
[2]Higher ENR and wider bandwidths available at additional cost.
[3]RF isolators can be supplied at additional cost.

SERIES 70 GAS-DISCHARGE NOISE SOURCE

All gas-discharge noise sources in the AILTECH 70 Series are two-port devices, and the output may be taken from either one. The other port must be terminated in a low-SWR load. Two noise sources (AILTECH 7010 and 7012), cover the frequency range from 200 MHz to 5 GHz. Data is provided on their Excess Noise Ratio (ENR) vs. Frequency, including correction data for coupling losses. Four waveguide noise sources cover the frequency range from 8.2 GHz to 40 GHz. They employ argon-filled, gas-discharge tubes mounted in sections of standard waveguide at a slant angle of approximately 10 degrees. All waveguide noise sources, except the AILTECH 7096, are supplied with low-SWR terminations installed.

Features

- Complete capability including noise-source standards.
- DC to 40 GHz coverage.
- Calibration service traceable to NBS available.

HOT/COLD STANDARD 7009

When used with the 13611 Precision Test Receiver (see pages 105 and 106), the AILTECH 7009 provides a noise-figure measurement system capable of better than ±0.1 dB accuracy. The noise-source standard employs two resistive terminations: one is immersed in liquid nitrogen (77.3K), the other is in a proportionally-controlled oven set to the temperature of boiling water (373.K). For the utmost in accuracy and repeatability, front-panel connections are via 14 mm precision connectors. The terminating impedances are carefully controlled so that they track each other, in both magnitude and phase, over the full frequency range of the instrument. Thus, mismatch uncertainties are virtually eliminated.

Specifications

Frequency Range: 0 to 9 GHz.

VSWR: 1.15 maximum (1.10 below 7 GHz)

Impedance Tracking: The distance between the complex impedance points of the hot and cold termintions (plotted on a Smith chart) is less than the diameter of a circle corresponding to an SWR of 1.05 from DC to 7GHz, and 1.10 from 7.1 to 9 GHz.

Termination temperature: Hot 373.2 ±1 kelvins.
Cold 77.3 ±1, -0 kelvins.

Noise Temperature: Termination temperature ± frequency correction.

Output connectors: 14 mm precision (GR-900BT).

Line Power: 115/230 V +10%, 50 to 400 Hz, 20 watts (nominal).

Size: 9¼" w x 15" h x 14¾" d (23.5 x 38.1 x 32.5 cm).

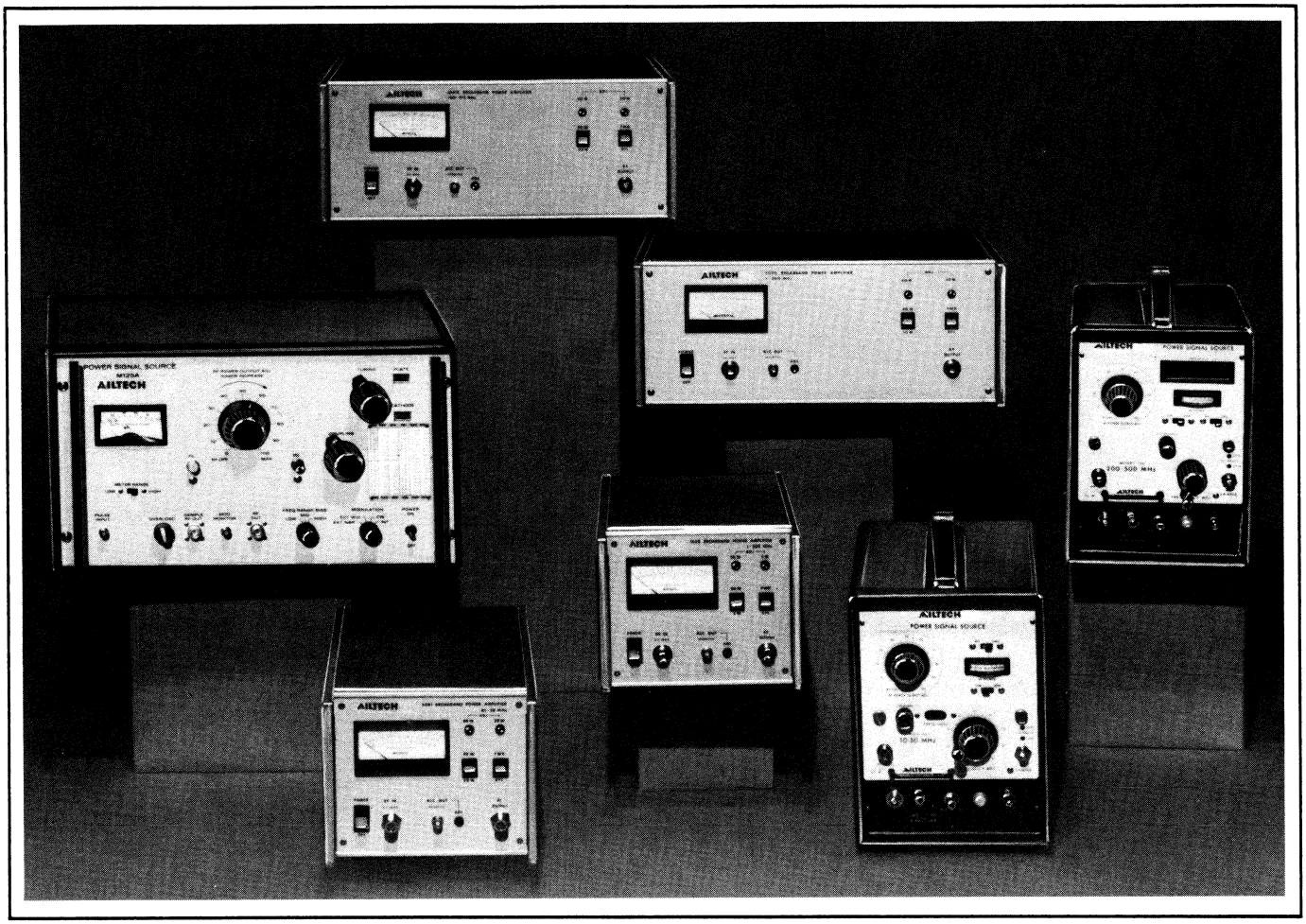
Weight: 16 lbs. (7.3 Kg) net, 27 lbs. (12.3 Kg) shipping weight.

High Power Broadband Linear Amplifiers

- 10 KHz-100 MHz.
- Up to 75 watts CW.

RF Power Signal Sources

- 10 KHz-2500 MHz.
- Up to 100 watts CW.



An Introduction to AILTECH RF Power Signal Sources and Broadband Linear Amplifiers

Eaton Corporation, Electronic Instrumentation Division has shown over 30 years of state-of-the-art leadership in R.F. Power Signal Sources. We are proud to have added to our long established position of leadership in R.F. Power Generation—High Power Broadband Linear Amplifiers. The Amplifiers are designed to be driven by milli-watt sweepers and frequency synthesizers which are intended for those applications where swept measurements or wide bandwidth is required.

The RF Power Signal Sources described in this brochure represent the ultimate in cavity-type, power signal sources. A wide variety of standard product offerings are available, spanning 10 KHz—to —2500 MHz in frequency and up to 100 watts in power output. The AILTECH catalog line of RF Power Signal Sources includes octave, double-octave, and decade frequency bands, plus the extraordinary versatility of plug-in frequency bands. The designs have been fully qualified under the most stringent environmental conditions and meet virtually all of the applicable MIL Specs. The cavities utilized have extremely high Q and as a result, the outputs are spectrally pure and are virtually free of harmonics.

power signal sources and linear amplifiers

power signal sources and linear amplifiers

APPLICATIONS

EMC SUSCEPTIBILITY TESTING

The AILTECH RF Power Signal Sources are universally used as a source for EMC susceptibility testing. Sufficient power is available to satisfy virtually all of the specified field strengths. The amplifiers can be used to amplify CW, AM, FM and pulse signals.

Eaton Corporation, Electronic Instrumentation Division is serving the following markets relative to their needs to qualify electronic systems and components to be immune to the effects of an RF field...

1. Manufacturers of military equipment. Almost without exception MIL-STD-461 must be met and AILTECH power sources and amplifiers are universally used.
2. Computer Market.
3. Medical Market.
4. Automotive Market.
5. Industrial Controls Market.

It is difficult to find an industry that does not use electronics. With the high RF fields present in everyday life...from CB radios, radars and communication equipment, it is becoming more and more important to design the electronics to be unaffected, AILTECH Power Sources and Amplifiers are convenient tools to evaluate designs early in their development cycle as well as to qualify in the final design.

For many applications where systems are to be automated or swept measurements are required. The Broadband Amplifiers when driven by low level Signal Sources are ideal.

WATTMETER CALIBRATION

The high power output of the AILTECH RF Power Signal Sources and Broadband Amplifiers make them suitable for calibration of the high power "in line" and terminated type of wattmeters. The Broad bandwidth of the Amplifiers allows for quick, accurate swept measurements to verify the flatness of output of the wattmeter under test.

HI-POWER TESTING OF TRANSISTORS/AMPLIFIERS/COMPONENTS

AILTECH RF Power Signal Sources are widely used in the testing of high-power, RF transistors and other components such as amplifiers, varactor multipliers, ferrite devices, and couplers. The complete freedom from spurious signals and transients, and the capability of having continual power adjustment, are distinct advantages.

The amplifiers are unconditionally stable and are capable of operating into any load. This makes them particularly suited for the testing of high-power transistors, and circuits utilizing high-power transistors.

For manufacturers of systems, Ailtech amplifiers and RF power sources are used by...

- Incoming inspection.
- Development engineers.
- Final production test.
- Calibration department.

COMPONENT TESTING
Under conditions of high power, components can fail or have their characteristics badly degraded. AILTECH Power Sources and Amplifiers are useful to component groups who must evaluate diodes, ferrite devices, switches, etc.—at high power levels.

NMR SYSTEMS
AILTECH Amplifiers when used in conjunction with a synthesizer such as the AILTECH 360 are ideal sources for NMR Systems requiring high power. These amplifiers are designed to be compatible with all synthesizers and all small signal generating instruments.

GENERAL HIGH POWER APPLICATION
AILTECH Power Sources and Broadband Amplifiers find a wide range of applications, particularly among the researchers involved with...

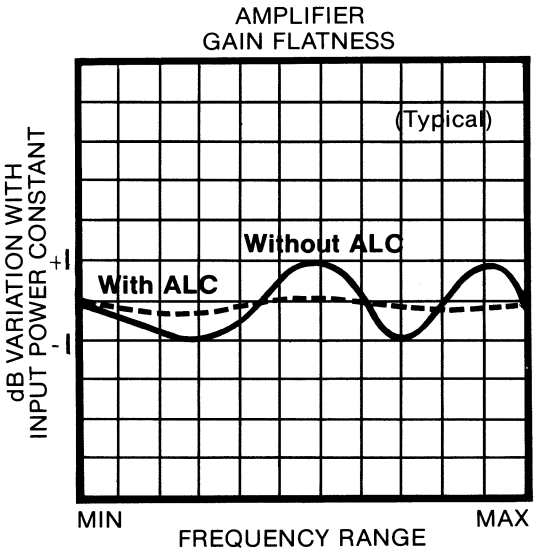
1. Laser—Modulation and Spectrum investigations.
2. Plasma experiments.
3. Radiological health effects.
4. Antenna Testing.

power signal sources and linear amplifiers

RF Power Sources and Solid State Linear Power Amplifiers for any application such as OEM, Laboratory Testing, and Production Testing

RF POWER SIGNAL SOURCES

Model	Frequency Range	Power Output	Comments
445	2 MHz-2500 MHz	Up to 50W	7 Plug-in heads
446	2 MHz-2500 MHz	Up to 50W	7 Plug-in heads Counter read out
125A	200 MHz-2.5 GHz	Up to 100W CW	Full frequency coverage in single unit



Typical variation over frequency range.

AMPLIFIERS

Model	Frequency Range	Power Output
5001	10 KHz-10 MHz	50 Watts
1020	1 MHz-200 MHz	10 Watts
2020	1 MHz-200 MHz	25 Watts
5020	1 MHz-200 MHz	50 Watts
10512	100 MHz-520 MHz	10 Watts
20512	100 MHz-520 MHz	25 Watts
35512	100 MHz-520 MHz	50 Watts
15100	500 MHz-1000 MHz	20 Watts

power signal sources and linear amplifiers

GENERAL FEATURES OF AILTECH'S BROADBAND AMPLIFIERS:

SOLID STATE
All of AILTECH Amplifiers are completely Solid State using the most advanced power transistors available. Minimum combining is done, rather transistors operating in a push-pull circuit are utilized. The use of a minimum number of transistors to derive the output power enhances the reliability.

BUILT IN WATTMETER
(reads forward & reflected power)
A dual-directional detector is connected in series with the output and measures both forward and reflected true average power. This feature is extremely useful when the application is one where a circuit under test is being adjusted to be 50 ohms. After setting the forward power to the desired level, one simply monitors the reflected power and tunes for a minimum reflected power. With the ALC loop connected, the forward power remains constant under all conditions of tuning. This prevents inadvertent overdrive of the circuit under test.

ALC SIGNAL
There is a DC voltage available from the front panel of each amplifier. This DC voltage is a direct function of the forward power and can be used to automatically level the output of the amplifier by varying the drive to the amplifier. Most modern sweepers have a capability to accept an external leveling signal. Over limited frequency ranges the flatness of output can be ±0.1 dB. (see typical curve)

LINEARITY
The basic approach of using a push-off circuit results in superior linearity. AILTECH conservatively rates the performance and specifies the linearity at an operating point when class A operation prevails.

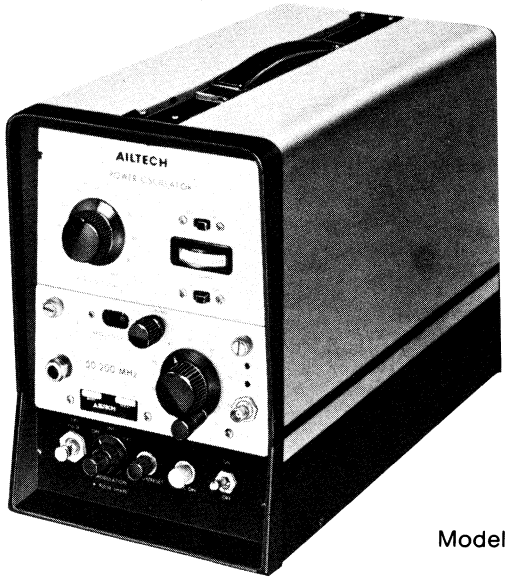
HIGH POWER
In all units where linearity is not a consideration up to twice the rated power is available. (see individual curve)

R.F.I.
All amplifiers utilize double shielded techniques and line filtering to minimize radiation from the unit.

PROTECTION AGAINST MISMATCH
All AILTECH Amplifiers are capable of operating into any load with no damage to the amplifier.

Models 445 and 446
Plug-In RF Power Signal Sources

Model 446



Model 445

The AILTECH Models 445 & 446 cover the 2 MHz to 2500 MHz frequency range using eight r.f. plug-in heads. Both instruments feature positive load mismatch protection, and forward and reflected power metering.

The Model 445 plug-in heads incorporate a direct reading frequency dial. The Model 446 plug-in heads feature a built-in 5-digit true frequency counter up to 1 GHz, and above 1 GHz a dial readout is provided.

All RF plug-in heads have a coupling control that provides for optimization of power transfer to the load. The output power is continuously variable from full rated power down to 50 mW. A low power sample is available for use with an external counter or detector.

Pulse and amplitude modulations pull the signal source frequency less than 0.1% typically. All power output and stability specifications are relatively unaffected by load VSWRS as high as 3.1.

The positive mismatch protection circuit is designed so that the power supply voltage is automatically turned off when the reflected power exceeds 10 watts. Up to 10 watts operation into an open or short circuit is possible without triggering the mismatch circuit or causing any damage to the unit.

On several plug-in heads power output flatness of the order of ±0.75 dB may be achieved by minor adjustments of the coupling control as frequency is scanned.

Harmonics are typically 40 dB below the carrier, and is a function of frequency. For example at 10 MHz they are approximately 30 dB below the carrier and at 1000 MHz they are approximately 50 dB below the carrier.

The AILTECH Models 445 & 446 are ideally suited for production and laboratory tests where frequency, accuracy, precision, and quick determination are of prime importance.

Features

- Plug-in heads for seven wide, frequency ranges.
- from 2 MHz to 2500 MHz.
- 5-digit, LED-counter up to 1 GHz available.
- Power output up to 50 watts.
- AM-FM options.
- Positive no-load protection.
- Reads true forward and reflected power.
- High-Q tuned cavity for spectral purity.
- Excellent frequency and power stabilities.

power
signal sources
and
linear amplifiers

FREQUENCY AND POWER SPECIFICATIONS FOR PLUG-IN HEADS

For Use with Model 445

Part Number	Frequency Range	Guaranteed Power Available
183	2-10 MHz	40 Watts
184	10-50 MHz	50 Watts
185	50-200 MHz	50 Watts
186	200-500 MHz	50 Watts
187	500-1000 MHz	50 Watts
188A	1000-2000 MHz	25 Watts
189A	2000-2500 MHz	15 Watts

For Use with Model 446

Part Number	Frequency Range	Guaranteed Power Available
193	2-10 MHz	40 Watts
194	10-50 MHz	50 Watts
195	50-200 MHz	50 Watts
196	200-500 MHz	50 Watts
197	500-1000 MHz	50 Watts
188A-6	1000-2000 MHz (Dial)	25 Watts
189A-6	2000-2500 MHz (Dial)	15 Watts

power signal sources and linear amplifiers

Special Frequency Ranges: For coverage down to 10 KHz use M5001, page 82.

ADDITIONAL SPECIFICATIONS

Frequency

Accuracy: 185 thru 189A: ±1% at optimum coupling after ½-hour operation at maximum rated power.
183: ±5%; same conditions as above. 184: ±2%; same conditions as above.
190 Series Counter 0 .005%.
Stability: ±0.001%/10 minutes after ½-hour stabilization at constant power and frequency.

Power

Metering: Forward power: 10 and 50 watts Full Scale.
Reflected power: 10 watts Full Scale.
Stability: ±0.1 dB/hr after ½-hour stabilization at constant power and frequency.
Sample output: 15 to 40 dB below main RF output.
Overload: Fully protected against excessive power reflected back into the output port.
Adjustment: Continually variable down to 50 mW.

Spectral Purity (CW Operation)

Residual AM: 1% maximum.
Residual FM: 0.003% maximum.

Modulation

Internal: 100% Square wave, 1000 Hz adjustable ±10%.
External: Pulse; zero residual; +15 volts required.

Line Power: 115/230 V ±5%, 50-60 Hz, 450 watts (nominal).
Size: 8" w x 11½" h x 17" d (20.3 x 29.2 x 43.1 cm).

Weight

Main Frame: 40 lbs. (18.2 KG) net, 60 lbs. (27.3 KG) shipping weight.
Plug-in Heads (typical): 10 lbs. (4.5 KG) net, 15 lbs. (6.8 KG) shipping weight.

Options

Amplitude Modulation: To order, specify "-1"; e.g., P/N 184-1, P/N 194-1).

Range & Frequency: 0 to 100%, 300 Hz to 5 KHz. 0 to 30%, 5 KHz to 20 KHz.
Input: 23 volts RMS (nominal) into 16 ohms.

Frequency Modulation (-2)

Frequency: 10 Hz to 300 KHz.
Input: 20 volts p-p.
Deviation: See table.

Wide Pulse (-6) (to order specify 445-6 or 446-6): Allows for turning oscillator off and on with application of +12V DC. Separate input is provided and can be used for pulse operation for any duty cycle up to 100%.

Part No.	Frequency (MHz)	Minimum Deviation (p-p)
184-2/194-2	20	15 kHz
185-2/195-2	50	25 kHz
	200	80 kHz
186-2/196-2	200-400	90 kHz
187-2/197-2	500	100 kHz
	1000	200 kHz
188A-6-2	100-2000	200 kHz
189A-2 **189A-6-2**	2000-2500	200 kHz (2200-2300 MHz)

Not available on 183 or 193.

NOTE: It is possible to have both AM & FM at the same time (to order specify "-1-2"; e.g., P/N 184-1-2).

Model 125A RF Power Signal Source

Description

The AILTECH 125A Power Signal Source provides highly stable, spectrally pure, RF power from 200 to 2500 MHz in three ranges.

The CW power available over a portion of this frequency range can be as high as 90 watts (see adjacent curve).

Signal-to-noise and signal-to-leakage ratios of the order of 80 dB each typify the operating performance of the M125A Power Signal Source. Frequency steps as small as 0.002%, and power steps as small as 0.01 dB can be made. A detected output available at the front panel is provided to monitor all modulation waveforms.

Specifications

Frequency
- **Range:** 200 to 2500 MHz
- **Accuracy:** ±1%.
- **Stability:** ±.004%/hr after 2-hour warm up.
  ±.002%/10 min. after 2-hour warm up.

Power
- **Output:** See curve.
- **Adjustment:** Nominally 60 dB over most of the range.
- **Stability:** ±0.1 dB/hr.
- **Indication:** Relative power meter.
- **Sample output:** Approximately 30 dB below main RF output.

Spectral Purity (CW operation)
- **Residual AM:** 1% maximum.
- **Residual FM:** 0.005% maximum.
- **Harmonics:** 40 dB down (typical).

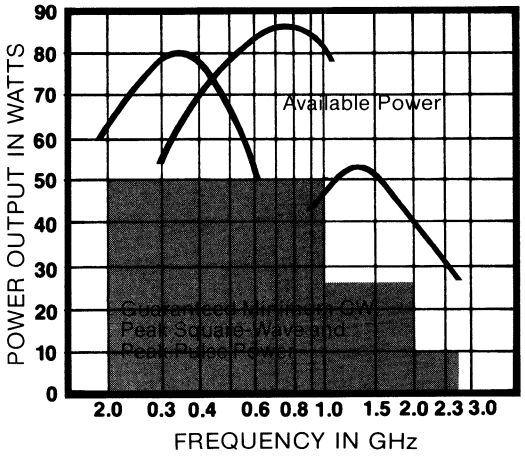
Modulation
- **Internal:** 100% square wave, 1000 Hz adjustable ±10%.
- **External:** Square wave and pulse.

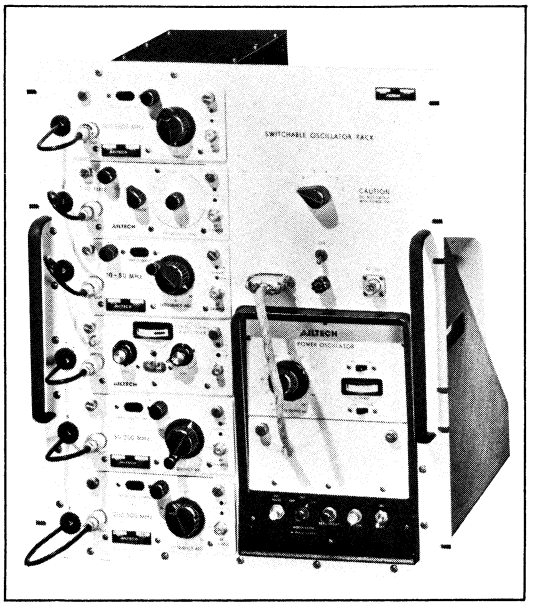
Line Power: 115/230V ±1%, 475 watts (nominal), 50-60 Hz.

Size: 11⅝" x 19⅞" x 20" (29.3 x 50.5 x 50.8 cm).
- **Net Weight:** 120 lbs. (54.7 KG).
- **Shipping Weight:** 185 lbs. (84 KG).

Features

- 200 to 2500 MHz in a single source.
- Up to 100 Watts CW power.
- Frequency accuracy of ±1%.
- Frequency stability of ±.004%/hour.
- Power stability of ±0.1 dB/hour.
- Detected output available at front panel.

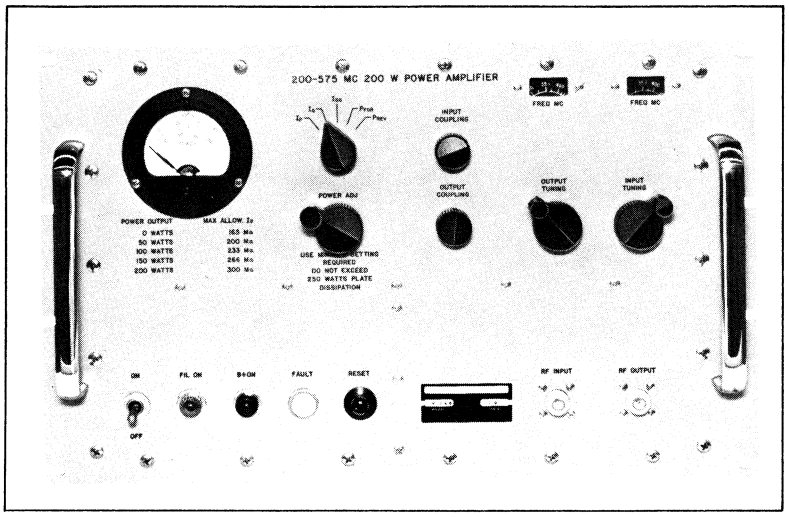




MULTI-BAND PLUG-IN RACK
Model 1927 Switchable Oscillator Rack

The AILTECH 1927 provides a convenient means of operating up to six, 180-Series, plug-in heads from a single, AILTECH 445 main frame without the need for interchanging heads in the Power Signal Source. All RF outputs are routed to a single, front-panel connector. Band switching is performed by means of a single, front-panel switch.

NOTE: M1927 available for the 180-Series plug-in heads ONLY.



power signal sources and linear amplifiers

M248A POWER AMPLIFIER SPECIFICATIONS

Frequency
- **Range:** 200 to 575 MHz.
- **Bandwidth:** 1 to 5 MHz.

Power
- **Output:** 200 watts CW minimum.
- **Input:** 15 watts CW maximum.
- **Stability:** ±0.2 dB/hr after warm-up at a fixed line voltage and power input, with an ambient temperature change of 5° C maximum.

Impedances: 50 ohms nominal, input and output.

Load Protection: Protected against loss of load.

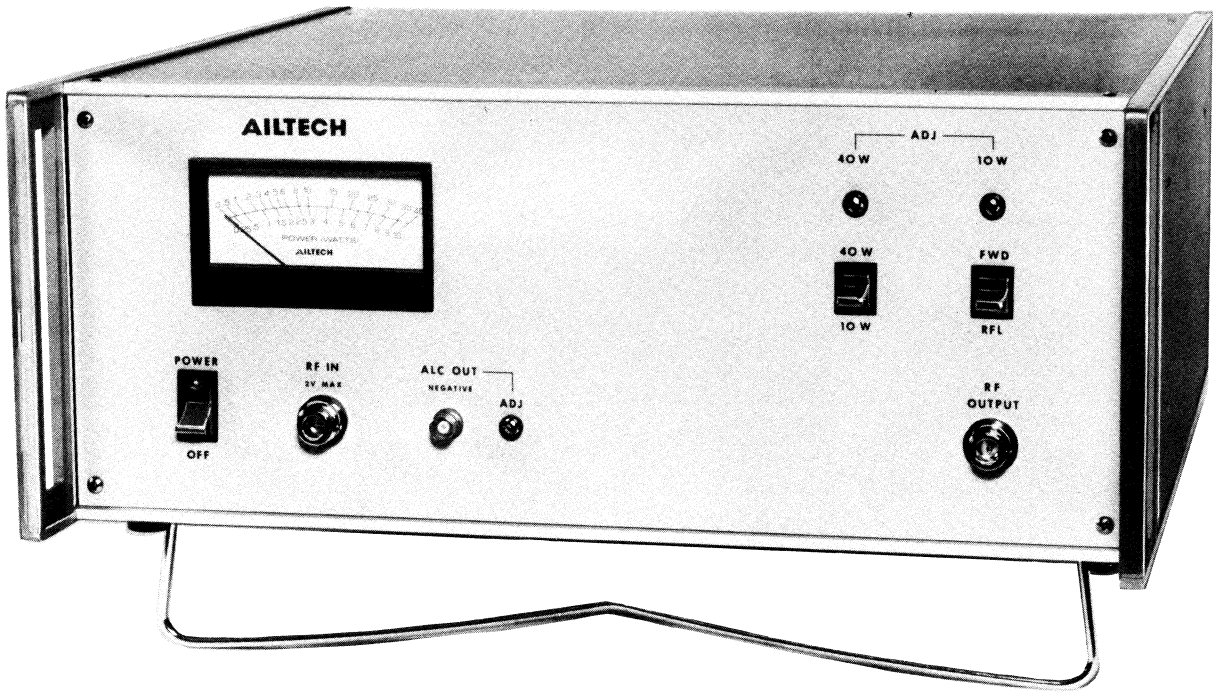
Spectral Purity (CW operation)
- **Residual AM:** Less than 2%.
- **Harmonics:** 40 dB below CW output.

Line Power: 115/230V, 50-60 Hz. (For 400 Hz, specify, M248A-1).

Size: 11¾" x 19" x 13" (29.8 x 48 x 33 cm).

Weight: 75 lbs. (34 KG) net.

High Power
Broadband Linear Amplifiers



2020 20 Watts

10 kHz-10 MHz

MODEL 5001

Features

- 10 kHz-10 MHz.
- For use as a driver for ultrasonic apparatus. Can be supplied with power outputs of up to 1 KW depending on bandwidth.
- Covers the low frequency limit for susceptibility testing to MIL-STD-461.
- All Solid State.

MODELS 1020, 2020, AND 5020

Features

- 1 to 200 MHz.
- Up to 75 watt available.
- All solid state.
- Can deliver 100 watts narrow band.

MODELS 10512, 20512 AND 35512

Features

- 100-520 MHz.
- Up to 50 watts output. Covers two important Mobile bands plus the Military communications band.
- All Solid State.

MODEL 15100

Features

- 500-1000 MHz.
- High Power (up to 25 watts).
- All Solid State.
- Modular Design.

Specifications

Model Number	1020	2020	5020	5001	10512	20512	35512 A	15100
Frequency Range (MHz)	1-200			0.01-10	100-520			500-1000*
Power Output (Watts-min)	10-20	25-45	50-75		10-20	25-35	50-65	20-30
Compression (dB typical)	1				<1 @ 10W	<1 @ 15W	<1 @ 30W	<1 @ 15W
Gain/ Variation (dB)	40/1.5	43/1.5	47/1.5	37/1.5	40/2	43/2	46/2	42/2
Total Harmonic Distortion (dB)	25 down							
Third Order Intercept (dBM)	+50	+53	+57		47	50	53	47
Input VSWR (typical)	1.5:1				2:1			3:1
Load Impedance (up to)	1.5:1							
Noise Figure (dB) max.	9			10	12			
Protection in dB @ 1.5:1	10							
Output Metering (volts)	−1 @ 10W	−1 @ 25W	−1 @ 50W		−.3 @ 15W			
Power Required 50/60 Hz, 115/230 volts (Watts)	125	350	500		200	400	500	
Size inches/cm metric	7 x 8½ x 17/ 17.8 x 21.6 x 43.2	17¼ x 8½ x 17/ 43.8 x 43.2 x 17.8		7 x 8½ x 17/ 17.8 x 21.6 x 43.2		17¼ x 7 x 17/ 43.8 x 17.8 x 43.2		
Weight lbs/kg	22/10	43/19.5		22/10		43/19.5		

*with −2 option, lower frequency limit is 460 MHz.

RF Modules

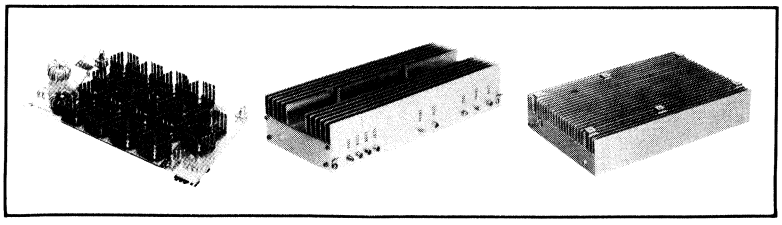
Features

- Supplied with amplifiers or separate for specific applications.
- Modules enclosed in RFI proofed enclosures, with heat sinks.
- Modules for Transmitter Drivers, NMR, Time Distribution, and EW and ATE systems.
- Modules require DC voltage and forced air cooling in some applications.
- Cost savings available through purchase of modules with power supply.
- Custom characteristics available— power, frequency, AM, FM, pulse modulation.
- Half and full rack mounting kits with slides available.

All modules have the electrical performance of the basic amplifier when supplied with the appropriate power.

Model No.	Dimensions (Inches)	Power Requirements (VDC, ±1%)	Cooling (Cubic Feet/Minute)
*ME 5001	2.0 x 6.66 x 12.40	24, 6 amps	100
*ME 1020	2.36 x 4.74 x 10.68	28, 3 amps	100
ME 2020	3.20 x 4.74 x 12.50	24, 6.5 amps	100
ME 5020	3.20 x 4.74 x 12.50	24, 10 amps	250
ME 10512	2.36 x 4.74 x 10.68	24, 9.4 amps	100
ME 15100	2.80 x 7.88 x 11.70	24, 10 amps	250
ME 20512	2.80 x 7.88 x 11.70	24, 9.4 amps	250
ME 35512	2.80 x 7.88 x 11.70	24, 12 amps	250

*Voltages available for metering and ALC.



Sweep Oscillators

9515D 20 mW
available to 18 GHz

488 GPIB

6600 B
with 9514D

Model 6600B/9514/15D Programmable Sweep Systems

.01 to 18 GHz Continuous Sweep

The AILTECH OPT 66-488 will get you on the bus with the best of both worlds—ASCII bus commands and data to execute ALL Analog Sweep Functions and more.

OPT 66-488 Features

- Every Front and Rear Panel Function is Programmable.
- Band Selection up to .01-18 GHz.
- Mode Selection.
- CW Frequency Selection—10,000 Steps per Band.
- Start (F1)—Stop (F2) Frequency Selection with 10,000 Steps per Band for both F1 and F2—Internal Ramp Generator *Sweeps from F1 to F2.*
- Fϕ/ΔF Sweep Selection—10,000 steps per band for Fϕ—10,000 Step Sweep Width. Resolution for ΔF width up to 20% of band.
- Sweep Time Selection from 10 msec to 160 sec.
- Internal or Bus Triggered Sweep.
- Three Intensity and/or Amplitude Markers/10,000 Steps per Band.
- Leveling Mode Selection including Power Meter Leveling.
- RF Level Selection—256 Step Resolution. (9514/15D)
- RF OFF.
- Internal and External AM.
- Linear AM with RF Power Offset.
- External Pulse Modulation.
- Automatic Pen Control for Sweep Times >10 sec.
- Sweep Pause—Stops Sweep for Fixed Frequency Data Acquisition.

Standard 6600 B/9514/15D Features

- All frequency indicators on one 13 inch scale.
- 10mW Leveled power (20 mW Optional).
- AILTECH "Air Duct—Heatsink" Chassis Cooling System.
- Oscillators are always on for maximum stability.
- Sweep Compensation for YIG Oscillators to maintain frequency accuracy, independent of sweep speed.
- Optimum YIG driver bandwidth automatically selected for CW and Swept Modes.
- Leveling loop gain is independent of RF power level for leveling accuracy.
- Single power level control for all bands.
- Single FM input for phase lock capabilities.
- Five push button selected modes of operation.

sweep oscillators

Specifications—6600 B/9514/15D Sweep Oscillator

FREQUENCY CHARACTERISTICS

Frequency Ranges: .01 to 4.0 GHz
2.0 to 8.0 GHz
4.0 to 12.4 GHz
8.0 to 18.0 GHz
.01 to 4.2 GHz†
.01 to 18.0 GHz

Frequency Accuracy Fϕ/CW, Full Band and M1-M2 Mode

Band	Range	Sweep Time
011	.01 to 4.0 GHz	≥20 msec ± (.5% + 15 MHz)
011	.01 to 4.2 GHz†	
100	2.0 to 8.0 GHz	≥20 msec ± .5%
101	4.0 to 12.4 GHz	≥20 msec ± .5%
110	8.0 to 18.0 GHz	≥20 msec ± .5%
111	.01 to 18.0 GHz	≥35 msec ± (.5% + 30 MHz)

FϕΔF Sweep Width Accuracy: ± (.5% ΔF set + 1% ΔF Max) (Excluding band crossover)

Frequency Continuity at Band Crossover: 0% to 1% overlap.

Frequency Stability

Frequency	.01-2.0 GHz	.01-4.2 GHz	2.0-4.0 GHz	4.0-8.0 GHz	8.0-12.4 GHz	12.4-18.0 GHz
With Temp 0-50° C	±300 kHz/° C	<250 kHz/° C	±300 kHz/° C	±500 kHz/° C	±1 MHz/° C	±2 MHz/° C
With Line Voltage ±10%	±40 kHz	<±20 kHz	±20 kHz	±30 kHz	±40 kHz	±50 kHz
With Power Level 10 dB change	±1 MHz	<250 kHz	±1 MHz	±1 MHz	±1 MHz	±1 MHz
With Load VSWR 3:1 any phase	±.05%	<100 kHz	±.05%	±.05%	±.05%	±.05%

RF OUTPUT CHARACTERISTICS

RF Power Output @ 25° C

Standard:	≥10 mW	.01-18 GHz
Option 20:	≥20 mW	2-18 GHz*

Power Output Flatness

Internally Leveled: ±1 dB (.01-18 GHz) @ specified sweep rate**

Externally Leveled: (Excluding variations of the external sampler) ±0.1 dB (.01-18 GHz) @ specified sweep rate**

Power Output Control Range: ≥10 dB.

SPECTRAL PURITY CHARACTERISTICS

Residual FM: CW Mode, measured in a 1 Hz to 10 KHz bandwidth.

Frequency Range	Residual FM—Peak
.01-4.0 GHz	<7.5 kHz
.01-4.2 GHz	<15.0 kHz†
4.0-8.0 GHz	<10.0 kHz
8.0-12.4 GHz	<12.5 kHz
12.4-18.0 GHz	<15.0 kHz
.01-18.0 GHz	<20.0 kHz

*Typically 20 mW .01 to 18, but harmonics and spurious may degrade below 2 GHz.

**≥20 msec per band except ≥35 msec for .01 to 18 GHz.

†6600B system with 6608EDA plug-in specifications

Residual AM:

Measured in a 1 Hz to 10 kHz bandwidth, 200 kHz from the carrier: >50 dBc (.01-18 GHz)

External FM (9515 D Rear Panel)

Modulation Rate	Deviation
DC-1 kHz	±60 MHz (.01 to 12.4 GHz) ±30 MHz (12.4-18 GHz)
1 kHz-100 kHz	>10 MHz Pk-Pk
FM Sensitivity	≈6 MHz/V (.01-12.4 GHz) ≈3 MHz/V (12.4-18 GHz)

†External FM (6600B with 6608EDA Plug-in)

Modulation Rate	Deviation
DC-200 kHz	±20 MHz
FM Sensitivity	4 MHz/V nom.

Harmonics: >20 dBc—.01-18 GHz at specified power.

Non-Harmonics: >35 dBc—.01-2 GHz at specified power.
>35 dBc—.01 to 4.2 GHz, +10 dBm output†
>50 dBc—2.0-18.0 GHz

MODULATION CHARACTERISTICS

Internally Leveled	Rise and Fall Time
Internal AM, External AM, or External PM	<10 μsec at specified power <5 μsec rise, <1 μsec fall time†
Unleveled @ Max. RF Power Internal AM, External AM, or External PM	<3 μsec

On/Off Ratio: >45 dB at specified power.
>40 dB†

External PRF Range

Leveled: DC-30 kHz.
Unleveled: DC-100 kHz.

External Linear AM

Modulation Frequency Range: DC-20 kHz.
Modulation Sensitivity: ≈1 V/10%.
Modulation Depth: >30%,>50%†

GENERAL CHARACTERISTICS

Output Signals

Sweep Ramp (6600 B Front Panel): 0-10 V independent of sweep width.

Voltage Proportional To Frequency

6600B Rear Panel: 0-10 V (Proportional to start and stop frequencies.)

9515D Rear Panel: 1 volt per GHz ± (20 mV +2%).

Scope Blanking

	Blanked	Sweep
+ Blanking	0 V ±0.5 V	+10 ±.5 V
− Blanking	0 V ±0.5 V	−10 ±.5 V

Dimensions

Height: 10.5 inches, 26.67 cm—5.25 inches, 13.34 cm†

Width: 16.75 inches, 42.55 cm—16.75 inches, 42.55 cm†

Depth (Behind Panel): 16.75 inches, 42.55 cm—14.75 inches, 37.5 cm†

†6600B system with 6608EDA plug-in specifications

AILTECH FM-100 Communications Service Monitor

Features

- New multifunction service monitor.
- Ruggedized modular construction.
- Frequency range 0.1 to 999.99999 MHz.
- TCXO controlled synthesizer for added stability.
- Built-in tone generator.
- Fully portable light weight construction.
- 12 VDC, 115-230 VAC operation. Battery module optional.

Description

The advanced technology AILTECH line of Communication Service Monitors has been totally human engineered for ease of operation. This small, lightweight (33 lbs.) portable Monitor provides the same long-term reliability that our FM-10 delivered.

Controls and ports are color coded and grouped by function for fast, easy operation. Front panel controls have been kept to a minimum.

High quality, rugged modular construction with plug-in, bolted-down PC boards and strip-line circuitry eliminate maintenance problems. If service is ever required, it can be accomplished in your own shop. All parts are readily accessible.

SPECIFICATIONS

GENERATE MODE

Frequency Range: 1 to 999.99999 MHz
- **Accuracy:** 1 x 10^{-6}
- **Resolution:** 10 Hz steps
- **Stability:** 1 x 10^{-6}/yr. max. 1 x 10^{-7}/mo. max.
- **Residual FM:** 30 Hz rms
- **SSB Phase Noise:** Better than −105 dBc/Hz at 20 kHz removed from carrier
- **Setting Time:** Typically less than 100 ms

Output Level:
- **Antenna:** −80 dBm to 0 dBm
- **Transmit/Receive:** −120 dBm to −40 dBm
- **Accuracy of Step:** ±2 dB at antenna at −10 dBm and 25° C
- **Attenuator at 500 MHz:** ±.5 dB/10 dB step, ±1 dB 0 to 50° C
- **Flatness of Step Attenuator:** ±2 dB over a 2:1 frequency range, ±4 dB 1 MHz to 1 GHz
- **Transmit/Receive:** 40 dB ±2 dB from antenna port
- **Impedance:** 50 ohm nominal leveled
- **Spectral Purity:** Spurious typically −40 dBc, Harmonics −15 dBc
- **Attenuator Range:**
  - 0 to 70 dB in 10 dB steps
  - 0 to 10 dB variable
  - 40 dB between antenna and transmit/receive ports

MODULATION

Tone Generator: 10 to 9999.9 Hz
- **Accuracy:** 1 x 10^{-6}
- **Resolution:** 0.1 Hz
- **Distortion:** 5% max.
- **Display:** Thumbwheel switch

1 kHz Accuracy: 1 x 10^{-6}

External Input, Frequency: 5 Hz to 10 kHz
- **Input Impedance:** 10 k ohms

Frequency Modulation: 0 to 15 kHz peak deviation
- **Indicator:** Oscilloscope graticule

MEASURE MODE

- **Frequency Range:** .1 to 999.99999 MHz
- **Accuracy:** 1 x 10^{-6}
- **Resolution:** 10 Hz steps
- **Setting Time:** 100 ms to within 5% at selected frequency
- **Sensitivity:** 2 μV for 10 dB E1A sinad with 15 kHz BW
- **Frequency Error:** ±1.5, 5, 15, 50 kHz full scale using panel meter
- **Display/Select:** Lever switch

Bandwidth:
- **Wide:** 150 kHz if Dev. ≥15 kHz
- **Narrow:** 15 kHz if Dev. ≤5 kHz

Frequency Modulation:
- **Peak Deviation:** 0 to 1.5, 5, 15, 50 kHz full scale
- **Indicator:** Oscilloscope graticule

RF Power Range: 0 to 5, 0 to 50 watts
- **Accuracy:** ±10% of full scale
- **Indicator:** Panel meter
- **Overload Warning:** Audible

Sinad:
- **Accuracy at 12 dB:** ±1 dB
- **Input Level:** 0.5 V to 10 V rms

GENERAL

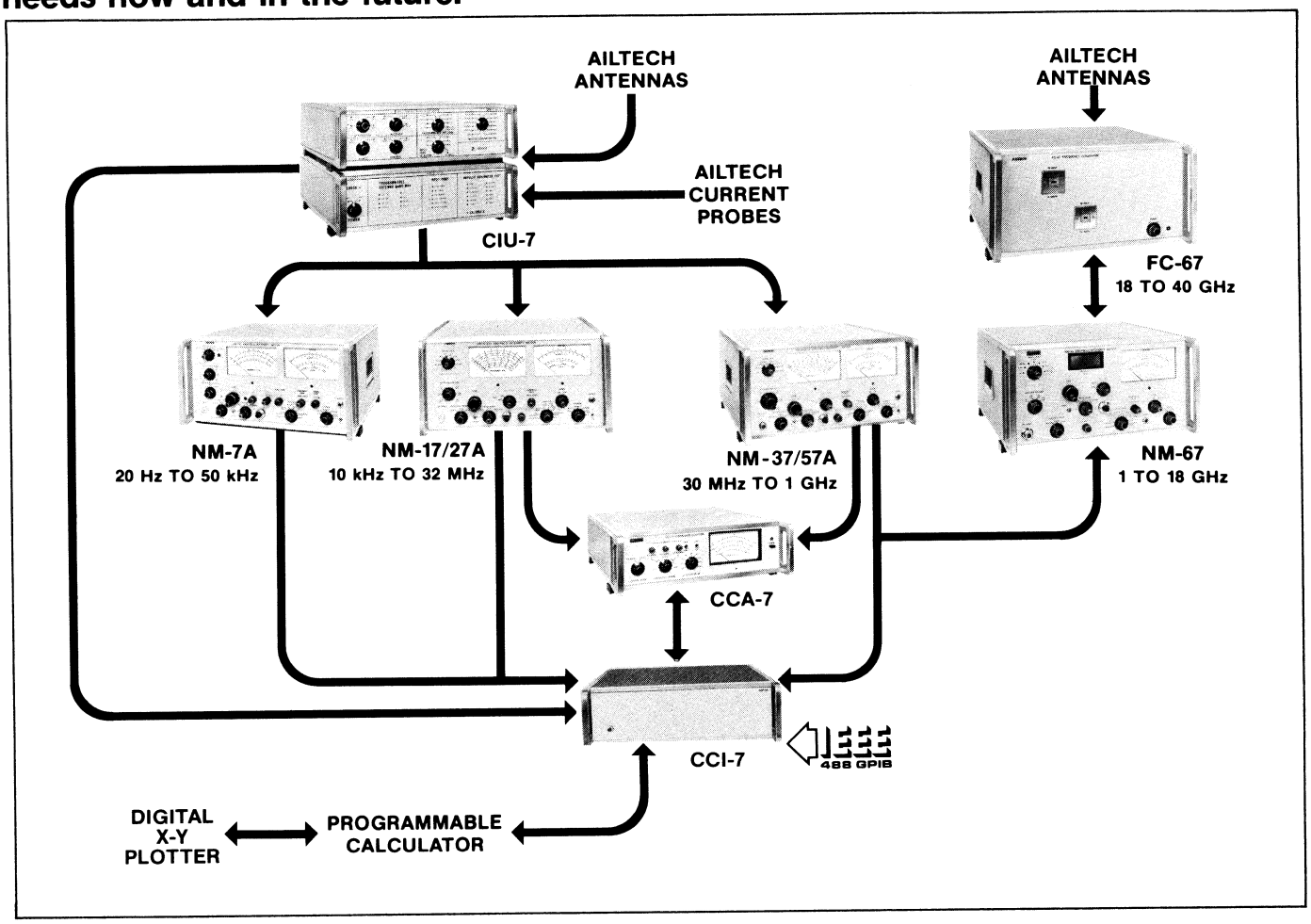
Speaker: 7.6 x 12.7 cm (3 x 5 in.)

Power:
- **AC:** 115 V, 230 V ±10% to 400 Hz
- **DC:** ±11.5 V to 16 V dc
- **Battery Optional**

Mechanical:
- **Dimensions:** 28H, 22.2W, 47.6D cm. (11H, 8.75W, 18.75D in.)
- **Weight:** 15.9 kg. (33 lbs.)

AILTECH Series VII EMI Data Collection Systems

a modular system concept that provides automation for your needs now and in the future.



Manual System

- One receiver provides required frequency range.
- Spectral display.
- Hard copy with analog plotter.

Semi-Automatic System

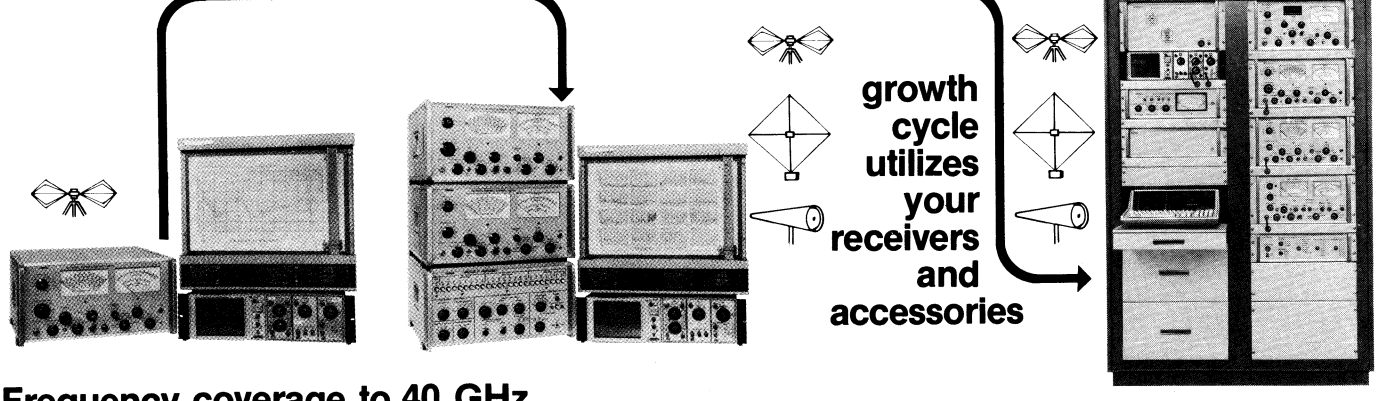
- Additional receiver extends frequency range.
- Preset-manual controller permits programs to be preset on front panel.
- Spectral display.
- Hard copy with analog plotter.

Fully Automated Computer/Calculator Controlled System

- Full frequency range—20 Hz to 40 GHz.
- Operated by programmable controller, computer, calculator or in manual mode.
- Fully automatic testing to MIL-STD 461/462.
- Automatic CISPRI/ANSI/VDE measurements.
- Automatic control of antennas for each frequency range.
- Programmed correction factors and specification limits on hard copy documentation in final engineering units.

can grow to

can grow to

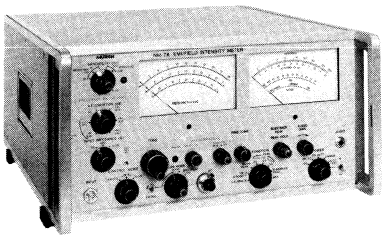


growth cycle utilizes your receivers and accessories

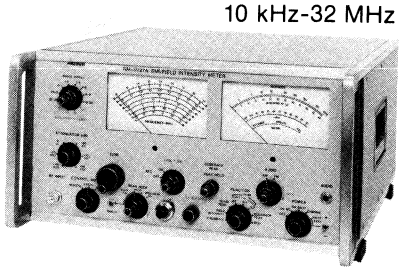
Frequency coverage to 40 GHz

AILTECH EMI Field Intensity Meters

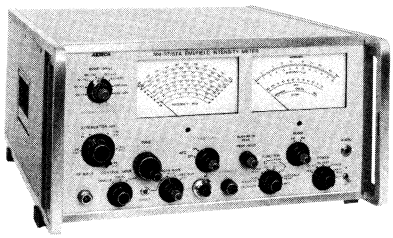
AILTECH NM-7A
20 Hz to 50 kHz



AILTECH NM-17/27A
10 kHz-32 MHz



AILTECH FC-67
18 GHz-40 GHz
(with NM-67)



AILTECH NM-37/57A
30 MHz-1 GHz

AILTECH NM-67
1 GHz-18 GHz

emi/rfi test instrumentation

Overall Features

- Perform manual or programmable EMI emission measurements to MIL-STD 461/462 Series MIL-STD 461A and other applicable military specifications and commercial standards.
- Operate under calculator/computer control as elements in the Series VII System.
- Supply amplitude and frequency analog data outputs for X-Y recorder presentation or for conversion to digital data format.
- Provide average (FI), quasi-peak, direct peak, with variable hold time and slideback detector functions.
- Internal solid-state impulse generator for calibration source.
- Internal solid-state impulse or sinewave generator for calibration source.
- Excellent sensitivity, VSWR, gain flatness and spurious rejection assure accurate and dependable test results.
- With CIU-7 in the system, bandswitching of antenna accomplished automatically when receiver bands are changed.
- Operate from 115/230 V AC line power or internal rechargeable battery for field use. (except NM/FC 67)
- Rugged, modular construction.

General Description

AILTECH programmable precision EMI/FI meters measure conducted or radiated RF interference to MIL-STD 461/462 Series, MIL-STD 461A and other applicable military specifications and commercial standards. CISPR, ANSI and VDE measurements can be performed using CCA7 CISPR adapter. Frequency and signal amplitude outputs are suitable for conversion to a digital data processing system.

The instruments are all solid state, rugged and portable and 3 RFI meters operate from internal rechargeable batteries. They can be used to analyze narrowband or broadband signals in the available frequency range. Average (FI) or direct peak detector functions may be used for measurements in addition to quasi-peak, slideback peak and BFO detection modes (except NM-67). AM, FM and PM signals may be detected and are available at the video output for oscilloscope display. When used in conjunction with an oscilloscope, the meters become improved spectrum analyzers with integral pre-selection.

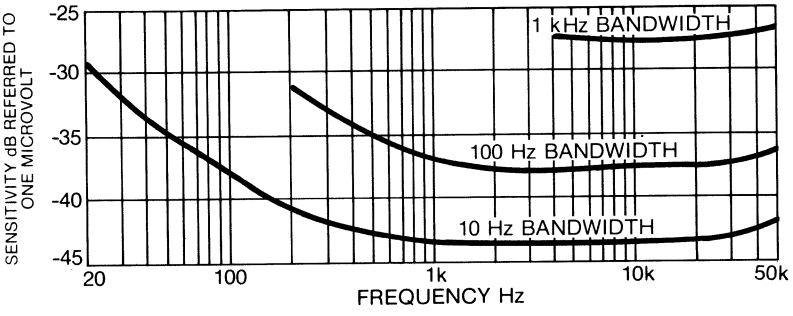
AILTECH Model NM-7A EMI/Field Intensity Meter

Description

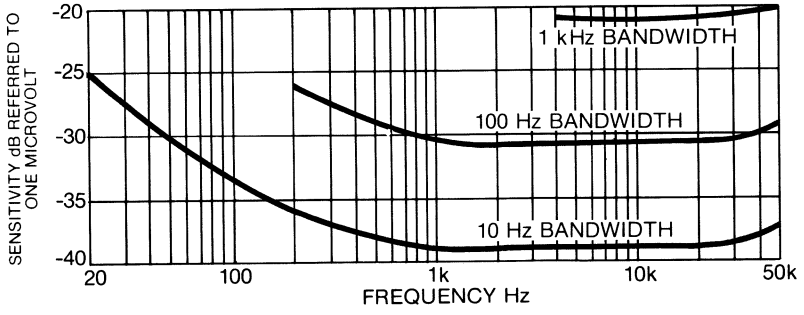
The NM-7A provides both frequency selective (tunable) and wideband signal analysis in a single instrument. It may be used to analyze and measure narrow-band or broadband signals in the 20 Hz to 50 kHz frequency range. An output meter provides three measurement scales: 1-1000 μV, 0-60 dB referred to 1 μV and −107 to −47 dBm. The dynamic range of the input signal may be 60 dB without requiring a change in setting of the built-in input attenuators. By using the attenuators, a total measurement range of 160 dB is possible. Three input impedances of 50 ohms, 600 ohms and 100 K ohms are provided to maximum flexibility of low frequency signal measurement.

As a selective tunable receiver, or voltmeter, the NM-7A covers the 20 Hz to 50 kHz frequency range in one band. To facilitate low frequency resolution, two expanded frequency scales of 20 Hz to 500 Hz and 20 Hz to 5 kHz are provided. Frequency selection is voltage controlled and may be accomplished by a front panel main tuning control, a fine tune control, a built-in automatic frequency scan or by providing an external 0-10 VDC tuning ramp. When any of these tuning modes are used, the tuned frequency is indicated on the front panel frequency meter. A frequency counter may be connected to the NM-7A tracking output for high accuracy frequency measurement.

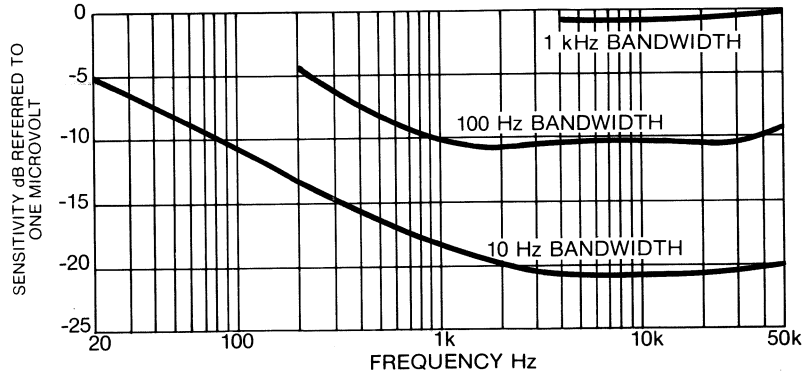
50 ohm Input Impedance Two Terminal Sensitivity

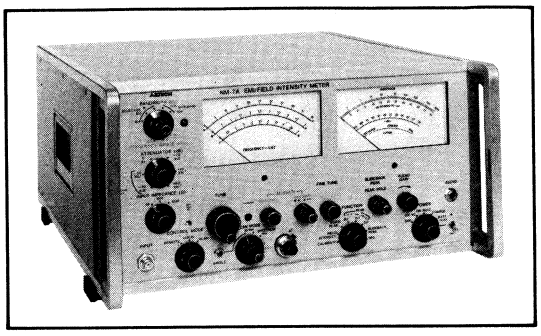


600 ohm Input Impedance Two Terminal CW Sensitivity



100k ohm Input Impedance Two Terminal Sensitivity

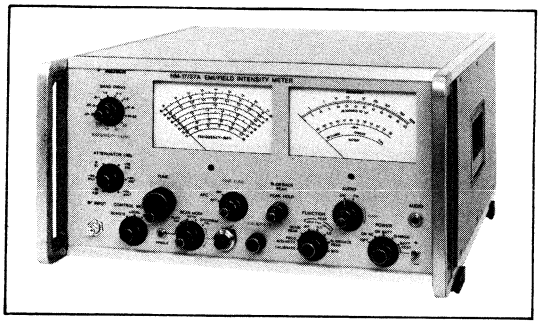




AILTECH NM-7A
20 Hz to 50 kHz

Features

- Performs manual or programmable EMI emission measurements from 20 Hz to 50 MHz in accordance with MIL-STD-461A and other applicable military specifications and commercial standards.
- Has 3 bandwidths in selective mode (10 Hz, 100 Hz and 1 kHz) and 2 bandwidths in wideband mode (20 kHz and 50 kHz).
- Has fine tune control for ease of tuning in narrow bandwidths.
- Provides BFO for CW signal location and ease of signal identification.



AILTECH NM-17/27A
10 kHz—32 MHz

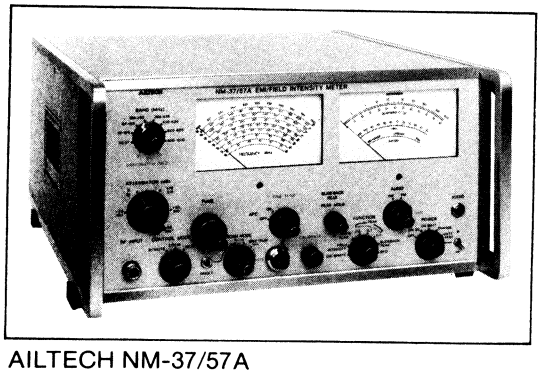
AILTECH Model NM-17/27A EMI/Field Intensity Meter

Features

- Performs manual or programmable EMI emission measurements from 10 kHz to 32 MHz in accordance with MIL-STD-461A and other applicable military specifications and commercial standards.
- Has four bandwidths (100 Hz, 1 kHz, 10 kHz, and 50 kHz).
- Internal solid-state impulse generator for calibration source.
- 60 dB meter scale, overall measurement range 160 dB (.01 μV to 1.0 volt).

Description

In the NM-17/27A, internal frequency scan capabilities have been expanded to provide two modes, PLOT and SPECTRUM. The PLOT mode, used for X-Y recorder presentation, produces a single scan operation triggered by a front panel switch. The SPECTRUM mode produces a repetitive scan which is used for a spectral display on an oscilloscope. Both modes feature variable sector width and scan rates adjusted by front panel controls.



AILTECH NM-37/57A
30 MHz—1 GHz

AILTECH Model NM-37/57A EMI/Field Intensity Meter

Features

- Performs manual or programmable EMI emission measurements from 30 MHz to 1 GHz in accordance with MIL-STD-461A and other applicable military specifications and commercial standards.
- Model NM-37/57S, 20 MHz to 1 GHz.
- Has three bandwidths (10 kHz, 100 kHz, and 1 MHz).
- Internal solid-state impulse generator for calibration source.
- 60 dB meter scale, overall measurement range 140 dB (.1 μV to 1.0 volt).

Description

Exceptional gain flatness is inherent in the design of the NM-37/57A. This feature permits X-Y plotting of signal amplitude and frequency information without an extreme deviation of accurate calibration.

In the NM-37/57A internal frequency scan capabilities have been expanded to provide two modes, PLOT and SPECTRUM. The PLOT mode, used for X-Y recorder presentation, produces a single scan operation triggered by a front panel switch. The SPECTRUM mode produces a repetitive scan which is used for a spectral display on an oscilloscope. Both modes feature variable sector width and scan rates adjusted by front panel controls.

AILTECH NM-67 EMI Receiver

Features

- Performs manual or programmable EMI emission measurements from 1 GHz to 18 GHz in accordance with MIL-STD-461A and other applicable military specifications and commercial standards.
- RF preselection in all bands.
- Fundamental mixing in all bands.
- Tuned RF preamplifiers/preselectors.
- Required detector functions built in.
- Calibrated impulse bandwidths.
- Digital display of frequency.
- Special peak detector built in for improved display of radar antenna pattern data.
- Dynamic measurement range typically —100 dBm to +13 dBm.

Description

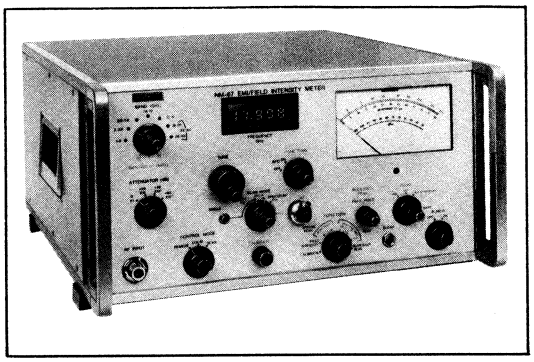
The AILTECH NM-67 is a programmable, precision Electromagnetic Interference (EMI) Receiver used for the measurement of conducted or radiated RF signals, within the frequency range of 1 to 18 GHz in accordance with military and commercial EMI test specifications. The instrument performs automatic and semiautomatic testing when supplied with appropriate command signals and provides outputs of signal amplitude and frequency that are suitable for input to a digital data processing system.

RF preselection is employed to minimize the Receiver's response to undesired signals. Both the preselector and the local oscillators are tuned by YIG resonators permitting remote control of frequency by means of a variable voltage source. Frequency is indicated on a digital display. Three IF bandwidths are available; 0.1, 1.0, and 10 MHz.

The instrument uses a logarithmic IF amplifier which provides 60 dB of dynamic amplitude display range on the panel meters. In conjunction with three 20 dB attenuator steps the overall measurement range is 120 dB, from one microvolt to one volt. An internal calibrator module enables standardizing the gain of the Model NM-67 assuring accurate amplitude measurements.

Various detector functions are available to facilitate signal measurement and analysis. Along with the conventional functions of field intensity (average), direct peak, and slide-back peak, a "special peak" detector is included for improved display of radar antenna pattern data. In the direct peak function, the detector hold time may be varied from 3 msec to 3 sec permitting a wide range of data collection rates and display devices. Demodulation of AM and FM signals is provided with simultaneous video outputs and a selectable audio output to headphones. Other data outputs include voltages for X-Y recorder or oscilloscope display, and voltage outputs suitable for direct conversion to a remote digital display of frequency and amplitude.

Semiautomatic testing capability is provided in the Model NM-67 by two modes of internal frequency scanning. The PLOT mode produces a relatively slow frequency scan suitable for X-Y recorder display and triggered by a front panel pushbutton switch. The SPECTRUM mode gives a faster, recurrent frequency scan for presentation on an oscilloscope. In both modes, the scan rate is variable to obtain an optimum display, and the scan sector can be adjusted from zero to full bandwidth.



AILTECH NM-67

Programmable Functions:

- Frequency band selection.
- Frequency tuning.
- Attenuator selection.
- Bandwidth selection.
- Receiver gain (calibration).
- Function selection; CAL, FI, SPECIAL PEAK (FAST), PEAK (0.03, 0.3, 3.0 SEC HOLD TIME).

AILTECH NM-67 (with FC-67)
18 GHz—40 GHz

NM-67, FC-67 System and Components

Features

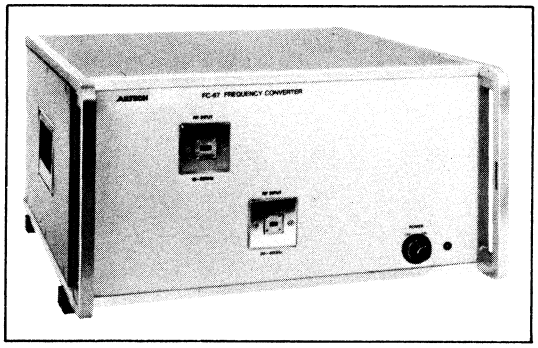
- Frequency coverage 1-18 GHz.
- Dynamic range −100 dBm to +13 dBm.
- Tracking YIG preselection.
- Operates alone, with manual controllers or as part of the AILTECH CCI-7 Counter/Interface controlled EMI data collection system.

Description

The AILTECH EMI/Field Intensity Meter NM-67 and Frequency Converter FC-67 operate as a team for EMI testing to MIL-STD 461/462 Series, MIL-STD 826A requirements and other applicable military specifications and commercial standards in the frequency range 1 GHz to 40 GHz.

The NM-67 can operate alone, covering the frequency range 1 to 18 GHz. The Model FC-67 extends the frequency coverage to 40 GHz. All control functions and data readouts (including digital) are performed by the Model NM-67 and the same programmable functions are provided. The FC-67 range becomes bands 6 and 7 as indicated on the NM-67 front panel. Band 6 is 18 to 26 GHz and band 7 is 26 to 40 GHz.

The NM-67/FC-67 team operates alone, with manual controllers or as part of AILTECH's Series VII computer/calculator programmable EMI Data Collection System covering the frequency range 20 Hz-40 GHz.



AILTECH FC-67

FC-67 FREQUENCY CONVERTER FEATURES

The FC-67 Frequency Converter is believed to be the only continuous coverage 18 to 40 GHz, directly tuned superheterodyne receiver commercially available.

The basic conversion method, using a 400 MHz IF, is conventional but, due to the frequency range covered, unusual high technology components are required. Examples are the multipliers and mixers in the K and KA band preselector. Fundamental mixing is used to achieve sensitivity figures desirable for these microwave frequencies.

Tracking YIG preselection is used to achieve the intermodulation and image rejection performance that characterizes the AILTECH line of EMI measurement receivers.

Exact tuned frequency can be determined by measuring a sample of the local oscillator with a microwave counter. Frequency is read directly to a 1% accuracy by means of the LED display on the NM-67 receiver for 1-18 GHz and controller for the FC-67. Amplitude calibration of the FC-67 is accomplished by the unique (Eaton Corp. patented) method that is used in the NM-67. An internally generated signal is passed through the first mixer and preselector of the receiver. Earlier microwave measuring receivers have relied on a calibration curve that assumes everything is working properly. For EMI testing and other critical applications, such assumptions can be catastrophic.

The Model NM-67 has minimum of 60 dB on scale dynamic range. Electronically switched RF vane attenuators extend the dynamic measurement range from the noise floor at typically -100 dBm to +13 dBm for a total dynamic range of 113 dB.

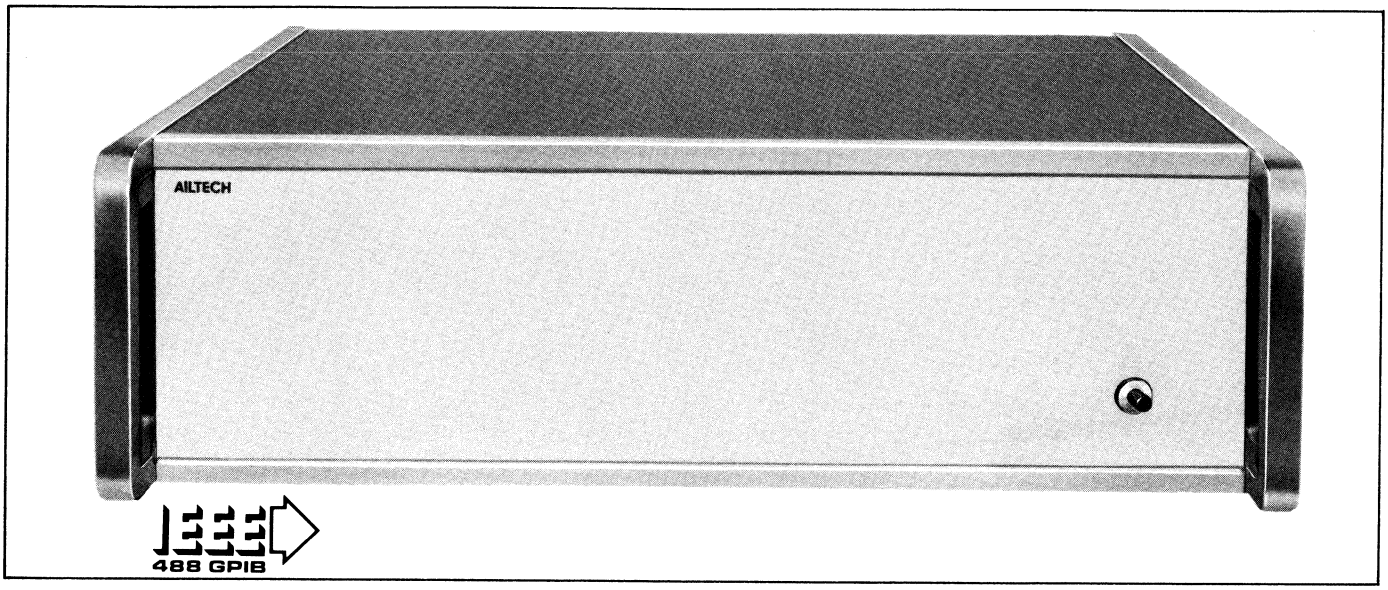
Model No.	NM-7A	NM-17/27A	NM-37/57A	NM-67 and FC-67
Frequency Range **Band 1** **Band 2** **Band 3** **Band 4** **Band 5** **Band 6** **Band 7** **Band 8** **Wideband**	20Hz-50kHz 20-500Hz 20Hz-5kHz 20Hz-50kHz 20Hz-50kHz or 20Hz-20kHz	0.01-32MHz 0.01-0.25MHz 0.25-0.5MHz 0.5-1.0MHz 1-2MHz 2-4MHz 4-8MHz 8-16MHz 16-32MHz	30-1000MHz 30-57MHz 55-105MHz 101-192MHz 186-292MHz 285-445MHz 430-620MHz 600-825MHz 800-1000MHz	1-40GHz NM-67:1-2GHz 2-3.6GHz 3.6-7.6GHz 7.6-12GHz 12-18GHz FC-67:18-26GHz 26-40GHz
Intermediate Frequency	100kHz	Bands 1 & 4: 455MHz Bands 2, 3, 5, 6: 1.6/.455MHz Bands 7, 8: 5.0/.455MHz	Bands 1, 2, 3: 20.5MHz Bands 4-8: 16.0/20.5MHz	1st 400MHz 2nd 60MHz 3rd 10.7MHz 3rd IF only in 0.1MHz BW
RF Input Connector	BNC		Precision N	Precision N (NM-67) Waveguide (FC-67)
RF Input VSWR **(Ref. to 50Ω)**	1.2:1 max. 100Hz to 20kHz 1.5:1 max. 20Hz to 100Hz and 20kHz to 50kHz	1.2:1 typ., 1.5:1 max.	Band 1-3: 1.25:1 typ., 1.5:1 max. Band 4-8: 1.35:1 typ., 2:1 max.	VSWR 2:1 typ., 3:1 max.
Frequency Accuracy	±2% (% of full scale)	±2% (or ±5kHz)	±2%	±1%
Gain Flatness **(Ref. to a straight line)**	±1dB max.	±1dB typ. ±2dB max.	±1dB typ. ±2dB max. @ 25°C ±3dB @ −15 to +50°C	±3dB
Calibrator, Internal, generator, fixed amplitude	Internal sine wave tracked to tuned frequency, fixed amplitude	Solid-state 500Hz rep rate impulse generator	Solid-state 450Hz rep rate impulse generator	Patented signal processing technique
Voltage Measurement Range	Narrow band 160dB (60dB meter, 100dB attenuation in 20dB steps) .01μv to 1.0v (160Hz) Wideband: 120dB (60dB on meter, 60dB attenuation in 3 steps)		140dB (60dB on meter, 80dB attenuation in 20dB steps; 0.1μv to 1V)	120dB (60dB on meter, 60dB attenuation: 1.0μv to 1V)
Voltage Measurement Accuracy	±1dB, CW; ±2dB, Impulse signals	±2dB, CW; ±3dB impulse signals		
Undesired Response Rejection	Image and intermediate freq: 80dB min. spurious: 70dB min.	Image, intermediate freq. & spurious: 70dB min.	Image, intermediate freq. & spurious: 60dB min. (except 41MHz, 40dB min.)	IF; 80dB min. Image freq. & spurious: 60dB min. (Image 50dB min. for FC-67)
Sensitivity, Narrow band, CW signal, FI Detector, two terminal at 50 ohms	Varies with impedance and bandwidth, see individual brochure.	100Hz BW −36dBμv or −143dBm 1kHz BW −26dBμv or −133dBm 10kHz BW −16dBμv or −123dBm	10kHz BW Band 1, 2 or 3: −17dBμv or −124dBm Band 4, 5, 6, 7 or 8: −10dBμv or −117dBm	0.1MHz BW +7dBμv or −100dBm 1.0MHz BW +17dBμv or −90dBm 10MHz BW +27dBμv, or −80dBm
Sensitivity, Broadband, Impulse Signal, Peak Detector	1kHz BW from 2kHz to 50kHz: 43dBμv/MHz	50kHz BW: .07-32MHz, +26dBμv/MHz: 10kHz BW .01-.014MHz, +43dBμv/MHz 10kHz BW: .014-.02MHZ, +37dBμv/MHz: 10kHz BW .02-32MHz, +33dBμv/MHz	Band: 1, 2, 3, 5.6μv/MHz, +15dBμv/MHz Band: 4, 5, 6, 7, 8 10μv/MHz, +20dBμv/MHz	0.1MHz Band: 100μv/MHz, +40dBμv/MHz 1.0MHz Band: 31μv/MHz, +30dBμv/MHz 10MHz Band: 10μv/MHz, +20dBμv/MHz

Model No.	NM-7A	NM-17/27A	NM-37/57A	NM-67 and FC-67
Noise Figure of Receiver in 1MHz BW	13dB	10dB	Band 1-3, 9.5dB Band 4-8, 16.5dB	23.5dB
Local Oscillator Emission	50 ohm impedance <1μv	50 pico watts		−73dBm max.
Shielding Effectiveness	80dB min.	100dB typ. 80dB min.		80dB min.
DETECTOR **Field Intensity**	Average value of the 60dB logarithmic detector			
Quasi-Peak	Weighted output of log detector: charge time 1ms, discharge 600ms			n/a
Special Peak				responds to peak value, exponential decay
Direct Peak	responds to true peak value, in RMS of eq. sine wave. hold time: variable from 3msec. to 3sec: hold time			
Slide Back Peak	manual detector with aural null indication			n/a
BFO for CW reception and tuning	600Hz nom.	1kHz nom.		n/a
IF Bandwidths (6dB values ±10%)	10 & 100Hz and 1kHz	0.1, 1, 10 and 50kHz	10 & 100kHz and 1MHz	0.1, 1 and 10MHz
Internal Frequency Sweep **Scan mode:** **Plot mode:**	Spectrum display rate: 1-30 scans/sec., variable X-Y plot scan time variable <30 to >1000 sec/scan			
Scan width 0-100% of band	Blanking during retrace.	Blanking during retrace. Isolated pen closure in plot mode only.	Blanking during retrace.	nom. variable. Video blanking, pen lift provided.
OUTPUTS **Local Oscillator**	50mv/min. P-P into 50 ohms, 100 kHz > frequency. Rear BNC.	Optional single LO output, SL version, 20dBm/min. across 50 ohms. Rear BNC.		−20dBm/min. across 50 ohms 400MHz frequency. Rear SMA conn.
Tracking Oscillator	−7dBm ±1dB into 50 ohm load. Rear BNC.	n/a		
Full scale indication: IF output	100kHz 80mvrms across 50 ohms. Rear BNC.	455kHz 80mvrms min. across 50 ohms.	20.5MHz 20mvrms min. across 50 ohms. Rear BNC.	60MHz 80mvrms across 50 ohms. Rear BNC. 400MHz 500μv nom. across 50 ohms to 60dB. Output meter & 0dB attenuation. 20MHz BW nom.
Log Video from 360mv ±10% Peak (50μv change /10dB input, rear BNC	to 50kHz.	to 10kHz.	DC to 500kHz.	DC to 5 MHz.
Linear Video	with 30% amp. mod., 100mv P-P across 50 ohms, 20Hz −10kHz. Rear BNC.	with 30% amp. mod., 100mv P-P across 50 ohms, 20Hz −15kHz. Rear BNC.	with 30% amp. mod., 100mv P-P across 50 ohms, 20Hz to 200kHz. Rear BNC.	
Audio with 30% amplitude modulation	20mw min. across 600 ohms, 20Hz-4kHz. Front phone jack.	50mw typ., 30mw min. across 600 ohms, 20Hz-4kHz. Front phone jack.		20mw min. across 60° ohms, 20Hz-4kHz. Front phone jack.
FM Video	n/a	100mv min. P-P across 50 ohms. 25mv/5kHz typ. deviation. DC-5 kHz min. BW. Rear BNC.	±300mv min. across 50 ohms. ±300Hz typ. deviation, DC-100 kHz. Rear BNC.	1v/BW ±10% Rear BNC.

Model No.	NM-7A	NM-17/27A	NM-37/57A	NM-67 and FC-67
Data (simultaneously available) **X Axis, Single Band**	0 to 1v ±5% across 1k ohms 0 to 2v open circuit. Rear BNC. Multi-band same as frequency readout.			
X Axis, Multiband	same as frequency readout			
Scope X Output	±5 volts nominal, Rear BNC			
Y Axis	0-1v ±5% across	1k ohms, 0-2v open circuit, Rear BNC.		0 to +2v ±2%
Frequency Readout	100mv/kHz ±2% Rear programmer conn.	Bands 1-3:10mv/ kHz, Bands 4-8: 100mv/MHz, ±2%. Rear programmer conn.	10mv/MHz ±2% 0.3 to 10v full range. Rear programmer conn.	100mv/GHz, 0.1 to +1.8v full range. Rear programmer conn.
dB Readout	10mv/dB, −0.4 to +1.2v full range. Rear programmer conn.		10mv/dB, −0.2 to ±1.2v full range, ±2dB. Rear programmer conn.	10mv/dB, 0 to +120v full range. Rear programmer conn.
Programming Functions/ Electrical Requirements **Frequency Select**		−12v, 30mA max.	12v, 50mA max.	−12v, 22mA, nom.
Frequency Tune	0 to +10V sawtooth/band			
Input Resistance	2k ohms			100k ohms nom.
BW Select	+12v, 20mA max.	+12v, 12mA max.	+12v, 14mA max.	
Detector Function Select	+12v, 60mA, max.			+12v, 12mA nom.
Receiver Gain	0 to −6v, input resist, 100k ohms.		+4.8 to +7.2v input resist, 50k ohms. IF Attenuator Step & Peak Detector Dump: Logic Low	0 to +10v, input resist 5k ohms nom. Attenuator Select/ TTL logic low Bandwidth Select/ +12v, 3mA nom. Peak Detector Dump Grd or TTL low from open collector.
OPERATIONAL Power Required	105-125 or 210-250v, 50-400Hz, 30w. Removable, rechargeable cadmium cells. 8 hrs. cont. operation. Internal Circuits charge in 14-16 hrs. Battery test on front panel.			105-125 or 210-250v, 50 to 400Hz 120-170w @ 115v, 60Hz nom.
SIZE, including handles	8¾ H x 16¾ W x 18.75 D (22.22 x 42.42 x 47.62 cm)			8¾ H x 16¾ W x 18½ D (22.22 x 42.42 x 46.87cm) (each)
Weight	58 lbs. (26.3kg) incl. batteries	60 lbs. (27.2kg) Incl. batteries	65 lbs. (29.5kg)	65 lbs. (29.5kg) (each)

AILTECH CCI-7 Controller Counter Interface

Provides IEEE-488 GPIB compatible interface for external calculator/computer control of AILTECH EMI Data Collection Systems



Application

Use with AILTECH Series VII EMI Data Collection Systems for calculator/computer control.

Features

- Integrated Counter provides accurate frequency settability and readout up to 1 GHz.
- Positive feedback of all receiver control parameters.
- Controls all remotely controllable functions of all Series VII Receivers.
- Through Calculator/computer, output data can have necessary correction factors applied and can be formatted in final engineering units.
- Small size saves rack space.

Description

The AILTECH CCI-7 Controller Counter Interface is an IEEE-488 GPIB compatible interface unit which permits the complete Series VII EMI Data Collection System to be operated from a digital system controller.

The CCI-7 provides all necessary control and reading functions for system control by an appropriate calculator, controller or computer with GPIB compatibility. The keyboard and display of the controller serves as virtual front panel and provides for operator interaction with the system.

All remotely controllable receiver functions are operated by the calculator/computer or the operator through the CCI-7 and digital readout of all remotely controlled receiver parameters is presented on the controller display.

Control all parameters on all receivers with one interface

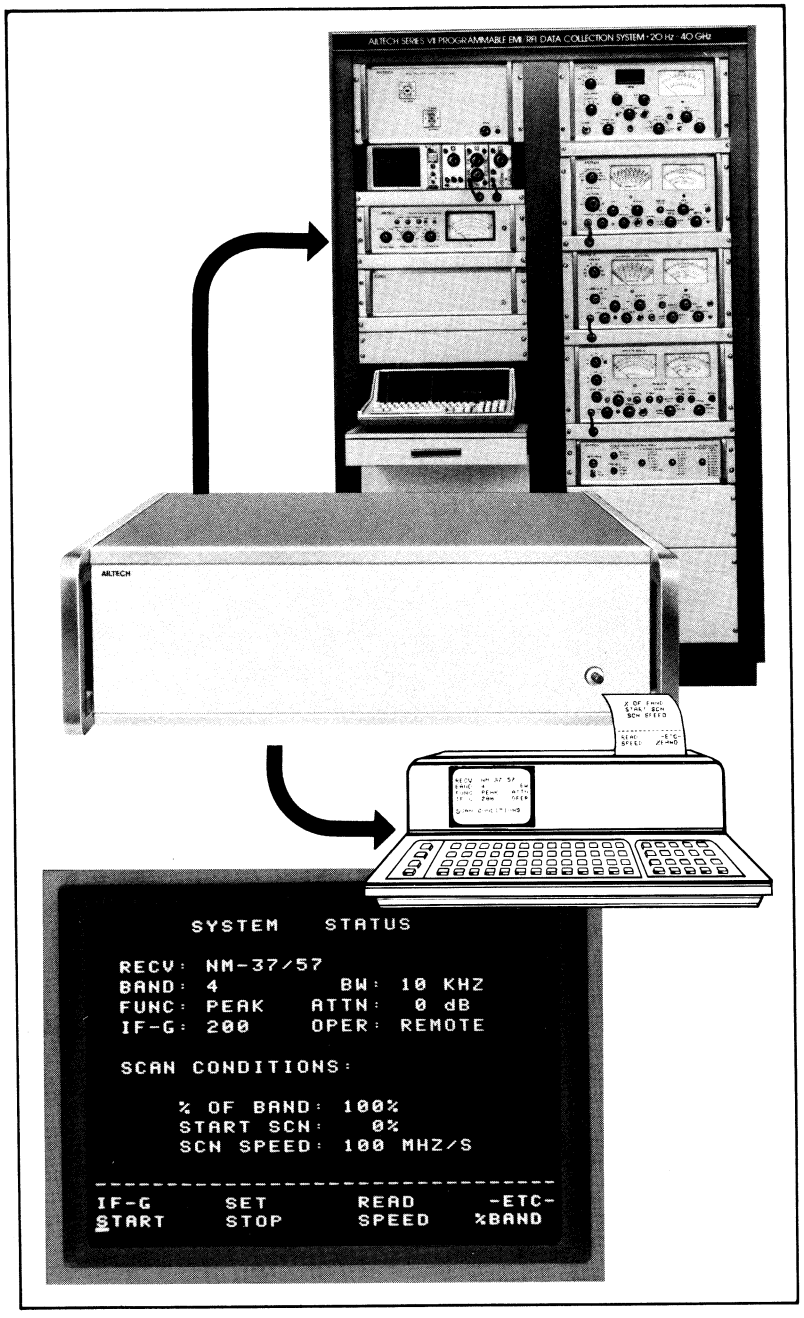
All remotely controllable functions of AILTECH EMI/FI Receivers are operated by the controller software or the operator through the CCI-7. These functions are:

- Freqency band selection.
- Frequency tuning with counter accuracy.
- Bandwidth selection.
- Peak detector dump.
- Detector function selection
  Calibrate, FI, Quasi-Peak, Direct Peak and Hold Time.
- Receiver gain (cal control).
- IF attenuation.
- RF attenuation*.
- Antenna switching*.

*Requires Input Unit CIU-7 in the system.

Built-in Programmable Counter provides digital frequency readout 20 Hz to 1 GHz

A built-in counter measures the LO frequency and the CCI-7 processes the data through the system calculator to read out the exact frequency of the AILTECH EMI/FI Receivers NM-7A, NM-17/27A, and NM-37/57A. The same performance is available for 1 GHz to 18 GHz with an external bus-compatible counter.



Free software for appropriate calculator/controller

- *Display* of major receiver parameters during the data taking.
- *Control* of all receiver functions directly from the controller keyboard.
- *Narrowband/broadband signals* measured simultaneously in one sweep.
- *Digital tuning* of receiver frequency with crystal accuracy up to 1 GHz. Same 1 GHz to 18 GHz with external counter.
- *MIL-STD-461/462* complete data package.
- *CISPR and VDE* test packages.
- *System self-test* data package.
- *General purpose test* routines.

Build your AILTECH Automatic EMI Data Collection System with these modular building blocks—designed and optimized for EMI testing

- EMI/FI Receiver NM-7A—20 Hz to 50 kHz.
- EMI/FI Receiver NM-17/27A—10 kHz to 32 MHz.
- EMI/FI Receiver NM-37/57A—30 MHz to 1 GHz.
- EMI/FI Receiver NM-67—1 GHz to 18 GHz.
- EMI/FI Receiver NM/FC-67—.1 GHz to 40 GHz.
- Programmable Controller CCI-7.
- IEEE-488 GPIB compatible calculator/controller
- CISPR/ANSI Adapter CCA-7.
- Input Unit CIU-7.
- AILTECH Antennas, Current Probes and Accessories.

Programmer Model P-7

emi/rfi test instrumentation

Features

- Scans 24 bands of the NM-7A, 17/27A, 37/57A, NM-67 according to program set up by switches on front panel.
- Wide range of scanning speeds.
- Provides signals for Input to the X-Y Axis of oscilloscope, X-Y plotter, other display/recording devices, singly or in combination.
- Automatic plots, frequency vs. amplitude.

Description

Semi-automatic systems for applications not requiring calculator/computer control can be assembled using the P-7 programmer and analog Plotters. The P-7 is designed to control remotely controllable functions of AILTECH EMI/FI Meters, NM-7A, 17/27A, 37/57A and 67. Programs are preset on the P-7 front panel. It is an ideal unit for use with a recorder or an oscilloscope and one or two EMI/FI Meters to form a high-speed, high volume mobile test station.

The P-7 will scan the 24 bands of the AILTECH EMI/FI Meters over a wide range of scanning speeds and produce on an X-Y recorder, one, four, eight, 16 or 24 plots per page according to the program set up on the front panel.

Simultaneously with the scanning process, the programmer supplies a choice of output signals. These include signals appropriate for input to the X-Y axes of an oscilloscope an X-Y plotter or other display and recording devices, singly or in combination. The programmer is supplied with full scan controls (including Af and sector scan) similar to those of a spectrum analyzer. The semi-automatic system can thus be used as a spectrum analyzer—with tracking preselection—when X and Y outputs of the programmer are supplied to a regular or variable persistence oscilloscope.

The following auxiliary unit may be required depending on system application.

Specifications

Tuning Voltage (for remote EMI/RI Meters)

Range: 0 V to +10.0 V nominal into 2 kilohm load.
Sweep Dial Accuracy: ±0.2%.
Repeatability: ±0.1%.
Tuning rate: Adjustable from 30 ms/sweep nominal to 300 s/sweep nominal, or manual operation.
Hum and noise: Less than 50 μV wideband composite.
Video Display Bandwidth: DC to 5.0 MHz minimum.
Sweep Drift in STOP Mode: Approximately 5 mV/second (20 seconds for 1% drift).
Plotting Modes: 1 plot/page, 4 plot/page, 8 plot/page , 16 plot/page , and 24 plot/page

X-Y Recorder Interface

X-Data and Y-Data Open Circuit Signal Characteristics:
Voltage Range: 0 volts to 2.0 volts nominal.
Current Range: ±20.0 milliamperes (limited).
Output Impedance: Z_0 = 1000 ohms maximum.
Pen Control: Relay closure. @ .0 amps resistive, 1.0 amp inductive and 350 V rms.

CRT Interface

X-Data Characteristics:
Voltage Range: ±5.0 volts nominal.
Current Range: ±20.0 milliamperes (limited).
Output Impedance: Z_0 = 10 ohms maximum.
Y-Data Characteristics:
Voltage Range: 0 volts to 60.0 millivolts nominal into 1 megohm load.
Output Impedance: Z_0 = 300 ohms maximum.
Z-Blanking: Normally open or normally closed switch. (Z-blanking should be used only with the oscilloscope connected to the X-Y RECORDER receptacles.)
Input Voltage Limits: ±50 volts.
Input Current Limits: ±1.0 amp (resistive load).
Power Handling Capability: 5.0 watts maximum.

Remote Attenuator Interface

Voltage Range: 0 volts to 30.0 volts nominal (high level depends on attenuator termination).
Current Range: 0 milliamperes to 40.0 milliamperes.
Logic "True": 0 volts.

Input Power: 115 V or 230 V rms, 47 Hz to 420 Hz, approximately 100 watts.

Temperature Range: 0° to +50° C (+32° F to +122° F).

Dimensions (including handles):

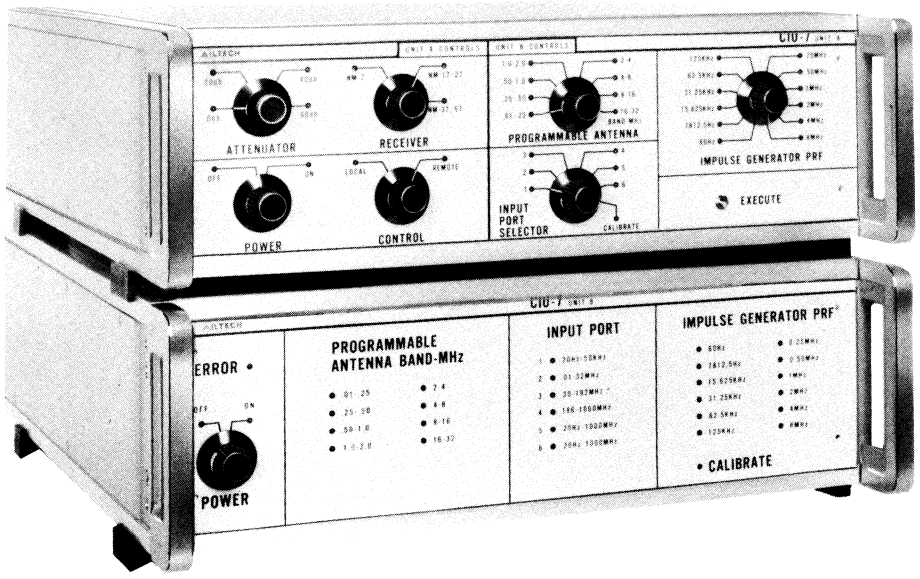
Approximate Height: 22 cm (8¾ inches).
Approximate Width: 43 cm (16¾ inches).
Approximate Depth: 47 cm (18½ inches).

Weight: Approximately 19 kg (41 pounds).*

*Excluding rack mounting brackets

emi/rfi test instrumentation

AILTECH Input Unit Model CIU-7



Features

- Model CIU-7 is a system module in the AILTECH Programmable EMI Data Collection System.
- Provides an automatic switching interface between the three meters in the system and the pickup device.
- Inserts a controllable attenuator between selected meter and antenna (or probe).
- Selection of attenuator settings and of antennas is controlled by Counter Controller Interface model CCI-7.

Description

Input Unit CIU-7 consists of two separately packaged assemblies, Unit A (top in the photograph) and Unit B. Together, they provide capability to switch five RF input ports to any of three EMI/FI Meters and to switch one special input port to the NM-7A EMI/FI Meter; capability to attenuate the signal paths by up to 60 dB in 20 dB steps; capability to control a variable PRF impulse generator for system calibration.

Unit A accepts and decodes remote control signals from a CCI-7 or provides 10 local manual inputs, selected by front panel switches, to control the various functions. It also provides control signals to Unit B which is designed for installation at a remote site. For either manual or remote control, functions selected are indicated by light emitting diodes on the front panel.

Unit B contains the input port switch, impulse generator and programmable antenna coupler. It is connected to Unit A by three coaxial cables and one triaxial cable. Unit B has no switches for local control except Power. However, Unit B functions, remotely selected by Unit A, are indicated on the front panel of Unit B by light emitting diodes.

Specifications

Warm-up Time to Rated Accuracy: Five Minutes

Power Requirements: 105 V rms to 130 V rms or 210 V rms to 250 V rms, 50 Hz to 400 Hz.

Unit A: 25 Watts. **Unit B:** 25 Watts.

Physical Dimensions

Dimensions (with handles but without rack brackets). 13.3 cm (5.25 inches) H, 42.4 cm (16.7 inches) W, 47 cm (18.5 inches) D.

Weight: Unit A: 53 kg (24 lbs.). **Unit B:** 52 kg (23.6 lbs.).

Environmental

Temperature:
Operational: 0°C to +50°C (+5°F to +122°F).
Non-Operational: −50°C to +75°C (−58°F to +167°F).
Vibration: Meets MIL-T-21200, Class 3 non-operating.
Altitude: Operational to at least 4570 m (15,000 ft.) above mean sea level.

Specifications subject to change without notice.

AILTECH Input Unit Model IU-7A

Description

The Model IU-7A is an input unit for the Series VII EMI Data Collection System. This unit provides either four connections for antennas or three for current probes. Three outputs are available for connection to Models NM-7, NM-17/27 and NM-37/57. When a band on one of these meters is selected on the programmer, the programmer automatically switches the antenna or current probe appropriate to the frequency selected. The IU-7 inserts a controllable attenuator between the selected meter and antenna (or probe). Operation of both the attenuator and antenna selection is controlled by the programmer. The IU-7A also controls the antenna band selection of programmable rod and loop antennas used with the NM-17/27.

Specifications

Four coaxial inputs:
BNC: 20 Hz to 50 kHz, 10 kHz to 32 MHz,
N: 30 MHz to 192 MHz, 186 MHz to 1 GHz

Three coaxial outputs:
BNC: Model NM-7, Model NM-17/27,
N: Model NM-37/57

Frequency Range: 20 Hz to 1 GHz

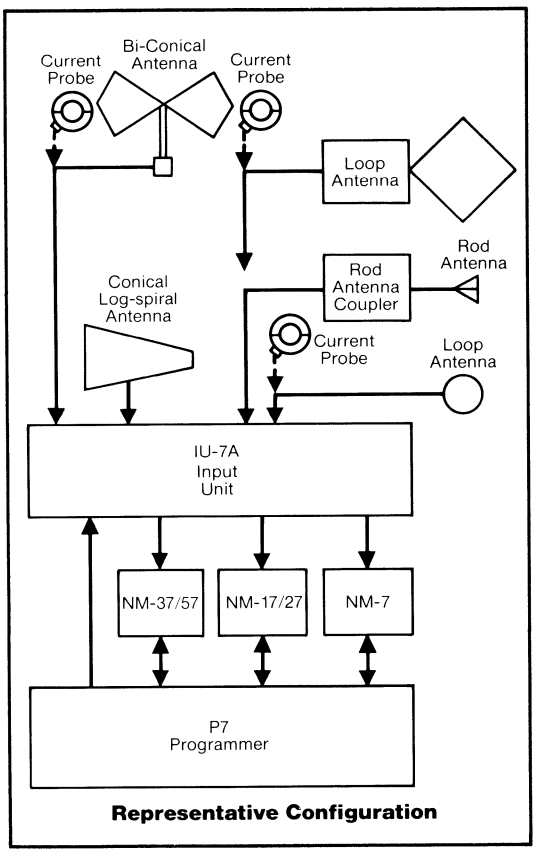
Attenuation: 0 dB to 100 dB in 20 dB steps

Attenuation Accuracy: ±1.5 dB

Power Required: 105V to 130V or 210V to 260V,
50 Hz to 400 Hz, 40 watts maximum

Mechanical:
Dimensions (including knobs and receptacles without rack mounting brackets):
Approx. Height: 14.0 cm (5.5″)
Approx. Width: 43.2 cm (17.0″)
Approx. Depth: 30.5 cm (12.0″)
Weight: 8.2 kg (18 lb.)

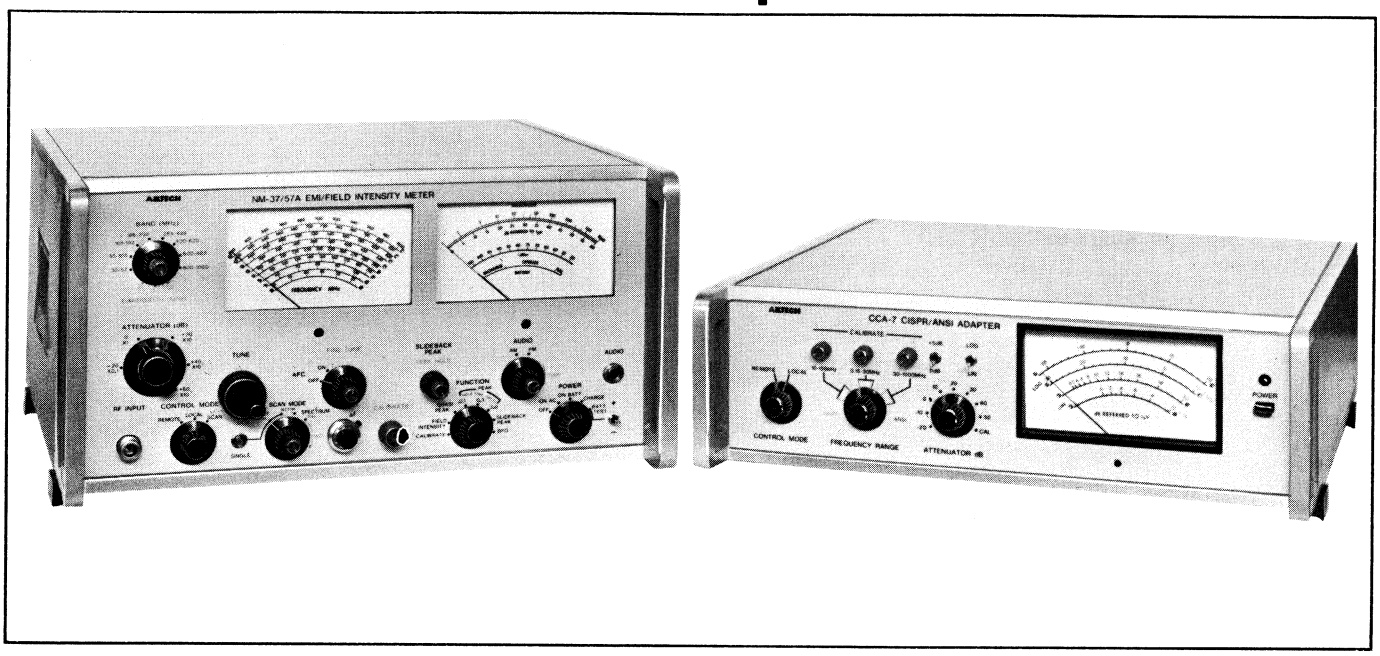
Environmental:
Temperature:
Operational: —15°C to +50°C (+5°F to +123°F)
Non-operational: —50°C to +75°C (—58°F to +167°F)



Representative Configuration

Specifications subject to change without notice.

AILTECH CISPR/ANSI Adapter Model CCA-7



emi/rfi test instrumentation

Features

- Provides CISPR/VDE and ANSI measurement capability to AILTECH EMI/FI Meters NM-17/27A, NM-37/57A.
- Expands capability of EMI/FI Meters NM-17/27A, NM-37/57A without affecting normal operation.
- Three frequency ranges: 10 kHz-150 kHz, 0.15 MHz-30 MHz, 30 MHz-1000 MHz selected by switch on front panel.
- Provides simultaneous peak or average (FI) and Quasi Peak measurements.
- Hard copy can be obtained using dual pen plotter.
- Built-in power supply.

Description

The model CCA-7 Adapter Module expands the capabilities of EMI Receivers NM-17/27A and NM-37/57A to permit measurements in accordance with the requirements specified in the publications of the Comité International Spécial des Perturbations Radio-Electrique (CISPR), the Verband Deutscher Elektrotechniker (VDE) and the American National Standards Institute (ANSI).

Expansion of the NM-17/27A and NM-37/57A capability is accomplished without restricting standard performance in any way. The CCA-7 can be used with either meter alone or with both to cover the frequency range from 10 kHz to 1000 MHz. The Adapter Module is rack mountable and all connections are on the rear panel to provide physical compatibility with the Series VII System.

Specifications

Characteristics	Frequency Ranges						
	10-150 kHz		0.15-30 MHz		30-1000 MHz		
	CISPR	ANSI	CISPR	ANSI	CISPR	ANSI	Tol.
Bandwidth, 6 dB	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz	120 kHz	±10%
Detector charge time constant	45 msec	1 msec	1 msec	1 msec	1 msec	1 msec	±20%
Detector discharge time constant	500 msec	600 msec	160 msec	600 msec	550 msec	600 msec	±20%
Meter mechanical time constant	160 msec	160 msec	160 msec	160 msec	100 msec	100 msec	±20%
Pre-detection overload factor (min.)	24 dB	24 dB	30 dB	30 dB	43.5 dB	43.5 dB	
Post-detection overload factor (min.)	6 dB	6 dB	12 dB	12 dB	6 dB	6 dB	
Connected to EMI/FI Meter	AILTECH NM-17/27A				AILTECH NM-37/57A		
Intermediate Frequency	455 kHz				20.5 MHz		
EMI/FI Meter Bandwidth	10 kHz				1.0 MHz		
EMI/FI Meter IF Output nom.	100 mV rms				25 mV rms		
Meter Scales	20 dB Linear, and 40 dB Log				10 dB Linear, and 40 dB Log		
Repetition rate restriction	None				PRF > 5 above 450 MHz		
Attenuator	-20 to +50 dB in 10 dB steps and 5 dB						
Y Output	1.0 V across 1 KΩ load at full-scale meter deflection						
CW signal reading accuracy	±2 dB	±2 dB	±2 dB	±2 dB	±2 dB	±2 dB	
Reference PRF for pulse response	25	25	100	100	100	100	
Spectral intensity at the reference PRF for a Q-P response which equals to 10 μV CW response.	100 dB μV/MHz	95* dB μV/MHz	67 dB μV/MHz	64 dB μV/MHz	50 dB μV/MHz	50 dB μV/MHz	±1.5 dB
PRF	Relative input level for constant indication						
10^3			-4.5 dB	-2 dB**	-8 dB	-7.5 dB	±1 dB
100	-4 dB	-1 dB	0	0	0	0	±1 dB
25	0	0	+5.5 dB	+2 dB**	+8 dB	+7 dB	±1 dB
10	14 dB	+0.5 dB*	+10 dB	+5.5 dB**	+14 dB		±1.5 dB
2	+13 dB	+2.5 dB*	+20.5 dB		+26 dB		±2 dB
1	+17 dB	+3.5 dB*	+22.5 dB		+28.5 dB		±2 dB
Isolated pulse	+19 dB		+23.5 dB		+31.5 dB		±2 dB
CW Sensitivity	0.03 μV		0.2 μV		0.64-1.4 μV		
AC power requirements	105 to 125 V or 210 to 250 V, 50 to 400 Hz, approximately 12 watts.						
Dimensions	Height: 15.2 cm (6-), Width: 42.4 cm (16.7-), Depth: 47 cm (18.5-).						
Weight	Approximately 10 kg (22 pounds).						
Temperature range	Operating: -15° C to +50° C (+5° F to +123° F).						
	Storage: -50° C to +75° C (-58° F to +167° F).						
Vibration	Meets MIL-T-2100, Class 3 non-operating.						
Altitude	Operating to 4,570 m (15,700 ft.) above sea level.						

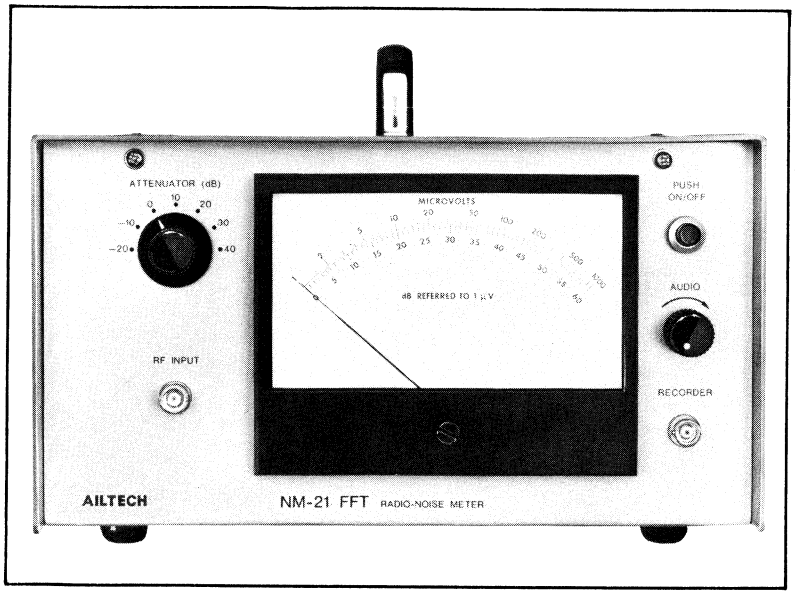
According to CISPR specification, the time to reach 35% of the steady deflection.

* Not specified by ANSI.

** Specified at 1 MHz.

Specifications subject to change without notice.

AILTECH NM-21FFT Radio Noise Meter



Applications

- Is designed primarily for the power industry.
- Ideal for long term monitoring (e.g., pre-installation site surveys).
- Convenient for production line accept-reject testing.

Features

- Accurately measures electromagnetic interference.
- Operates at one fixed frequency (selectable anywhere in the range 600 kHz to 1500 kHz).
- Is extremely simple to operate (two controls).
- Does not require gain standardization prior to use.
- Calibration required only at regular maintenance intervals.
- Enables an untrained operator to measure EMI accurately.
- Conforms with NEMA-107 and ASA C63.2 specifications.
- Provides readings compatible with Stoddart NM-20B, NM-25T, and Ferris 32D.
- Narrowband sensitivity is 0.1 μV across 50 ohm input.
- Broadband sensitivity is 0.07 μV/kHz.
- Measures over 120 dB voltage range.
- Drives a 1500 Ω, ImA recorder.
- Overall voltage accuracy is $\pm$2 dB.
- Contains built-in loudspeaker.
- Image and IF rejection is better than 90 dB.

Description

The AILTECH NM-21FFT radio noise meter is designed especially for use by the power industry to make highly accurate measurements of broadcast band EMI pollution. However, it is also extremely useful as a production line test instrument because of its simplicity.

The NM-21FFT operates at one fixed frequency and is available with a standard frequency of either 834 kHz or 1000 kHz.

The NM-21FFT is also available on special order with a fixed frequency anywhere in the range 600 to 1500 kHz.

These bands are chosen because there are virtually no broadcast transmitters which operate in the 834 kHz band in the northwest of the United States nor in the 1000 kHz band in the northeast. Bands in which there is no broadcasting activity are chosen because they allow high accuracy surveys to be made at the future sites of power installations.

Because of its single frequency capability, the instrument is inherently high in sensitivity and simple to operate. The absence of broad frequency coverage eliminates all tuning and calibration requirements. It also enables the circuitry to be designed for high image rejection, high IF rejection, low spurious response and high overall accuracy.

The NM-21FFT conforms with NEMA-107 and ASA C63.2 specifications for single frequency RFI instruments and is compatible with AILTECH Model NM-20B, NM-25T and Ferris Model 32D for all pulse repetition rates above 50 pulses per second.

The instrument is hand portable, withstands rough field use and has low (5 watt) power consumption.

Technical Characteristics

Frequency Range: Single frequency, crystal controlled. Standard frequencies available are 834 kHz and 1000 kHz. Other special single frequencies are available in the range 600 to 1500 kHz. Specify frequency on ordering. (Important: See Ordering Instructions for correct ordering procedure).

RF Input Impedance: 50 ohms standard. Input VSWR is less than 1.25.

Bandwidth: The 6 dB bandwidth is 5 kHz $\pm$10%. The 60 dB to 6 dB overall bandwidth ratio is 3.5 max.

Detector Function: Quasi Peak detector only. Time constant of one millisecond charge and 600 millisecond discharge.

Sensitivity, CW*
Conducted: 50 ohm impedance-0.10 μV.
Radiated: 94460-(*) Rod Antenna-0.7 μV/Meter. 92198-3 Antenna-Coupler and 92197-3 Rod Antenna-3.0 μV/Meter.

Sensitivity, Broadband*
Conducted: 50 ohm impedance-0.07 μV/kHz.

Output Meter: Two 5-inch scales are provided: a) 1 to 1000 μV scale in Logarithmic increments. b) A 0 to 60 dB above 1 μV linear scale, divided into 60 equal increments.

Measurement Range: 60 dB (output meter range) in the lowest step attenuator position. An additional 60 dB of attenuation is provided in 10 dB steps for a maximum voltage range of 120 dB.

Measurement Accuracy: $\pm$2 dB.

Oscillator Radiation: Less than 50 Picowatts.

Shielding Effectiveness: 80 dB min. with 94460-1 rod antenna.

Image Rejection: Greater than 90 dB at standard frequencies.

IF Rejection: Greater than 90 dB at standard frequencies.

Other Spurious Responses: Greater than 90 dB at standard frequencies.

Loud Speaker: A small loud speaker with front panel level control is provided.

Recorder Output: 1.5 VDC across a 1500 ohm resistive load at full scale meter deflection. Recorder output is proportional to meter deflection.

IF Amplifier: Operates at 455 kHz.

Size: 152.4mm high (6"), 279.4mm wide (11"), 304.8mm deep (12").

Weight: Approx. 5.4kg (12 lbs.).

Power Supply: AC power supply standard.

AC Line Voltage: 105/125 Volt, 50 to 70 Hertz.

Power Consumption: 5 watts.

Ordering Instructions

Please specify the Model NM-21FFT operating frequency desired by adding the frequency in kilohertz to the model number. For example, if you wish an operating frequency of 1000 kilohertz, specify a Model 21FFT-1000. Standard frequencies available are 834 and 1000 kHz. Other frequencies are available in the range of 600 kHz to 1500 kHz for an additional charge.

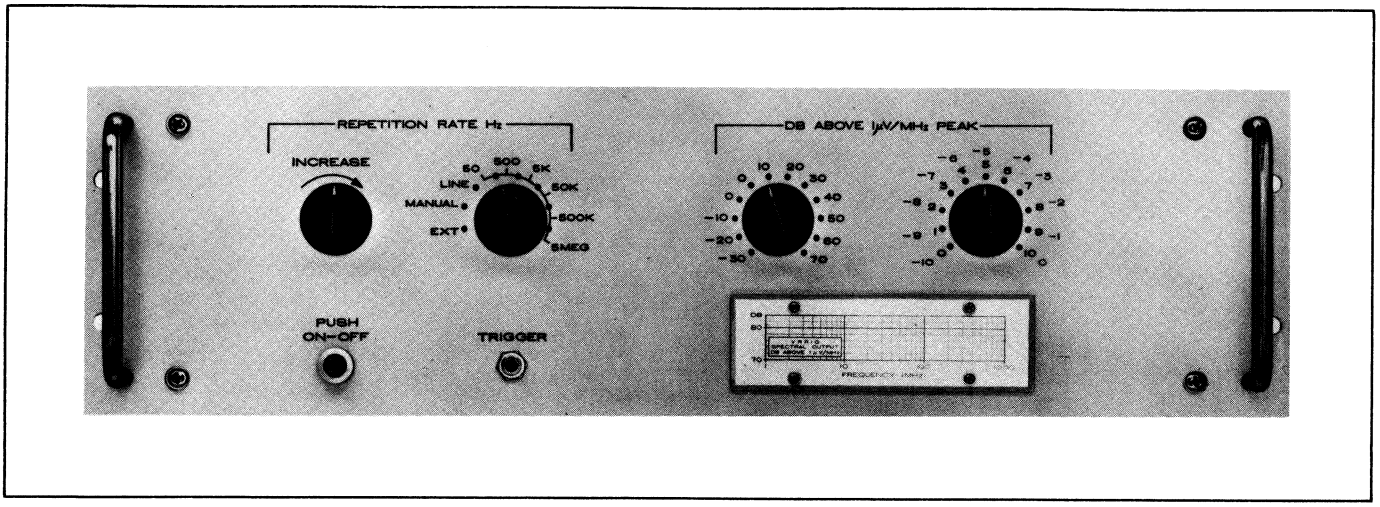
The Model 94460-(*) 41" Rod Antenna is available for any single frequency between 600 kHz and 1500 kHz. For the standard frequencies of 834 and 1000 kHz, specify the Model 94460-2 (834 kHz) or the Model 94460-3 (1000 kHz). For other than standard frequencies, please specify the desired frequency when ordering and contact your local AILTECH representative or the factory for price information.

emi/rfi test instrumentation

*Signal plus noise to noise ratio of one with Quasi Peak detector.

Specifications subject to change without notification.

AILTECH Model 533X-11
Variable Repetition Impulse Generator



Features

- Pulse rate 0-5 MHz, manual or external triggering. Pulse rate from 50 Hz to 5 MHz, continuously variable.
- Triggering: internal, power line frequency, external source or manual.
- Solid-state, extremely stable impulse output.
- Spectral output flat to 100 MHz, less than 6 dB down at 1 GHz.

emi/rfi test instrumentation

Applications

- Calibrated broadband signal source.
- Used as a calibrator for substitution type broadband interface measurements.
- Receiver bandwidth measurement.
- Rapid gain checking of tuners.

Description

Variable Repetition Rate Impulse Generator, (VRRIG), Model 533X-11 is a calibrated broadband signal source primarily intended for use as a calibrator when performing substitution type interference measurements. The Model 533X-11 pulse repetition rate is variable from 50 Hz to 5 MHz, or it may be triggered by the power line frequency, an external trigger source or manually. The availability of these various operating modes provides a versatility not found in other impulse generators.

The Model 533X-11 is completely solid-state and is packaged in a 5¼ inch high 19 inch rack-mountable case.

Specifications

Pulse Repetition Rate

Internal: Variable from 50 Hz to 5 MHz or controlled by power line frequency.
External: 0 to 5 MHz. Requires negative pulse trigger of 1 to 3 volts with a pulse width between 0.1 and 1 microsecond.
Manual: Controlled by activation of front panel switch.

Output Amplitude: Calibrated in terms of "Peak Value." Variable in one dB steps from minus 40 to plus 80 dB above one microvolt per megahertz across 50 ohms.

Pulse Width: Less than one nanosecond.

Output Polarity: Positive.

Spectral Flatness: Better than one dB from 10 kHz to 100 MHz, down less than 3 dB at 500 MHz and less than 6 dB roll-off at 1 GHz. Calibration curve furnished.

Sync Output: One volt positive pulse into high impedance.

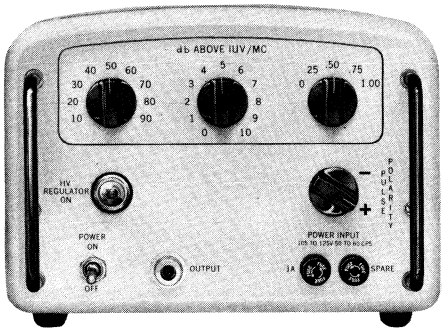
AC Power Requirements: 105 to 125 volts, 50 to 70 Hz, 8 watts nominal.

Physical Size: 133.35mm high (5¼"), 482.6mm wide (19"), 330.2mm deep (13"). Mounts in a standard 482.6mm (19") rack.

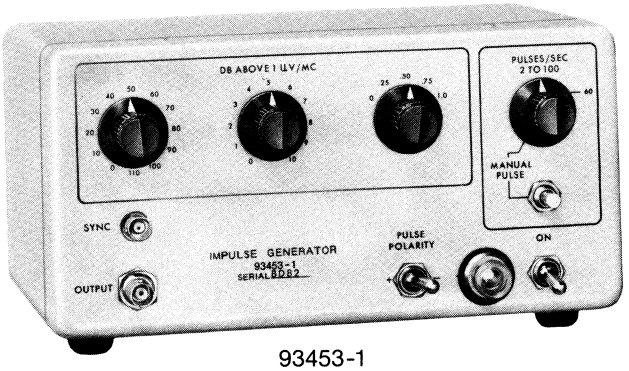
Weight: 6.65kg (14½ lbs.).

Specifications subject to change without notice.

Accessories



91263-1



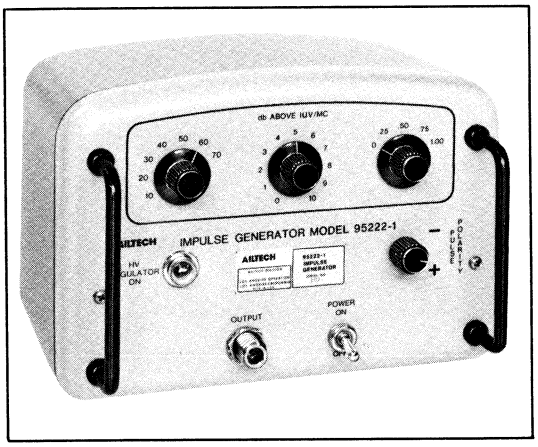
93453-1

AILTECH 91263-1 and 93453-1 Impulse Generators
60 kHz to 1000 MHz and 500 Hz to 35 MHz

- Wideband spectral outputs.
- Maximum outputs: 101 dB and 121 dB above 1μV/MHz.
- Fixed and variable pulse repetition rates.
- Adjustable output levels.

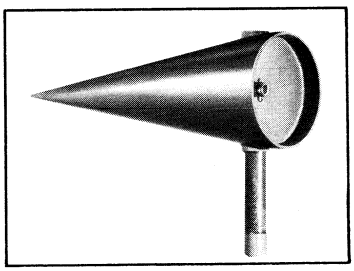
AILTECH 95222-1 Microwave Impulse Generator

- Frequency range 10 MHz-12 GHz.
- Provides precise calibration of EMI instrumentation.
- Substitute-type EMI measurement of impulse signals.
- Receiver bandwidth measurements.
- Broadband measurement capability in accordance with MIL-I-11748 (Sig. C), MIL-I-26600 (USAF), MIL-I-6181D (USAF) and MIL-STD-461/462 series.

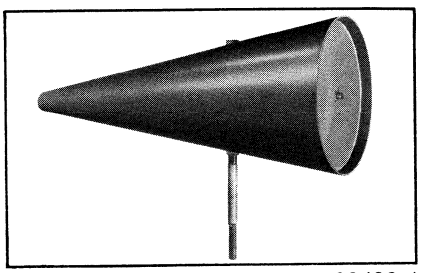


95222-1

emi/rfi test instrumentation accessories



93491-2



93490-1

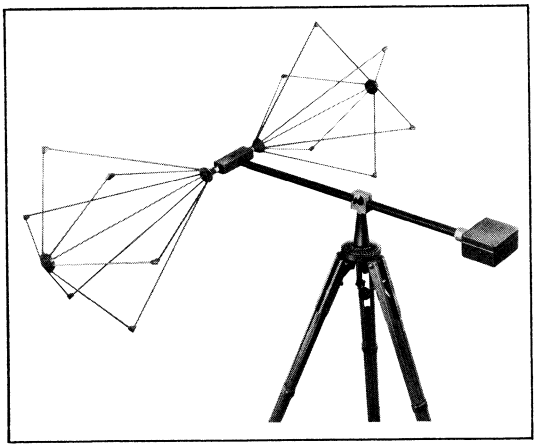
AILTECH 93490-1 and Model 93491-2 Conical Log-Spiral Antennas
200 to 1000 MHz and 1 to 10 GHz

- Excellent back lobe suppression.
- Cover frequency ranges 0.2 to 1 GHz and 1 to 10 GHz.
- Circular polarization.
- Conform to USAF drawings 62J4040 and 62J4041.

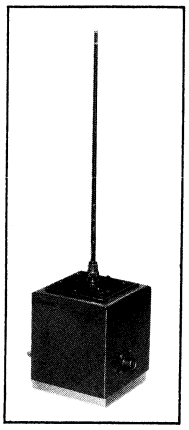
AILTECH 94455-1 Biconical Antenna
20 to 200 MHz

- Frequency range 20 to 200 MHz.
- No adjustments, bandswitching or external tuning over full operation range.
- Calibration curves provided.
- Designed in accordance with MIL-STD-826/461.

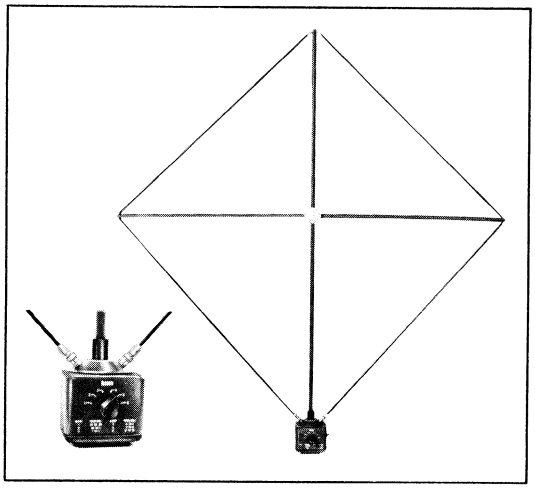
94455-1



94607-1
Rod Antenna
Preamplifier

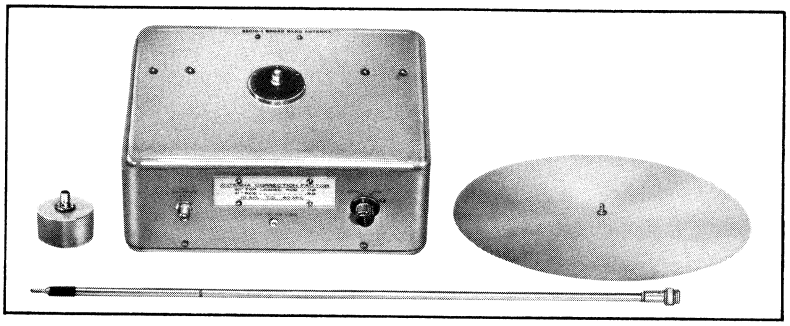


95100-1
Collapsible Loop Antenna



AILTECH 94607-1 Rod Antenna Preamplifier
10 kHz to 32 MHz

- Matches High Impedance 41" Rod Antenna to 50 ohm load.
- Constant μV/Meter Antenna Factor of 20 dB.
- Measures up to 5 V/Meter field without over load.



AILTECH 95010-1 Active Broadband Rod Antenna
10 kHz to 40 MHz

- 10 kHz to 40 MHz without bandswitching or tuning.
- One meter effective height—actual height only 50 inches.
- Constant antenna factor over entire frequency range.

AILTECH 95100-1 Collapsible Loop Antenna
150 kHz to 32 MHz

- 150 kHz to 32 MHz.
- Six band coverage with individual coupling transformers.
- Compatible with any 50 ohm meter/receiver.

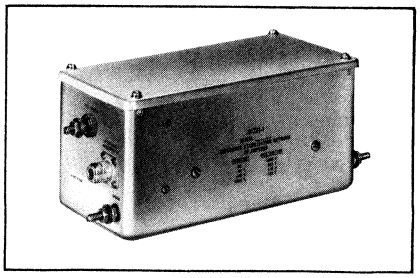
AILTECH 91221-1
Line Impedance Stabilization Network

- Less than 1 ohm RF impedance presented to power source.
- Impedance presented to test sample varies in accordance with MIL-1-6181, MIL-1-16910 (SHIPS) and MIL-1-26600 (USAF).
- 1000 VDC rating.
- 480 VAC rating (60 Hz).

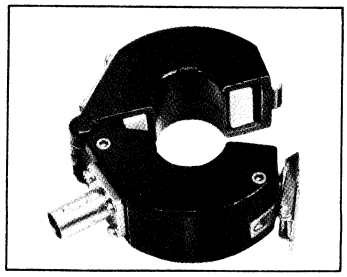
AILTECH RF Current Probes for Conducted Measurements

- AILTECH current probes are, with some exceptions, of the split type clamp-on design for fast, convenient measurements.
- For measurements in accordance with MIL-STD-826/461, MIL-1-26600 (USAF), MIL-1-6181D (USAF).
- Models available with operating frequencies as low as 20 Hz and as high as 1 GHz.
- Window diameters range from ½" to 4".
- Transfer impedances range from 0.003 to 10 ohms.
- RF pulse handling capabilities up to 500 amps.

91221-1
Line Impedance Stabilization Network

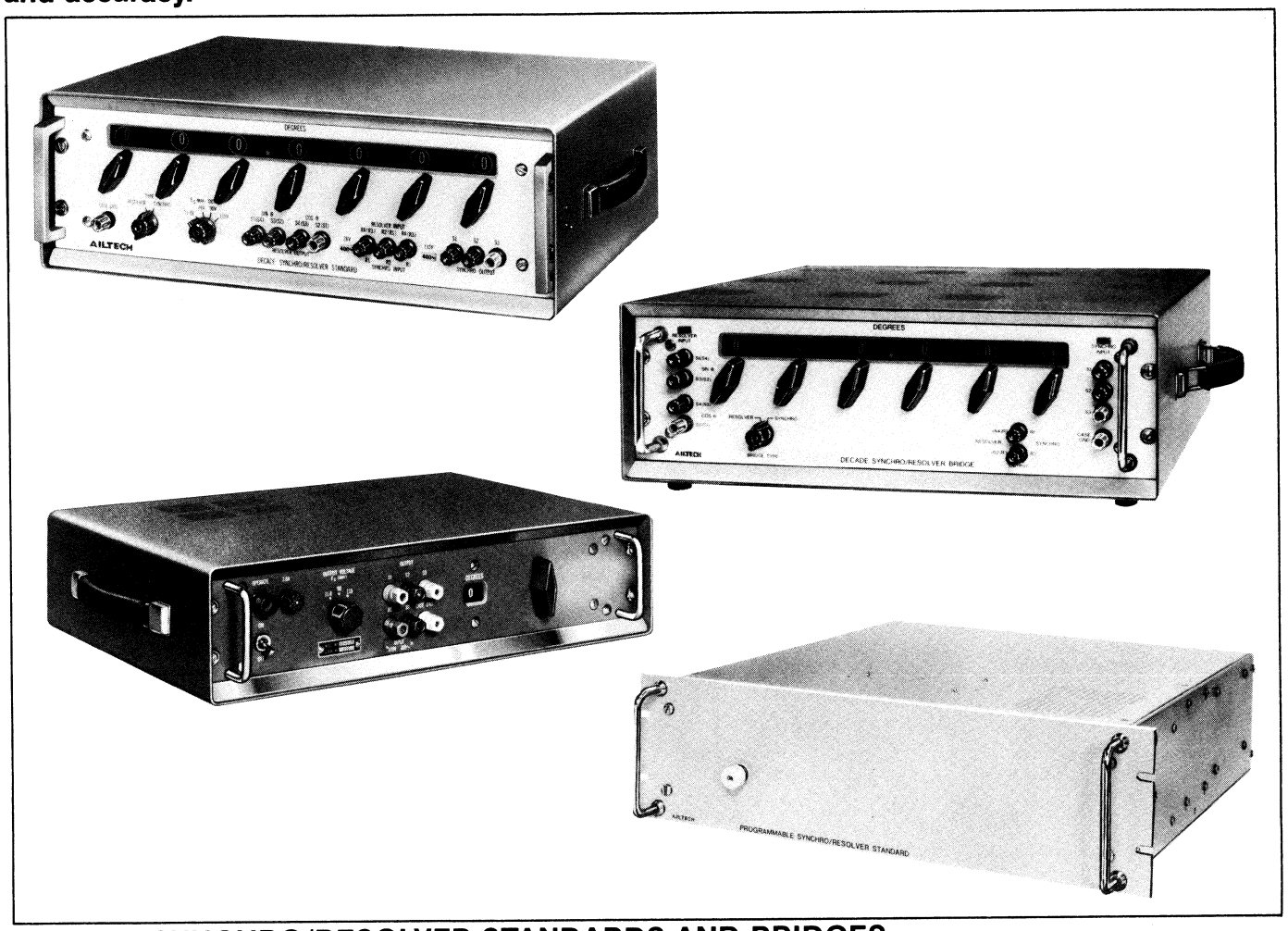


AILTECH RF Current Probes



Synchro/Resolver Test Instruments

From the creators of the Ratio Trans-Synchro/Resolver test instruments of high quality and accuracy.



DECADE SYNCHRO/RESOLVER STANDARDS AND BRIDGES

Features

- 2 seconds-of-arc accuracy.
- Low output impedance unbalance.
- Heavy duty switches.
- Isolated and shielded inputs and outputs.
- Direct angular readout (large numerals).

Applications

- Testing autopilots, aircraft indicators.
- Transmitting precise angular data to a test component.
- Testing CDX's and CRT's; TDX's, TDR's and TR's.
- Testing RD's and RC's.

Description

AILTECH Decade Synchro/Resolver Standards combine the functions of a decade synchro standard and a decade resolver standard into a single unit. A front panel switch changes the unit from one mode to another. In system tests, the standard may be used to introduce accurately known inputs for testing autopilots, aircraft indicators, etc. This technique can also be used to check the response of a servo loop. In component tests, the standard may be used to transmit precise angular data to the test component. As a synchro standard, the unit may be used to test CDX's, CT's, TDX's, TDR's and TR's. As a resolver standard, the unit may be used to test RD's and RC's.

Decade Synchro/Resolver Standards -DSRS Series

Model DSRS-5D
(Case Model)

Features

- 2 seconds-of-arc accuracy.
- Low output impedance unbalance.
- Heavy duty switches.
- Isolated and shielded inputs and outputs.
- Direct angular readout (large numerals).

Description

Model DSRS is essentially a decade resolver standard with a Scott-Tee to convert the output to a synchro standard output. As a resolver standard, the DSRS generates two isolated outputs: one proportional to the sine of the angle displayed on the dials and the second proportional to the cosine.

In the synchro mode, the sine and cosine outputs are interconnected into a Scott-Tee. This transformer arrangement produces the three output voltages of an ideal synchro control transmitter.

Most commercially available components may be tested without affecting the 2-seconds-of-arc accuracy. Low output impedance unbalance permits severe loading without introducing error. For testing components, either the proportional voltage gradient or the proportional voltage nulling method may be used. If the proportional voltage nulling method is used, the Model DSRS may be adjusted to obtain a null instead of the dividing head. In this case, the angular error may be read directly from the setting of the control switches.

Specifications

Angular Range: 0 to 400 degrees.

Angular Accuracy ($Z_{so}=\alpha$): 2 seconds-of-arc at nominal frequency.

Angular Resolution: 0.0001 degree.

Readout: Direct readout in degrees 0.375″ high readout numerals, permits easy reading.

Nominal Frequency*: 400 Hz ±5%.

Nominal Input Voltage: 115 or 26 Vrms.

Maximum Stator Output Voltage: 115, 90, 26, or 11.8 Vrms.

Maximimum Effective Output Impedance Unbalance at Nominal Frequency

115 and 90 Vrms: .05 + j.005 ohms.
26 and 118 Vrms: .01 + j.001 ohms.

Input and Output Connections: 5-way binding posts. Separate synchro and resolver inputs (on front and rear) permit simultaneous connection of both a synchro and resolver. Mode switch determines which is selected.

Isolation and Shielding: All inputs and outputs are electrostatically shielded and isolated from each other and case ground.

Size (Rack Models): 19″ W x 5¼″ H x 15″ D.

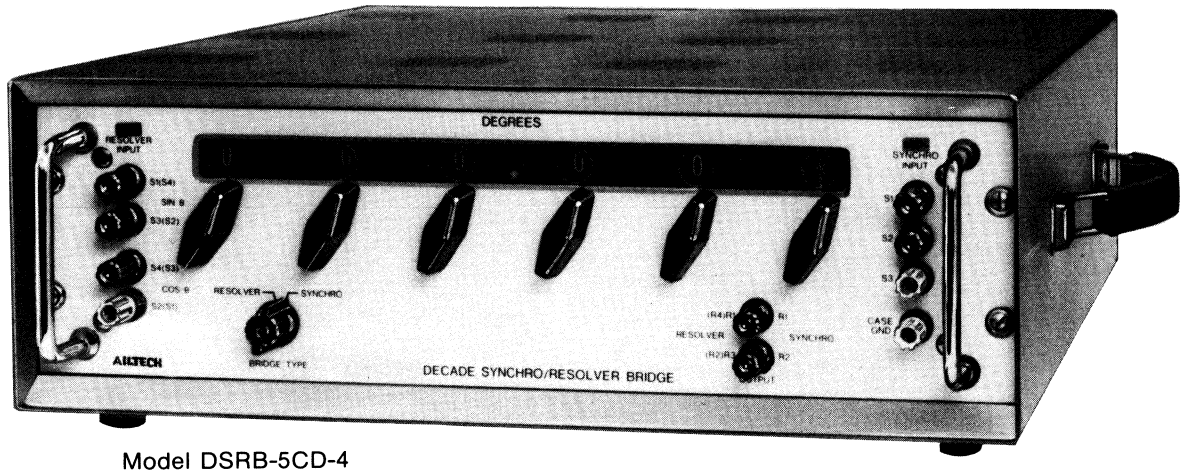
Standard Models†

Model Number	Description
DSRS-5DR	400 Hz, Rack Mount
DSRS-5D	400 Hz, Case Model
DSRS-6R	60 Hz, Rack Mount

*Although nominal frequency is stated to be ±5%, all units are usable far beyond this range. As a result of thumb, the angular accuracy at higher frequencies decreases as the square of the frequency ratio.

†Special models are available with various forms of readout (90° quadrant switching: degrees, minutes, and seconds; etc.), form factors, and frequencies (50 Hz to 10 kHz).

Decade Synchro/Resolver Bridges DSRB-5CD-4 and 8



Model DSRB-5CD-4
(Case Model)

Description

The Model DSRB combines the functions of a decade synchro bridge and a decade resolver bridge into a single unit. A front panel switch changes the unit from one mode of operation to the other. The units are designed for testing control transmitters, differentials (rotors), and torque transmitters as components or for simulating an incremental control transformer in a servo loop.

As with all AILTECH bridges, operation consists of setting in the desired angle—no warm-up, no pre-use calibration.

The unit is essentially a decade resolver bridge. In the synchro mode, the three wire input is converted to two voltage signals in a Scott-Tee transformer arrangement. After conversion, the voltage comparator operates in the same manner as in the resolver mode.

Specifications

Angular Range: 0 to 400 degrees.

Angular Accuracy ($Z_{ss}=0$): 2 seconds-of-arc at nominal frequency.

Angular Resolution: 0.0001 degree (pot).

Readout: Direct readout in degrees. 0.375″ high readout numerals, permits easy reading.

Nominal Frequency*:
DSRB-5CD-4: 400 Hz ±5%.
DSRB-5CD-8: 800 Hz ±5%.

Maximum Input Voltage: 0.35 f (f in Hz) or 170 Vrms whichever is less.

Error Voltage Gradient: 4.85 x $10^{3/8^6}$ E_S (max) V/second ±1%.

Input Impedance at Nominal Frequency:
Synchro Mode: 1 megohm (approx.).
Resolver Mode: 750 K ohm (approx.).

Figure of Merit (γ) at Nominal Frequency:
Synchro Mode: 100 (minimum).
Resolver Mode: 75 (minimum).

Input and Output Connections: 5-way binding posts. Separate synchro and resolver inputs (on front and rear) permit simultaneous connection of both a synchro and resolver. Mode switch determines which is selected.

Isolation and Shielding: All inputs and outputs are electrostatically shielded and isolated from each other and case ground.

Size (Rack Models): 19″ W x 5¼″ H x 15″ D.

*Although nominal frequency is stated to be ±5%, all units are usable far beyond this range. As a rule of thumb, the angular accuracy at higher frequencies decreases as the square of the frequency ratio.

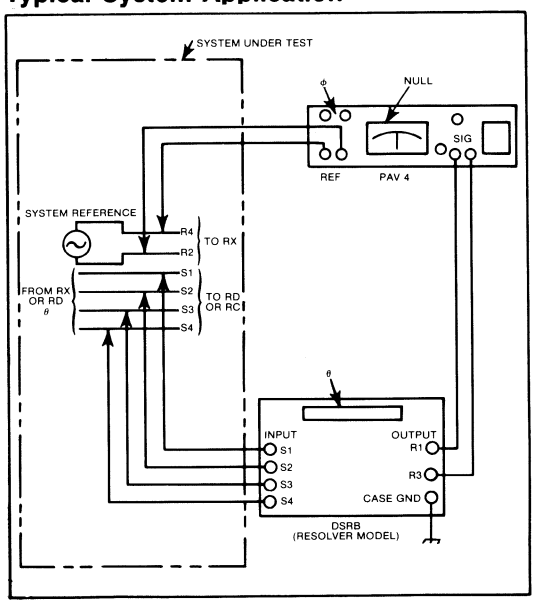
Features

- 2 seconds-of-arc accuracy.
- High input impedance.
- Large numeral direct angular readout.
- I:I transformation ratio.
- Isolated and shielded inputs and outputs.

Standard Models†

Model Number	Description
DSRB-5CD-4R	400 Hz, Rack Mount
DSRB-5CD-4	400 Hz, Case Model
DSRB-5CD-8R	800 Hz, Rack Mount
DSRB-5CD-8	800 Hz, Case Model

Typical System Application



5 Degree Synchro Standards

Model SS-5A

Features

- High input impedance—over 10 kilohms.
- Low output impedance.
- Low output impedance unbalance.
- High Reliability—no active circuitry.

Specifications

5° SYNCHRO STANDARDS

Angular Accuracy: ±2 seconds-of-arc.

Transformation Ratio, N:

$$\frac{Es\ (max)}{E_{IN}}$$ ±.1% max.

Effective Variation in Transformation Ratio from Nominal, as a Function of Angular Position: ±1% max (26 V units). ±.1% max (115 V units).

Angular Range: 0-360° continuous.

Angular Increments: 5°.

Description

AILTECH 5 Degree Synchro Standards and Resolver Standards are precision transformer instruments designed to simulate the electrical outputs of ideal synchro or resolver control transmitter (2 sec./arc). The Synchro Standards are ideal for testing CDX's (stator) and CT's. Resolver Standards test RD's and RC's.

AILTECH Ratio Trans techniques provide high accuracy and reliability. High input impedance, low output impedance, and very low phase shift are all inherent characteristics of these unique techniques. As a result of these characteristics, most commercially available synchros and resolvers may be excited without affecting the accuracy.

Maintenance is minimized by the passive design of the transformers. The units are essentially ageless devices thus reducing costs for periodic checks and recalibrations. High quality switches or relays minimize switching problems. Test *(maximum output voltage)* terminals are supplied on the rear panel.

A large variety of AILTECH synchro and resolver standard models have been designed to cover specific requirements. Functionally, all models are essentially the same. Primary differences are in form factor, type of angular positioning control, input and output voltages, output impedance unbalance, and frequency range.

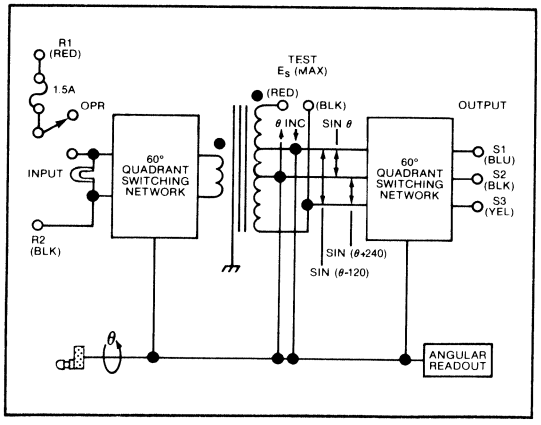
One Knob Control

One knob control units combine the coarse and fine switching mechanisms into a single control with a direct readout of angular position. These units are also designed for standard rack mounting and local control.

Synchro Standard Circuit Description

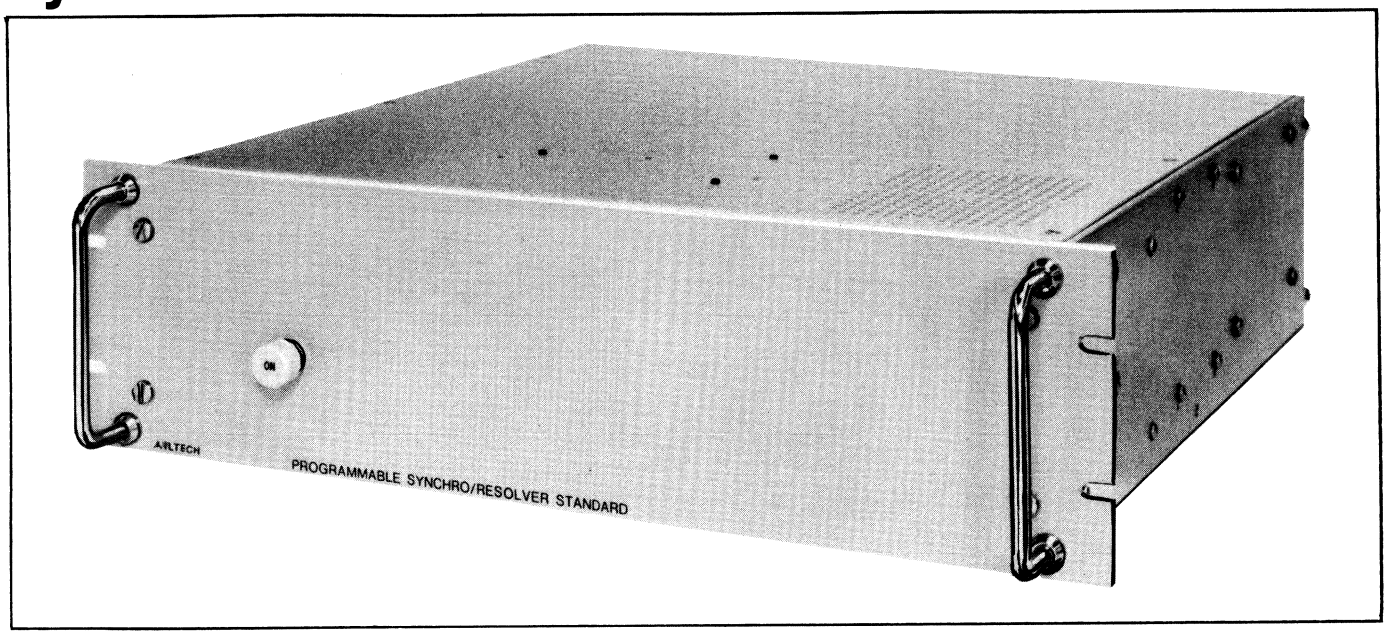
Synchro standards generate three output voltages (S1, S2 and S3) which correspond to the stator output of a master synchro transmitter. The three voltages are 120° in amplitude from each other and one of the three is directly proportional to the sine of the angle displayed on the dials. In an AILTECH synchro standard, a transformer is placed across the input voltage and functions as a voltage divider. The secondary of the transformer is tapped to provide the voltage ratios of an ideal synchro. One tap is fixed and supplies the reference point. The other two taps are selected and supply the various ratio voltage. The voltage ratios repeat every 60°; however for every 60° increments, the ratios exist between a different set of synchro output terminals. To apply the voltages to the correct set of output terminals, the quadrant switching mechanism is included.

Synchro Standard



Specifications subject to change without notice.

Model PSRS-2613R Programmable Synchro/Resolver Standard



Features

- Simulation of static or dynamic components.
- Four programmable angular velocities. (Dynamic).
- Fully TTL programmable.
- Low output impedance unbalance.

Description

The AILTECH Model PSRS-2613R Programmable Synchro/Resolver Standard provides a fully programmable source of three wire synchro or four wire resolver signals for use in testing of rotating components, synchro-to-digital converters, resolver-to-digital converters, and similar items requiring such stimuli. Component type, static or dynamic mode, angular output, and rotational velocity are fully programmable using TTL logic for direct interfacing with a computer in an automatic test system.

Static angles may be programmed in 0.1° increments over the full 360° circle, with accuracy of 0.03°, with load.

Static angles may be programmed in less than 10 μs from any angular position to any other angular position with full accuracy available in that time period.

The dynamic mode simulates a rotating component with four possible rotational velocities from 1.5 degrees per second to 5.0° per second, 30° per second, and 200° per second in either a clockwise or counter-clockwise direction. These dynamic signals are useful for testing servo system accuracy under slewing conditions as well as for exercising electro mechanical systems under test for repeatability of angular position.

Operation

The instrument is designed using RatioTrans techniques combined with high voltage, solid state switches to select voltage ratios appropriate to the angle required. Simulation of a rotating component is achieved by the addition of control logic for sequential selection of voltage ratios. The resultant signal closely approximates the output of a rotating synchro or resolver. Operation requires reference input voltage, logic commands for angle and mode selection, and 115 VAC power.

Maintenance

Maintenance is simplified by the use of high reliability transformer assemblies and plug-in printed circuit boards. All inputs are fused, and over voltage protection is provided in the reference input.

synchro/resolver test instrumentation

synchro/resolver test instrumentation

Definitions

Static Data: Angular data on lines D0 through D13.

Dynamic Data: Rate and direction data on lines D0 through D2.

Data Output: Angular data only on lines D17 through D30. Continuous indication of angle.

Control Data: D14 (MODE) and D15 (STOP).

Strobe: D16, initiates (on leading edge) a change of state. [Logical "0" to Logical "1" (5 V)].

Flag: D31, indicates (on leading edge) a change of state has been accomplished.

Static Buffer Register: An up/down preset counter which accepts static data. Content of register controls angular output. Content of register is indicated by "Data Output."

Dynamic Buffer Register: Accepts dynamic data. Content of register controls rate and direction of up/down counter.

Clock Register: Accepts "MODE" and "STOP" control data. Content of register controls the counter clock.

Specifications

This unit provides 3-wire synchro signals and 4-wire resolver signals in response to 5 VDC logic signals.

Reference Input

Voltage: 26 ±4 Vrms.
Frequency: 380 to 1000 Hz.
D.C. Level: 0.1 mV max.

Output (Resolver and Synchro)

Voltage: 11.8 V E_S (max).
Voltage Ratio Accuracy: ±0.2% No Load.
Voltage Ratio Accuracy as a Function of Angle: ±0.2%.
Load Impedance: 100 Ohm min Line to Line.
Angular Accuracy: ±0.03° (Z_{SO} = 250/73°).
Resolution: 0.1°.
Range: 0° to 360°

Programming Logic: TTL/DTL Compatible.

False: "0" = +2.4 to +5 VDC.
True: "1" = +0 to +0.5 VDC 15 mA Sink capability.

Programming Input

Data Lines: 14 D0, D1,..., D13.
Control Lines: D14 (Mode). D15 (Stop).
Strobe: D16.5 Micro-sec. min.

Programming Output

Data Lines: 14, D17, D18,..., D30.
Flag: D31 4 Micro-sec. max.

Dynamic Mode.

Angular Accuracy: ±2%.
Resolution: 0.1°.

D.C. Power Available: Isolated from Chassis Ground.

Voltage: +5 VDC +0.2 VDC.
Current: 0.5 Amp max.

Power Requirements

Voltage: 115/230 Vrms Switch Selected.
Frequency: 50/60 Hz.
Connector: U.S. 250 V 3-Wire (Hubbell No. 5666).

Front Panel Controls: Combination Push Button On-Off/Light.

Rear Panel Controls

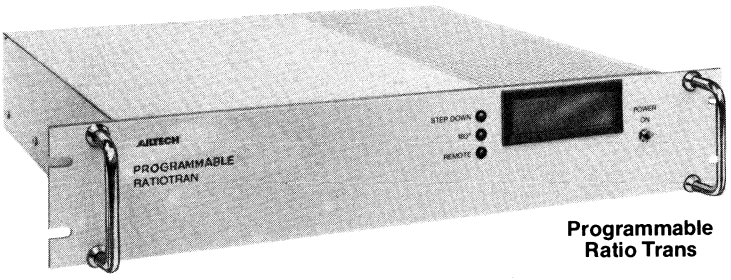
Fuses: F1—AC Power.
F2—DC Power.
F3—Reference Input.
Connectors: J1—Signal Connector, XMRE 34PF 2016.
Mate: XMRE 34SC 1406.
J2—Programmable Connector, XMRE 42PF 2016.
Mate: XMRE 42SC 1406.
J3—Signal Connector, Kings KC-79-67 (BNC).

Color: Grey.

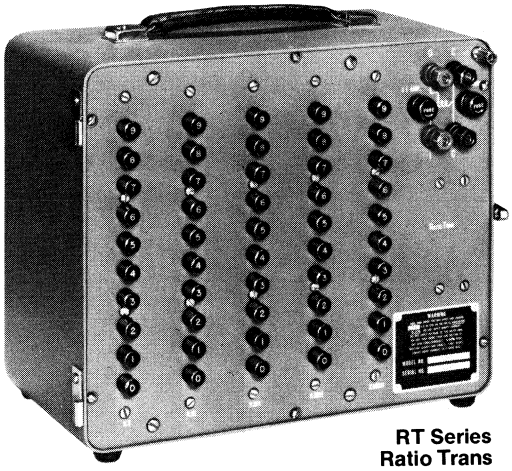
Size: 133.35mm high (5¼"), 482.6mm wide (19"), 457.2mm deep (18").

Specifications subject to change without notice.

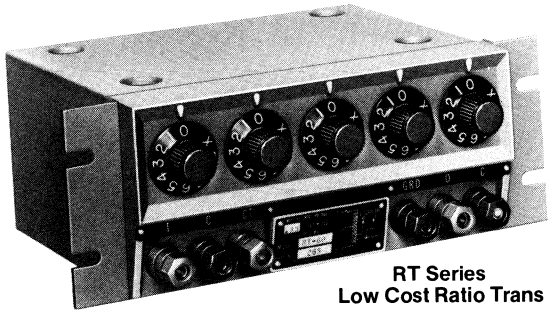
Ratio Transformers



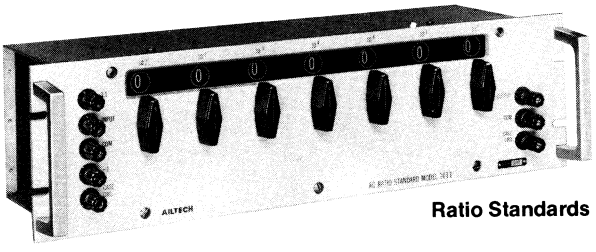
Programmable
Ratio Trans



RT Series
Ratio Trans

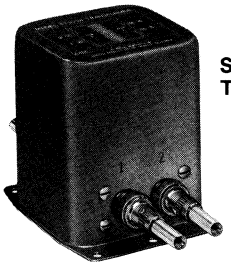


RT Series
Low Cost Ratio Trans

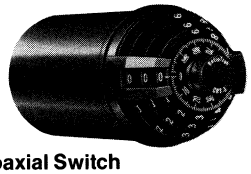


Ratio Standards

High/Low Frequency Ratio Standards



Special Purpose
Transformers



Coaxial Switch
Ratio Trans

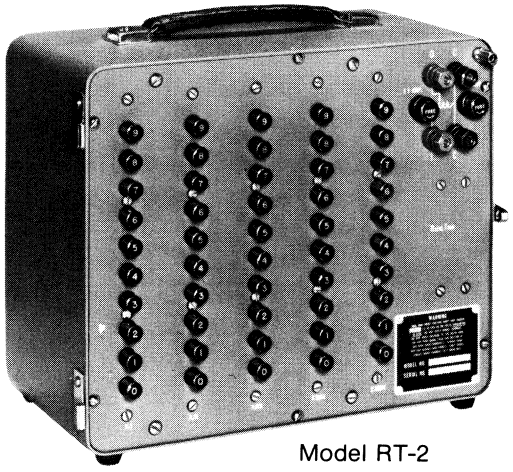
Featuring

- Very low output impedance
- Stable rugged design
- Switching transient suppression
- NBS traceable calibration

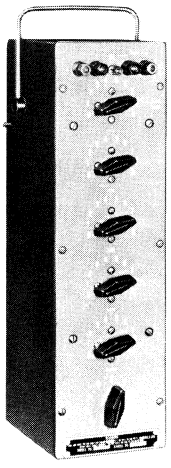
Precision Variable AC Voltage Divider Generates Voltage Ratios for...

- Checking resolvers and servos
- Voltmeter calibration
- Computer testing
- Transformer turns ratio measurement
- Ratio arms of bridges

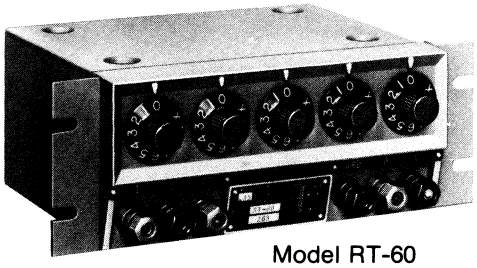
RT Series
Standard Ratio Transformers



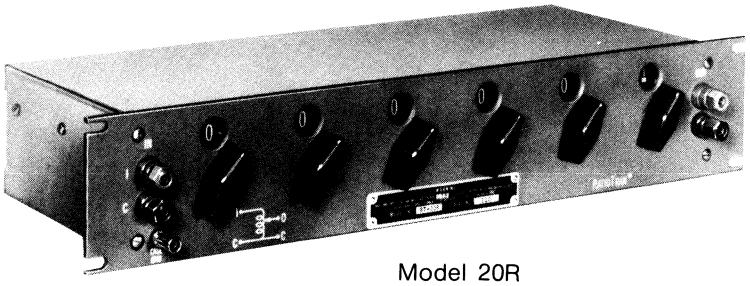
Model RT-2



Model RT-7



Model RT-60



Model 20R

Description

Transient Suppression

All "RT" series Ratio Trans (except Models RT-2) incorporate switching transient suppression. This feature is of great importance when using the Ratio Tran in a bridge circuit with a sensitive null indicator, when operating near null.

N.B.S. Traceability

These instruments can be supplied with certificates of accuracy showing traceability to N.B.S., to meet requirements of U.S.A.F. Bulletin NR. 520 (17 May, 1960) and other such requirements.

Mounting

All "RT" instruments described in this catalog (with the exception of Models RT-10R, 11R, 12R, 20R and 22R) are available in both case and rack mounting designs. The suffix "R" designates rack model. (Example: RT-2, case model; RT-2R, rack model.)

Heavy Duty Switches

It should be noted that a number of Ratio Tran models incorporate heavy duty switches. These are the multi-leaf silver instrument type switches insuring smooth action, long life, and extremely low contact resistance.

Applications

The RatioTran precision variable AC voltage divider provides extreme accuracy and high resolution in the measurement and generation of voltage ratios. Instruments are available in a variety of functional types and form factors for use in such applications as checking resolvers and servos, voltmeter calibration, computer testing, transformer turns ratio measurements, and ratio arms of bridges. All units illustrated are standard models. Special "RT" RatioTran voltage dividers can be designed to meet specific requirements, and/or for incorporation into customer systems.

Accuracy of Indicated Ratio (for ratios less than unity).

RT-2, RT-5R, RT-7R, RT-20R	$\pm(.001\% + \frac{.0001\%}{\text{Ratio}})$ @ 50-3000 Hz	$\pm(.01\% + \frac{.001\%}{\text{Ratio}})$ @ 3000-10,000 Hz
RT-9R	$\pm(.001\% + \frac{.0001\%}{\text{Ratio}})$ @ 30-400 Hz	

Accuracies Under Load Conditions

While the Ratio Tran is designed basically for use in an unloaded condition for maximum accuracy, because of design parameters, reasonable loads may be applied. The resulting accuracy is a function of this load. With reference to the equivalent circuit, assuming an ideal transformer, looking into the arm, we see impedance (Ls and Rs) in series with the arm, which is due to leakage inductance, wiring resistance, switch resistance, potentiometer resistance and other stray circuit parameters. From these series impedances, the effect of loading upon the transformer, and overall accuracy can be calculated. Typical values of Rs and Ls are 3 ohms and 75 μH. In the assumption of the ideal transformer, the indicated unloaded accuracies apply at the arm of the assumed ideal transformer.

Special RatioTrans

Low-Cost RatioTrans

Models RT-60, RT-61, RT-63 are precision inductive voltage dividers that have characteristics comparable to much more expensive instruments. Five decades of transformer switching is provided. Max ratio 1.1111. Instruments are designed as case models, and are easily adapted to standard half-rack mounting with brackets supplied. Units may be cascaded where additional resolution is required.

Accuracy of Indicated Ratio

RT-60	$\pm(.001\% + \frac{.0001\%}{\text{Ratio}})$ @ 50-3000 Hz	$\pm(.01\% + \frac{.001\%}{\text{Ratio}})$ @3000-10,000 Hz
RT-61	$\pm(.001\% + \frac{.0005\%}{\text{Ratio}})$ @ 30-400 Hz	
RT-63	±10 ppm @ 10 kHz (Terminal Linearity)	

High Frequency RatioTrans

This family of RatioTran precision voltage dividers is designed specifically for 10 kHz operation, providing high input impedance and optimum performance at that frequency. Six decades of voltage division permit 1 ppm adjustment of the input signal. Calibration by the National Bureau of Standards indicates a maximum deviation of 3 ppm from nominal at 10 kHz. (NBS calibration test 211.06/182606.)

Model RT-23R

Specifications

Linearity: 10 ppm at 10 kHz.

Frequency Range: 5 kHz to 20 kHz.

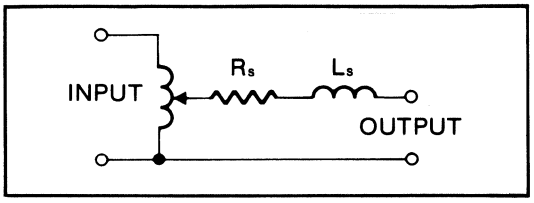
Maximum Input Voltage: .05 f (f in Hz) or 350 Vrms.

Resolution: 6 place.

Size: RT-23 3½" rack panel.

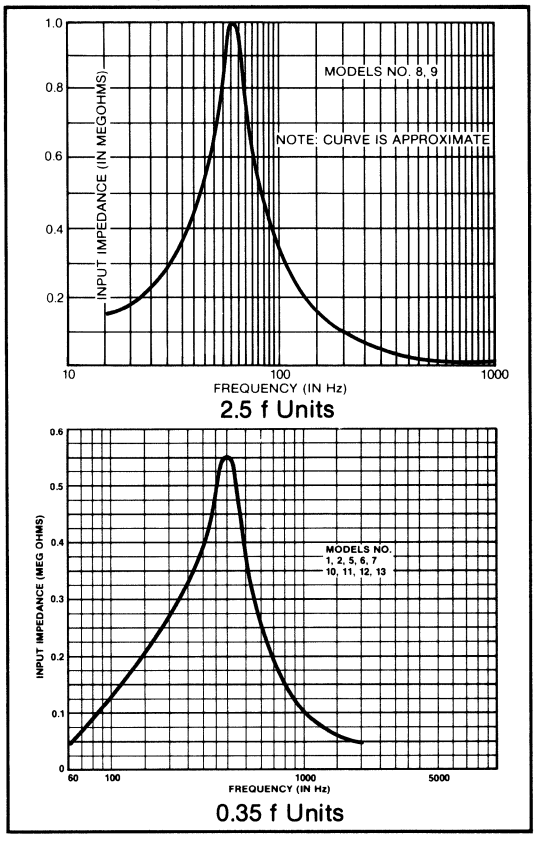
Input Impedance: 50 kilohms (min) at 10 kHz.

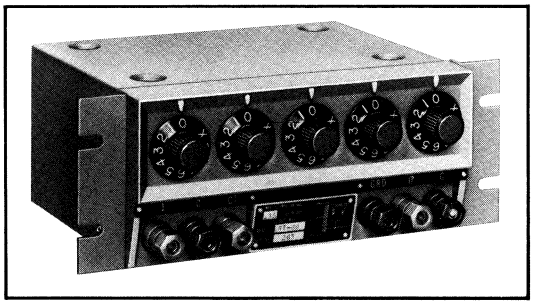
Output Impedance: 2 + j1 ohm (max) at 10 kHz.



Equivalent Circuit

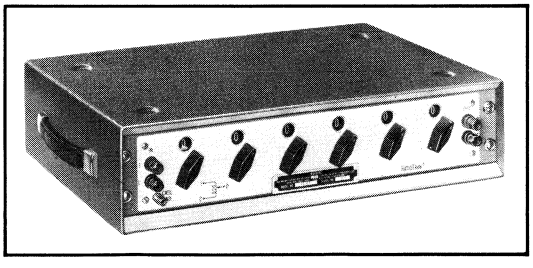
RatioTran Input Impedance Vs Frequency



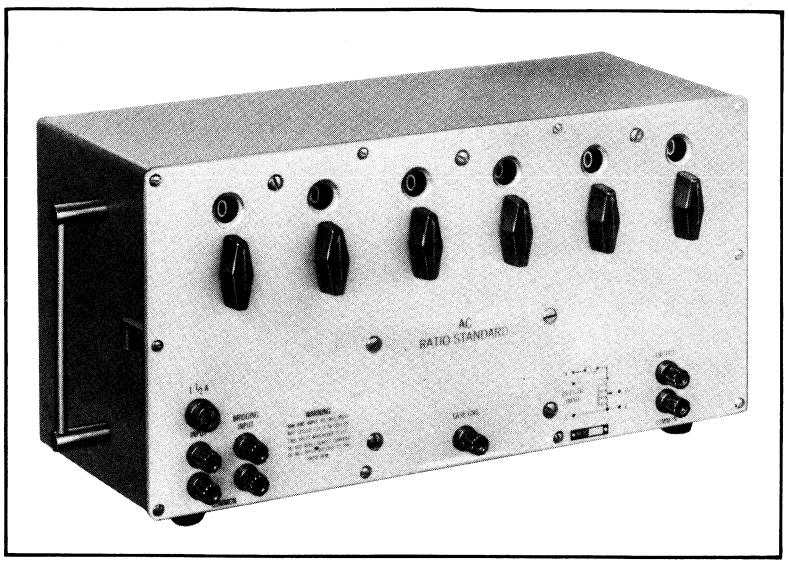


Model RT-60

Model RT-23



ratio transformers



High Voltage RatioTrans

Model RT-26R

These two RatioTrans were designed for wide frequency and high voltage application (up to 1000 vrms) such as calibrating DVM's.

Model RT-26R
Specifications

Frequency Range: 50 to 1,000 Hz.
Maximum Input Voltage: 2.5 f (f in Hz) 1000 V Max.
Resolution: 0.0001%.
Terminal Linearity: 0.001% (50 to 1000 Hz).
Maximum Effective Series Impedance: R=15 ohms; L=2 mh.
Ratio Range: .000000 to 1.111110.
Size:
Case: 514.35mm long (20¼"), 234.95mm high (9¼"), 254mm deep (10").
Rack: 472.6mm long (19"), 222.25mm high, 209.55mm deep (8¼").
Shipping Weight (Approx.): 16.81kg (37 lbs.).

Model RT-27R
Specifications

Frequency Range: 50 Hz to 10 kHz.
Maximum Input Voltage: 35 f (f in Hz) 1000 V (max).
Resolution: .0001%.
Terminal Linearity: .001% (50 Hz to 10kHz).
Maximum Effective Series Impedance: R=10 ohms; L=2.0 mh.
Ratio Range: .000000 to 1.111110.
Size: 472.6mm long (19"), 133.35mm high (5¼"), 165.1mm deep (6½").
Weight: 16.81kg (37 lbs.).

Step-Up RatioTrans

This RatioTrans was designed specially to measure step-up transformation ratios. They may also be used in such applications as checking resolvers and servos, voltmeter calibration, computer testing, transformer turns ratio measurements, and ratio arms of bridges.

Accuracy of Indicated Ratio

Ratios less than unity	±(0.001 +0.0001%) @ 50-3000 Hz Ratio ±(0.01 + 0.001%) @ 3000-10,000 Hz Ratio
Ratios greater than unity	$\pm \frac{0.5}{f\ (f \text{ in Hz})}$% @ 50-320 Hz ±(0.006 x Ratio−0.003) f^2% (f in kHz) @ 320-10,000 Hz

Specifications subject to change without notice.

Model RT-18R
Specifications

Maximum Ratio: 3.1111110.

Resolution: 0.00001%.

Frequency Range: 50-10,000 Hz.

Maximum Input Voltage: 0.35 f (f in Hz), 170 V max.

Maximum Effective Series Impedance:
Ratios less than 1: 4 ohms + 75 μh.
Ratios less than 2: 15 ohms + 3 mh.
Ratios less than 3: 35 ohms + 6 mh.

Size:
Rack: 472.6mm long (19″), 113.35mm high (5¼″), 152.4mm deep (6″).
Case: 533.4mm long (21″), 127mm high (5″), 152.4mm deep (6″).

Multipurpose RatioTrans

Features

- Direct or isolated input
- In-phase or 180 degree output
- Infinite resolution
- Ratio range —1.111110 to +2.111110

General Description

All of the experience in building RatioTrans is compacted into this new, low cost unit. Special features are direct or isolated input, in-phase or 180 degree phase shift output, infinite resolution, 0 to 1 ratios with overlap on each decade and the ability to measure ratios as high as 2.11110 to 1. These are in addition to the standard characteristics of high input impedance, low effective series impedance, and very low phase shift.

A five-decade ratio transformer and an interpolating potentiometer give accurate readings to seven places. Each decade is equipped with —.1 and 1.1 windings to provide the overlap of ranges. A single switch controls the direct/isolated input and the phase reversal. By inverting the input voltage, the unit may be used for over unity ratio measurements.

Model RT-30R
Specifications

Frequency Range: 50-10,000 Hz.

Maximum RMS Input Voltage: 0.35 f (f in Hz) or 350 volts, whichever is less.

Ratio Range: —0.111110 to +1.111110; +0.111110 to 1.111110.

Resolution: Continuous.

Terminal Linearity at 400 Hz: Direct: .0001%. Isolated: .0005% (normalized).

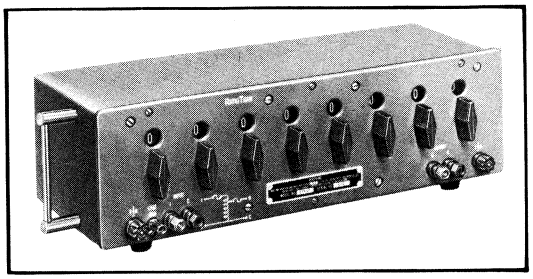
Maximum Effective Series Impedance: Direct: 4 ohm + 200 μh. Isolated: 12 ohm + 1.5 mH.

Input Impedance at 20 V-400 Hz: Direct: 150 K min. Isolated: 150 K min.

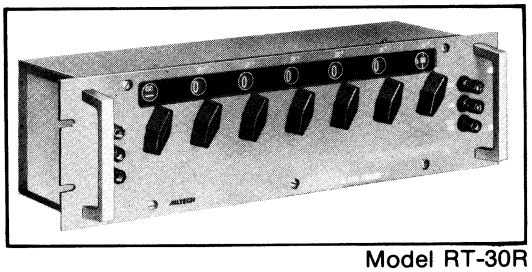
Dimensions: 472.6mm W (19″), 133.35mm H (5¼″), 165.1mm D (6½″).

Weight: 5kg (11 lbs.).

Accuracy of Indicated Ratio at 400 Hz: Direct: 0.0001/Ratio %. Isolated: (0.003 + 0.0005/Ratio)%.



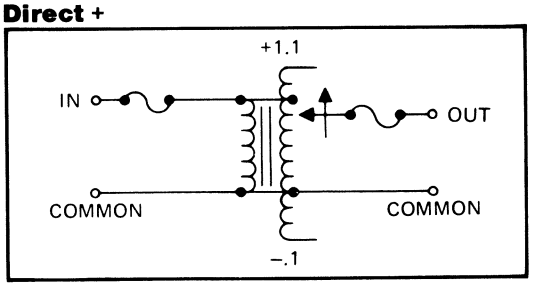
Model RT-18R



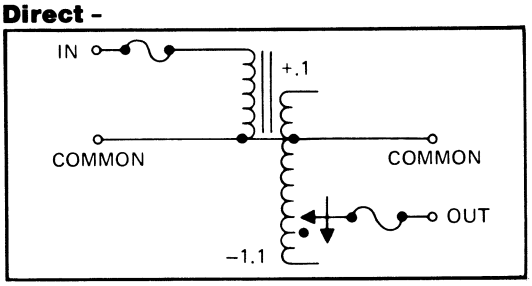
Model RT-30R

Configurations

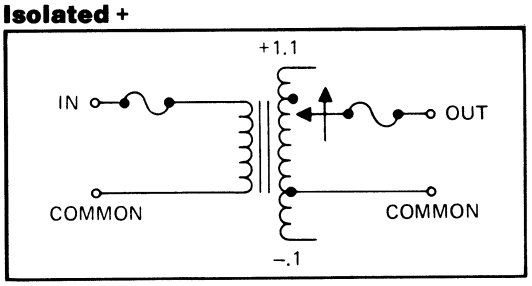
Direct +



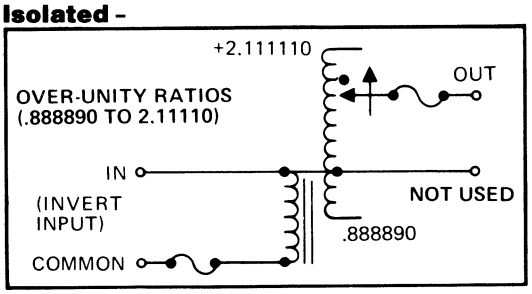
Direct –



Isolated +



Isolated –



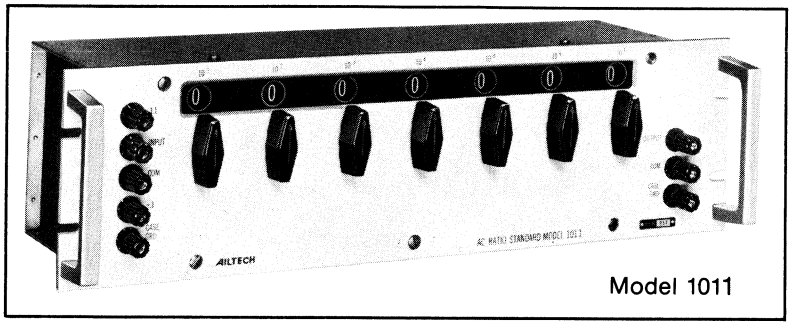
Features

- Terminal linearity 1 ppm.
- 6 or 7 place resolution.
- Switching transient protection.
- Ratios to 1.111111.

Precision Voltage Dividers for...

- Instrument standards, calibration laboratories.
- Applications requiring maximum accuracy.

Model 1000 Series Ratio Standards



Model 1011

Description

Many years of experience in the building of precision ratio transformers enable Eaton Corporation, Electronic Instrumentation Division to offer what we consider to be the ultimate in ratio standards.

This series of RatioTran precision voltage dividers was designed for instrument standards and calibration laboratories, or any applications where maximum accuracy is required.

Instruments feature maximum ratios up to 1.111111...minimum ratios down to —.111111. All units provide transient suppression, 6- or 7-place resolution, and terminal linearity better than .0001%.

All models (except 1009 and 1011 R) are equipped with extra-heavy duty instrument-type switches and are available in case or rack mount. Two basic ratio sections are available: high frequency and low frequency. See specifications.

Model 1011R

Model 1011R requires no special input voltage settings for specified accuracy—input voltage variations have no appreciable effect on linearity. Instrument is extremely stable and operates without recalibration throughout a wide range of environments.

Seven in-line control knobs permit quick, easy settings of required values. Unique circuitry keeps the output connected while settings are being changed, virtually eliminating switching transients. Range overlap between decades is ±10%, permitting accurate voltage ratios from 1.1 to —.1.

NBS Traceability

Eaton Corporation, Electronic Instrumentation Division provides certification and data on all Model 1000 Series AC Ratio Standards in terms of a standard which has been certified by the National Bureau of Standards in Washington, D.C. (NBS Calibration Test 211.06/184994).

Accuracy of Indicated Ratio

(for ratios less than unity)

High Frequency Sections:

$$\pm\left(.0001\% + \frac{.000025\%}{\text{Ratio}}\right) \text{ @ 50-1000 Hz}$$

$$\pm\left(.0001\% + \frac{.000025\%}{\text{Ratio}}\right) \times F^2 \text{ @ above 1000 Hz}$$

(F in kHz)

Low Frequency Sections:

$$\left(.0001\% + \frac{.00005\%}{\text{Ratio}}\right) \text{ @ 30-400 Hz}$$

Specifications

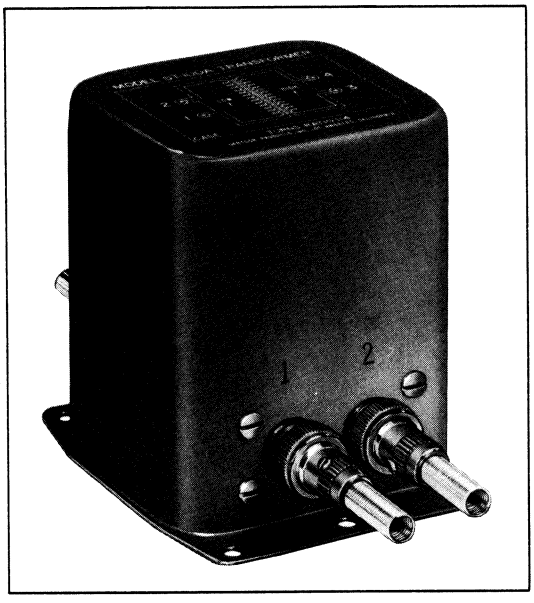
Model	Frequency Sections	Frequency Range	Resolution	Terminal Linearity	Input Voltage (freq. in Hz)	Max Effective Output Impedance	Dimensions and Approx. Shipping Weight	Remarks
1000	High	50 Hz 10 kHz	.0001% steps	.0001%	.35 f 350 V max	R-3.5 ohms L-75 μH	Case: 20¼" L x 9¼" H x 10" D Rack 19" L x 8¾" H x 8¼" D 60 lbs.	6 decades in this combination unit.
	Low	30-1000 Hz			2.5 f 350 V max	R-5 ohms L-350 μH		
1009	High	50 Hz 10 kHz	.00001%	.0001%	.35 f 350 V max	R-3.5 ohms L-75 μH	Case 20¼" L x 9¼" H x 10" D Rack 19" L x 8¾" H x 8¼" D 60 lbs.	7 decades in this combination unit, —.111111 ratio available.
	Low	30-1000 Hz			2.5 f 350 V max	R-5 ohms L-350 μH		
1011	High	50 Hz 10 kHz	.00001%	.0001%	.35 f 350 V max	R-3.5 ohms L-75 μH	Rack 19" L x 5¼" H x 7" D 17 lbs.	7 decades with a 1.1 and —.1 output. —.0111111 ratio available.

Special Purpose Transformers

Series ST-100 • Series ST-200 • Scott-Tee

General Description

AILTECH "ST" transformers are designed to meet the requirements of a wide variety of bridge circuitry, isolation, and calibration applications. Series ST-100 are double-shielded transformers which minimize interwinding capacity. Units can be used to provide a balanced output from an unbalanced source. These transformers may be combined with Ratio Transformers in bridging circuits, to isolate a null indicator. Series ST-200A features very accurate 1:1 ratio for isolation or phase inverting applications. Units are also used with Ratio Transformers to provide 180° phase shift to the input or output of the instrument in certain bridge applications. Both series are available with a variety of terminations and internal construction features. Units with other turns ratios, input voltages, and frequency ranges can be supplied to meet specific customer requirements.



Model ST-100A

Specifications

Series ST-100

Turns Ratio: 4:1.
Intershield Capacitance: Less than 25 pf.
Frequency Range: 20-5,000 Hz.
DC Resistance: (Approx) 100 ohms (Low Side) 2,700 ohms (High Side).
Insulation: 500 V Test.
Open Circuit Ratio Accuracy at 400 Hz: No Spec.
Open Circuit Phase Error at 400 Hz: No Spec.
Input Impedance (with Secondary Open Circuit) at 400 Hz; Greater than 15,000 ohms.
Input Voltage: 115 Vrms at 60 Hz into high side winding when load across low side winding is greater than 100 ohms.

Series ST-200A

Turns Ratio: 1:1.
Intershield Capacitance: Models ST-248A and ST-213: approx. 350 pf. No Spec for other models.
Frequency Range: 50-10,000 Hz.
DC Resistance: (Approx) 10 ohms.
Insulation: 500 V Test.
Open Circuit Ratio Accuracy at 400 Hz: .005%.
Open Circuit Phase Error at 400 Hz: Less than .03 milliradians.
Input Impedance (with Secondary Open Circuit) at 400 Hz; Greater than 250,000 ohms.
Input Voltage: Models ST-248A and ST-213: 35 f (350 V maximum). All others: .35 f (170 V maximum).

Features

- Double shielding—ST-100 Series.
- Accurate 1:1 turns ratio—ST-200A Series.

Transformers for...

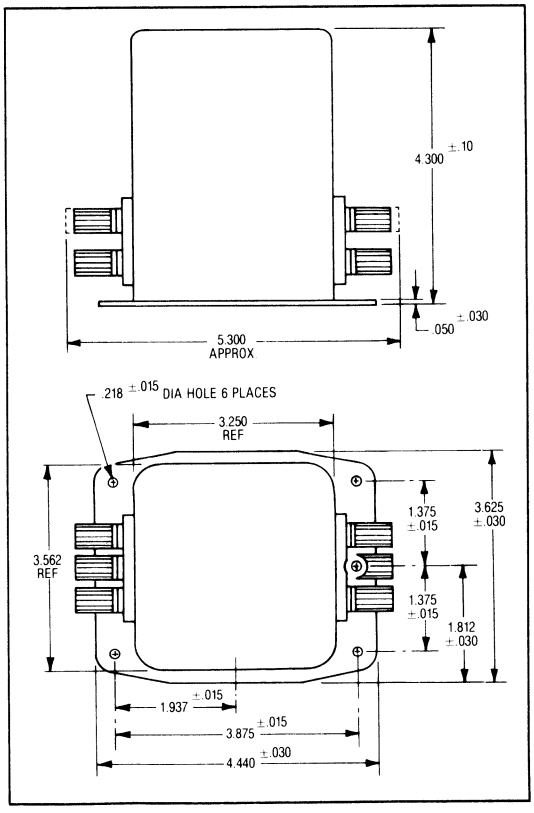
- Providing balanced output from an unbalanced source.
- Isolating null indicator.
- Providing 180° phase shift to input or output of the instrument in certain bridge applications.

Construction Variations

Model	Termination	Potting
ST-100†	binding posts	wax
ST-200A*	binding posts	wax
ST-213†	binding posts	epoxy
ST-248A†	binding posts	wax

†Electrostatic shields
*Center-tapped secondary
††Qualified to MIL-T-27A, Grade 4, Class R

Dimensions

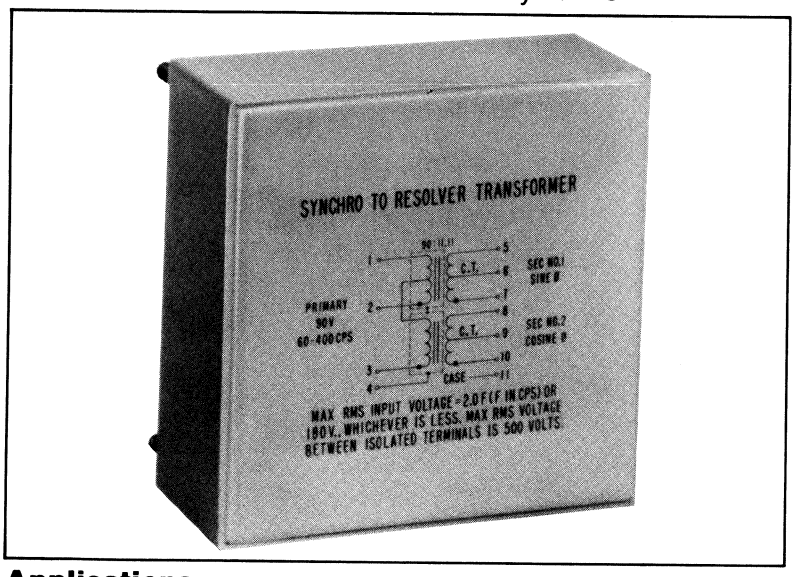


Specifications subject to change without notice.

Scott-Tee Transformers

Synchro to Resolver/Resolver to Synchro

ratio transformers



Features

- High accuracy.
- Passive design.
- Negligible phase shift.
- High input impedance.
- Low output impedance.

Applications

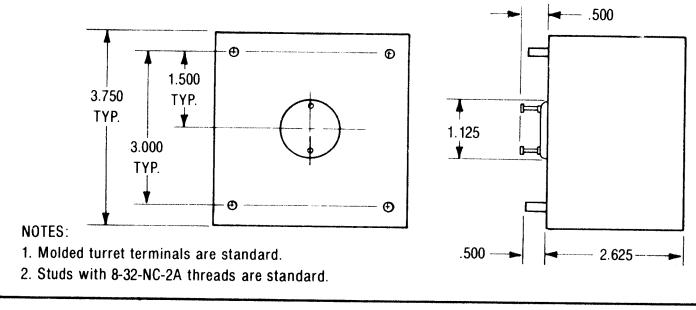
- Convert output of synchro to 4-wire resolver signal.
- Convert output of resolver to 3-wire synchro signal.
- Extend use of test equipment.
- Simple conversion for system applications.

Description

These special transformers convert either a 3-wire synchro signal to a 4-wire resolver signal or a 4-wire resolver signal to a 3-wire synchro signal. The conversion is accomplished in a Scott-Tee transformer arrangement as shown below.

Because of the number of variables, the transformers are normally optimized for a specific application. Specifications for some typical units are listed on the catalog sheet. Many other variations have been designed for specific applications.

Dimensions



Electrical Specifications

Model No.	Nom. Synchro Frequency Vrms	Nom. Resolver Frequency Vrms	Nominal Frequency Hertz	Angular Accuracy No Load	Transformation Ratio No Load	Input Impedance	Output Impedance	Notes
1841	90	11.11 C.T.	60,400	20″	.1%	500 K		1
2256	11.8	70.7	400	10″	.05%	40 K	1 + j1	2
2057	11.8	11.11 C.T.	380-420	30″	.02%	100 K	15 + J3	1
2205	140 (.35 f)	140 (.35 f)	400	2″	.005%	200 K	50 + J20	1
						200 K	50 + J20	2
2225	90 (1.56 f)	10 C.T.	60	30″	.2%	1 Meg	20 + J5	1

NOTES: 1. Synchro to resolver conversion.
2. Resolver to synchro conversion.

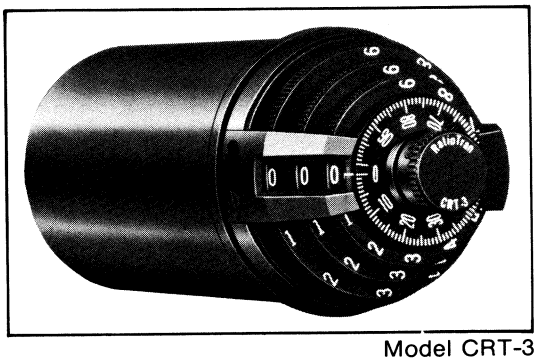
Coaxial Switch Ratio Trans

General Description

AILTECH Coaxial Ratio Trans, are precision AC voltage dividers designed for applications where panel space and weight must be kept to a minimum.

MIL Spec Units (only 2½" Diameter)

These sub-miniature instruments were designed to meet military specifications, and to operate under severe environmental conditions. All models are certified to MIL Specs for vibration, shock, salt spray, drip proof, fungus, and humidity.



Model CRT-3

Accuracy of Indicated Ratio

Model	50-3000 Hz	3000-10,000 Hz
CRT-3, CRT-6	$+(.001\frac{.0006}{\text{Ratio}})\%$	$\pm(.01+\frac{.006}{\text{Ratio}})\%$
CRT-3A, CRT-5A	$\pm(.002+\frac{.001}{\text{Ratio}})\%$	$\pm(.02+\frac{.001}{\text{Ratio}})\%$
CRT-5	$\pm(.005+\frac{.005}{\text{Ratio}})\%$	$\pm(.01+\frac{.005}{\text{Ratio}})\%$

Features

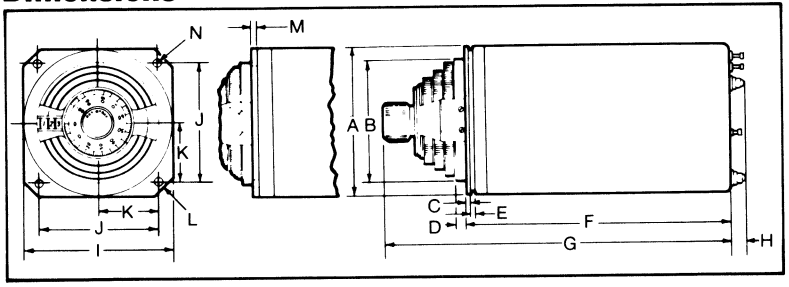
- Small Size.
- Terminal Linearity to .001%.
- Economical.

Technical Characteristics

Model	Type	Frequency Range	Resolution	Terminal Linearity	Input Voltage (f in Hz)	Maximum Effective Series Output Impedance	Input Inductance (Approx.)	Weight (Lbs.)	Notes
CRT-3	MIL Spec.	50-10,000 Hz	Continuous	.001%	.35 f 350 V max	R-14 ohms L-75 μH	150 henries	2	5-place readout with 3-decade transformer and 1-turn potentiometer with dial lock.
CRT-3A	MIL Spec.	50-10,000 Hz	Continuous	.001%	.35 f 350 V max	R-5 ohms L-75 μH	150 henries	2	5-place readout with 3-decade transformer and 1-turn potentiometer with dial lock.
CRT-5	MIL Spec.	50-10,000 Hz	Continuous	.005%	.35 f 350 V max	R-9 ohms L-50 μH	150 henries	2	4-place readout with 2-decade transformer and 1-turn potentiometer.
CRT-6	MIL Spec.	50-10,000 Hz	Continuous	.001%	.35 f 350 V max	R-14 ohms L-75 μH	150 henries	2	5-place readout with 3-decade transformer and 1-turn potentiometer.
CRT-6A	MIL Spec	50-10,000 Hz	Continuous	.001%	.35 f 350 V max	R-5 ohms L-75 μH	150 henries	2	5-place readout with 3-decade transformer and 1-turn potentiometer.

See price list for instruments in current production.

Dimensions

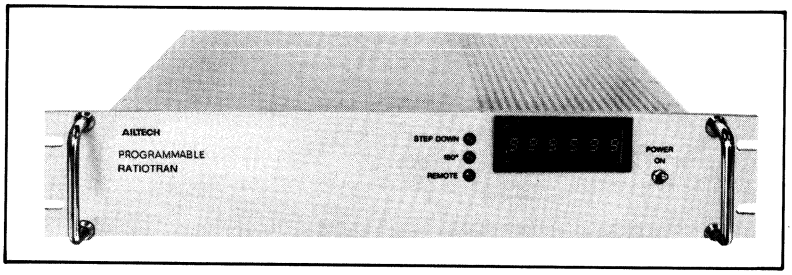


Specifications

Shock MIL-S-901B: (5 ft. drop, 400 lb. hammer).
Salt Spray: MIL-E-5272A.
Drip Proof: MIL-STD-108.
Vibration: Operating MIL-STD-167, Type 1.
Non-operating MIL-E-4970, Proc. III.
Sand and Dust: MIL-E-4970, Proc. 1.
Altitude: MIL-E-4970, Proc. 1.
Explosion: MIL-E-4970, Proc. 1.

Model	A	B	C	D	E	F	G	H	I	J	K	L	M	N
CRT-3	2.500 ±.020	2.490 2.510	.150 .170	.310 .350	—	4.100 Max	5.920 Max	.380 Max	2.620 Sq. ±.020	2.125 ±.010	1.062 ±.010	3.380 Dia.	.150 .170	.156 Hole Dial 4-Places
CRT-5	2.500 ±.020	2.490 2.510	.150 .170	.310 .350	—	4.170	5.920 Max	.380 Max	2.620 Sq. ±.020	2.125 ±.010	1.062 ±.010	3.380 Dia.	.150 .170	.156 Hole Dia. 4-Places
CRT-6	2.500 ±.020	2.490 2.510	.150 .170	.310 .350	—	4.200	6.020 Max	.380 Max	2.620 Sq. ±.020	2.125 ±.010	1.062 ±.010	3.380 Dia.	.150 .170	.156 Hole Dia. 4-Places

PRT-10
Programmable Ratio Trans



Model PRT-10
Programmable Ratio Tran
with digital readout

ratio
transformers

Features

- 50 Hz to 10 kHz frequency range.
- Built-in IEEE-488-1975 GPIB interface.
- Built-in BCD interface for operation in local mode.
- 30 part per million accuracy.
- 6 decade resolution.
- 6 voltage input selection levels.
- Phase shift 50 μ radians typical.

Description

AILTECH Model PRT-10 is the industry's first IEEE-488-1975 GPIB compatible ratio transformer. This feature permits remote control by external calculator or computer for fully automatic ratio measurements. Units may be used in direct or isolated input mode.

Specifications

Frequency Range: 50 Hz to 10 kHz.

Maximum RMS Voltage: 0.35 f (frequency in Hz) or 350 volts whichever is less.

Ratio Range: zero to .999999.

Ratio Accuracy at 400 Hz: $\pm(.003 + .0002/R)\%$ of indicated ratio.

Maximum Effective Series Impedance: Direct: 4 Ω + 75 μH; Isolated: 40 Ω + 3.5 μH.

Input Impedance at 20 V, 400 Hz: Direct: 150 Ω. Isolated: 150 KΩ.

Relay Data

Response Time: 30 milliseconds maximum.
Operating Voltage: 30 volts nominal.
Coil Resistance: 2.5 KΩ typical 10 Ma.

Power Input: 115 volts AC.

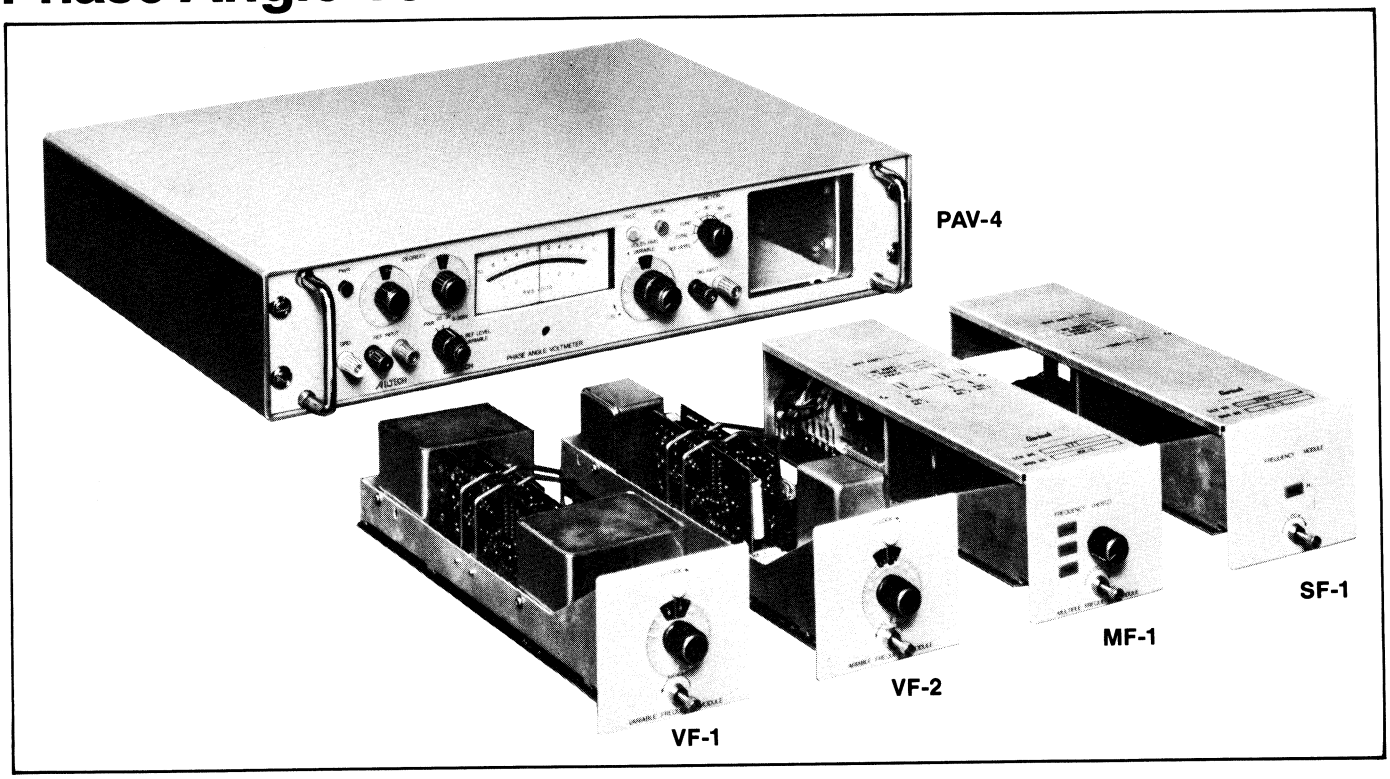
Configurations

Model	Isolated Input	Phase Inversion	Voltage Step-down
PRT-10C	•	•	• 100:100, 100:10
PRT-10D	•	•	• 115:115, 115:28
PRT-10E	•	•	• 115:15, 115:100

Certification and data on all ratio measurement instruments are provided in terms of an applicable standard which has been certified by the National Bureau of Standards, Washington, D.C.

Specifications subject to change without notice.

Phase Angle Voltmeters — PAV-4 Series



Description

Ailtech PAV-4 Series:

The PAV-4 series of Phase Angle Voltmeters provides complete capability for measurement of the amplitude and phase characteristics of AC voltages. Wide frequency coverage (30 Hz to 300 kHz), wide dynamic range (300 microvolt to 300 volt full scale), harmonic filtering and high input impedance (10 megohm) with or without input isolation are standard specifications in the PAV-4 series.

The PAV-4 offers the user high accuracy with the greatest economy at any frequency through the use of frequency control plug-ins. Single frequency plug-ins or variable frequency, broadband plug-ins are available to meet every type of requirement for phase sensitive measurements with minimum expenditure.

Signal and reference inputs may be direct or floating from ground. Either isolated inputs or direct inputs offer a unique feature of high input impedance at all frequencies (10 megohm from 30 Hz to 300 kHz). Isolation with high input Z is achieved by use of a floating buffer amplifier preceding the isolation transformers in both the reference and signal channels.

OPERATION

Phase angle measurements are made using three controls, a quadrant selector, a 10° increment selector, and a continuously variable control for 0 to 10°. This combination of coarse and fine phase controls resolves phase angle measurements down to 0.1°. The total voltage span is divided into thirteen ranges and is read out on a damped, zero-center 3½ inch meter.

Sensitive measurements of in-phase voltage components are possible with PAV-4 even when there is a large quadrature component. A quadrature component up to ten times larger than the in-phase full scale sensitivity will not result in instrument overload. A front panel light indicates overload of the PAV and warns the operator to decrease the sensitivity.

Features

- *Isolated or direct inputs with 10 megohm Z_{in}.*
- *Broadband frequency coverage with harmonic filtering.*
- *0.1° phase resolution.*
- *.0003 V to 300 V full scale ranges.*

Measurements of Amplitude and Phase Characteristics of AC Voltage for...

- Direct precision measurement of in-phase, quadrature and total voltages and phase angle.
- Measuring gain, insertion loss, phase shift and frequency response in amplifiers and servo loops.
- Phase shift and transformation ratios of rotary components.

The PAV-4 System consists of:

- 3 basic mainframes (30 Hz to 300 kHz).
- 2 broadband plug-ins (300 Hz to 10 Hz and 10 kHz to 300 kHz).
- 2 fixed-frequency plug-ins which accommodate 7 arrangements of 400, 800 and 4800 Hz in single or switched combinations.
- Infinite choice of non-standard plug-in filters (within 30 Hz to 10 kHz range).

Broadband plug-ins have:

1. Instant selection of bandpass frequency by one control covering signal and reference inputs.
2. Entire spectrum covered by single filter set.
3. Phase locked frequency.
4. Remote programmability.

phase angle voltmeters

The versatility of the instrument is increased by the addition of voltage and current analog outputs which can be used to drive a strip recorder or to operate a "go/no-go" indicator for production testing.

The PAV-4 series is all solid-state and consists of three types of mainframe — PAV-4A, PAV-4B, and PAV-4C — and four frequency plug-ins: SF-1, MF-1, VF-1, and VF-2. The VF-1 and VF-2 provide continuous frequency coverage within each range by means of a front panel tuning knob. A phase-lock circuit with indicator light allows instant frequency control. A rear panel connector also permits programmed tuning of the VF-1 and VF-2 from an external source. To select appropriate plug-ins, see the selection charts for both standard and non-standard frequencies.

MAINFRAME DIFFERENCES

Mainframes and plug-ins of the PAV-4 series are designed for various types of applications. Basic differences between them are listed below. Specifications not mentioned are unchanged and are listed in the specifications section.

PAV-4A

The PAV-4A has direct inputs and a frequency range of 30 Hz to 300 kHz in the total (unfiltered) mode. It has the broadest frequency range of the three mainframes and is the most economically priced.

PAV-4B

The PAV-4 has signal and reference inputs which are isolated from ground. The frequency range is 300 Hz to 300 kHz in the total mode.

PAV-4C

The PAV-4C has isolated inputs and a frequency range of 57 Hz to 20 kHz in the total mode.

PLUG-IN DIFFERENCES

All plug-in units are compatible with all the mainframes listed within the frequency coverage of each mainframe.

SF-1

The SF-1 single frequency plug-in will accept a single filter set in the range of 30 Hz to 10 kHz. Standard frequencies are 400, 800 Hz. Any frequency in the range 30 Hz to 10 kHz can be supplied on request.

MF-1

The MF-1 multiple frequency plug-in accommodates up to three fixed frequency filter sets. The MF-1 frequency range is 30 Hz to 10 kHz with 400 Hz, 800 Hz filter sets standard. The filter sets simply plug into the MF-1 module. Any of the three is instantly useable by means of a front panel switch. It is therefore possible for the user to acquire a range of filters which can be plugged into the MF-1 module as necessary. This system also permits immediate update of the instrument when frequency requirements change.

NOTE: Only two filters can be accommodated in the MF-1 module if one frequency is below 100 Hz. In this case, the second filter frequency must be over 100 Hz. Only one filter can be accommodated below 60 Hz.

VF-1

The VF-1 variable frequency module gives continuous coverage over the range 300 Hz to 10 kHz. A unique heterodyne technique and phase-locked oscillator circuit provides harmonic filtering in both the reference and input signal channels over this entire frequency range.

VF-2

The VF-2 variable frequency module gives continuous coverage over the range of 10 kHz to 300 kHz with circuitry similar to the VF-1.

Specifications

Voltage Range: 300 μVrms to 300 Vrms in 13 ranges.
Range Vernier: 100% to 30% without affecting overload ratio.
Phase Range: -10 to 360 deg. 0.1 resolution.
Frequency Range: Total Mode, PAV-4A: 30 Hz to 300 kHz.
Total Mode, PAV-4B: 300 Hz to 300 kHz.
Total Mode, PAV-4C: 57 Hz to 20 kHz.
Filtered Mode: see Plug-in Specifications.

Accuracy

Voltage: 3% (50 Hz to 20 kHz) of full scale from 15° — 35° C
5% (30 kHz to 100 kHz) of full scale from 15° — 35° C
6% (100 kHz to 300 kHz) of full scale from 15° — 35° C

Input Impedance

Signal: 10M, 25pf (Nom. w/o rear term)*.
Reference: 10M, 25pf (Nom. w/o rear term)*.
Input Common to Case Grd, PAV-4B/PAV-4C: 200pf (Max w/o rear term)*.

Reference Input Voltage: 0.03V to 300 Vrms.

Overload Ratio: 10 x full scale

Noise: PAV-4A	PAV-4B/PAV-4C
Total Mode: 20 μV (max)	30 μV (max)
Fund. Mode: 10 μV (max)	15 μV (max)
Nulling Sensitivity: 2 μV	2 μV

Harmonic Rejection: See Plug-in Specifications.

Temperature Range: 0 to +50 degrees C.

Recorder Output: ±1.0 VDC or 0.3 VDC, 1 ma DC equals full scale single-ended.

AC Amplifier Output: 200 mVrms (approx.) equals full scale single-ended.

Power: 115/230V ±10%, 50-400 Hz.

Size: 3½" high x 19" width x 14" deep.

MODEL SF-1, MF-1: Plug-in Modules

Frequency Range: 30 Hz to 10 kHz.

Bandwidth: 5%

Phase Accuracy: 1.5° over entire freq. range (min.)

Phase T/C: 0.01 degrees/degree C.

Harmonic Rejection:

Fund Mode: 40 dB (3rd harmonic and above).
PAV Mode: 55 dB.

MODEL VF-1, VF-2: Plug-in Modules.

Frequency Range: 300 Hz to 10 kHz (VF-1), 10 kHz to 300 kHz (VF-2).

Bandwidth: Phase-locked to input reference.

Phase Accuracy: (2.0 +0.01f kHz) degrees from 15° to 35° C.

Harmonic Rejection: 2nd 40 dB, 3rd 55 dB.

Noise: (VF-2 only) Total 40 μV max.
Fund 30 μV max.

PLUG-IN SELECTION CHART FOR STANDARD FREQUENCIES

Mainframe Type	PAV-4A	PAV-4B	PAV-4C
Mainframe Frequency Range in TOTAL Mode (unfiltered)	30 Hz to 300 kHz	300 Hz to 300 kHz	57 Hz to 20 kHz
Frequency Response of Combined Mainframe & Plug-in, in Filtered Modes			
SF-1 (one filter)	400 800		
MF-1 (three filters)	400 800		
VF-1 (variable)	300 Hz to 10 kHz		
VF-2 (variable)	10 kHz to 300 kHz		10 kHz to 20 kHz

PLUG-IN SELECTION CHART FOR NON-STANDARD FREQUENCIES

(Non-standard frequencies are available for SF-1 and MF-1 plug-ins only and are not available above 10 kHz)

Mainframe Type	PAV-4A	PAV-4B	PAV-4C
Mainframe Frequency Range in TOTAL Mode (unfiltered)	30 Hz to 300 kHz	300 Hz to 300 kHz	57 Hz to 20 kHz
Range of Possible Plug-in Frequencies			
SF-1 (one filter)	30 Hz to 10 kHz	300 Hz to 10 kHz	60 Hz to 10 kHz
MF-1 (three filters)	30 Hz* to 10 kHz	300 Hz to 10 kHz	60 Hz* to 10 kHz

*Only two filters can be accommodated in the MF-1 plug-in if one frequency of the two is under 100 Hz. When one filter is under 100 Hz, the second must be over 100 Hz. Only one filter can be accommodated below 60 Hz.

*Add 45 pf for rear terminals

Specifications subject to change without notice.

Facilities and Sales Representatives

representatives

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800 N.W. 62nd Street
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(305) 491-1054

Beacon Electronics
235 South Maitland Ave.
Maitland, FL 32751
(305) 647-3498

Beacon Electronics
Suite 6, 312 South Harbor City Blvd.
Melbourne, FL 32901

GEORGIA
Beacon Electronics
6135 Barfield Road, Suite 112
Atlanta, GA 30328
(404) 258-9640

IDAHO
Alster Communications
P.O. Box 4847, Boise, ID 83707
(208) 362-1272

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(312) 882-4808

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3512 Rockville Road, Room 140C
Indianapolis, IN 46222
(317) 243-6681

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6716 Old McLean Village Drive
McLean, Virginia 22101
(703) 442-9100

MASSACHUSETTS
R.J. Sickles Associates
44 Mall Road, Burlington, MA 01803
(617) 272-7285

NEW MEXICO
Sierra Technical Group Associates
3705 Westerfield, N.E.
Albuquerque, NM 87111
(505) 294-8408

Sierra Technical Group Associates
P.O. Box 116, Las Cruces, NM 88001
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1207 W. Bessemer Avenue, Suite 203
Greensboro, NC 27408
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2401 N.W. 39 Expressway, Suite 103
Oklahoma City, OK 73112
(405) 528-6071

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Hillsboro, OR 97123
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300 E. Huntland Drive, Suite 233
Austin, TX 78752
(512) 451-5174

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14235 Proton Road, Dallas TX 75234
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Data Marketing Associates, Inc.
3330 Bering Drive, Houston, TX 77057
(713) 780-2511

Data Marketing Associates, Inc.
P.O. Box 17928, San Antonio, TX 78217
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Brookfield, WI 53005
(414) 784-3790

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3109 Friendly Grove Road
Olympia, Washington 98506
(206) 754-6504

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ARIZONA
Ross Communications
P.O. Box 17913
7257 E. 28th Street, Tucson, AZ
85710 (602) 885-5368

CALIFORNIA
Ross Communications
2448 Cameron Avenue
Covina, CA 91724
(213) 967-2402

Ross Communications
356 Hillcrest Street
El Segundo, CA 90245
(213) 322-7114

Ross Communications
600 16th Street
Oakland, CA 94612
(415) 832-0938

Ross Communications
P.O. Box 490
Vista, CA 92083 (714) 941-0966

FLORIDA
Secom Systems, Inc.
10435 NW First Place
Coral Springs, FL 33065
(305) 753-6777

GEORGIA
Secom Systems, Inc.
5241-F New Peachtree Road
Chamblee, GA 30341
(404) 455-0672

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409 S. Erie Street
Wheaton, IL 60187
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Webster Associates
115 Bellarmine
Rochester, MI 48063
(313) 375-0420

MINNESOTA
Stan Clothier Co., Inc.
7423 Washington Avenue, South
Minneapolis, MN 55435
(612) 944-3456

MISSOURI
GT Sales, Inc.
10509 E. 79th Street
Raytown, MO 64138
(816) 358-7712

NEW JERSEY
Moses & Kline, Inc.
23-15 Broadway
Fairlawn, N.J. 07410
(201) 791-8538

NORTH CAROLINA
Secom Systems, Inc.
P.O. Box 31024, Raleigh, NC 27612
(919) 467-0852

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Webster Associates
3712 N. Roger Drive
Port Clinton, OH 43452
(419) 797-2084

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Tellico Plains, TN 37385
(615) 261-2352

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Dallas, TX 75234
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509 Malbar Lane
Madison, WI 53711
(608) 271-1119

Electronic Products
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(414) 241-3020

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Electronic Instrumentation Division
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Sunnyvale, CA 94086
(408) 733-6574 TWX: 910-339-9395

Electronic Instrumentation Division
2810 New Spring Road, Suite 104
Atlanta, GA 30339
(404) 435-6018

Electronic Instrumentation Division
Altamonte Springs, Florida 32701
(305) 830-0363

Electronic Instrumentation Division
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Building 9, Unit 76
Fairfield, New Jersey 07006
(201) 227-8990

EATON Advanced Electronics

ordering and leasing information

Electronic Instrumentation Division is committed to providing its customers the best possible sales/service on a worldwide basis. A complete listing of our offices appears on page 129 of this catalog.

Order Placement

Orders from customers in the United States should be made out to Eaton Corporation, Electronic Instrumentation Division and may be placed with the closest plant or Regional office. For customers outside the United States, please place orders with the Eaton Electronic Instrumentation Division (EID) Office or Sales Representative for your country as listed in this catalog. If a local Sales Representative is not available, then your order may be placed directly with the EID Operation in the United States which manufactures the instrument you require.

Purchase orders may be placed by telephone, telex, TWX, Telegram, or Cablegram pending confirmation on your company's purchase order form. Final acceptance of order, terms and conditions of sale will be confirmed by one Plant (Ronkonkoma, Los Angeles, City of Industry).

In the United States terms are net 30 from invoice date and 1/4 of 1% discount for payment within 10 days of invoice date if credit has been previously established with the Electronic Instrumentation Division. If credit has not been established, payment must be received before shipment. Shipment can be arranged on a C.O.D. basis to minimize delay.

Orders placed directly with any of the Electronic Instrumentation Division Operations in the United States will normally require an Irrevocable Letter of Credit confirmed by a specified U.S. Bank, or by Cash Against Documents. Payment terms for orders placed with one of our overseas Offices or Sales Representatives will be mutually determined when the order is being placed.

Shipments

Shipments to any destination in the U.S.A. are made directly from our manufacturing plant and shipments are F.O.B. origin. Electronic Instrumentation Division will select the shipping method on the basis of economy and delivery requirements unless directed otherwise at the time the order is placed.

Shipments by sea usually require special package and will incur a nominal extra charge.

Warranty

Except for tubes, semiconductors, mixer crystals, fuses and batteries, AILTECH products are warranted to be free from defects in material and workmanship and to perform within published specifications, under normal usage, for a period of one year from date of shipment. The limit of liability under this warranty is to repair, replace or adjust any product or part thereof (except for tubes, semiconductors, mixer crystals, fuses and batteries) which has been returned to Electronic Instrumentation Division within the specified warranty period by an original purchaser and is found to be defective or to have failed in normal service by our examination. All warranty returns must first be authorized by Electronic Instrumentation Division or one of its authorized sales representatives, and all transportation charges prepaid.

Electronic Instrumentation Division reserves the right to alter designs at any time on any of its products without incurring any obligation to install the same changes on units previously sold.

This warranty is to be considered the extent of Electronic Instrumentation Division's obligation with respect to its products. No other warranty, expressed or implied, exists nor is any other person or organization authorized to make or offer any other warranty or guarantee concerning AILTECH products.

Certification
The materials used in the fabrication of the parts have been inspected and to the best of our knowledge and belief conform to specification requirements of the applicable purchase order.

Records of material analysis, inspections, calibration standards traceability to N.B.S. and other required tests are maintained in our files for future reference.

Service and Spare Parts
Service and calibration information is included in the instruction manual supplied with each instrument. Diagnostic and repair procedures by technically qualified personnel may be accomplished with the detailed schematic and block diagrams included. A complete list of parts with factory-coded and original manufacturer's part numbers simplifies ordering any replacement part needed.

In the event a difficult service problem occurs, contact your nearest Electronic Instrumentation Division Regional Office or Sales Representative by letter, TWX or phone. Please indicate the model number, serial number and specific details of the difficulty involved with as much additional information as you consider necessary to aid in pin-pointing the cure to the problem.

Should it be necessary to return the equipment to the plant for repair or recalibration, please contact Electronic Instrumentation Division or an authorized sales representative in your area before shipping a unit. In your communication arranging for a return, please be sure to include model number, serial number, date of purchase and specific details concerning the problem (in the event of failure) or service desired (in the event of recalibration).

When an instrument is returned for service, we will proceed to work on the instrument until the charges reach $100. If the total charges exceed $100, an estimate of such charges will be submitted for approval.

When spare parts are ordered, please indicate a description of the part as well as its part number and also include the model number and serial number of the instrument being repaired.

ordering and leasing information

Direct Leasing—Now Available

AILTECH products can be provided with preferred leasing terms through the Eaton Credit Corporation. The plan is to provide an easier, less costly method for our customers to acquire the most modern electronic test equipment with minimal capital investment.

Advantages of Eaton Credit Corporation Leasing

- Leasing directly with the manufacturer is your guarantee of the best of service
- Leasing makes new equipment available now, when you can benefit immediately
- Leasing can conserve working capital for other needs
- Leasing helps maintain existing lines of credit
- Leasing helps hedge against dollar inflation—you pay todays price with tomorrows dollar
- Leasing combats obsolescence
- Leasing through Eaton Credit Corporation provides you with Investment Tax Credits

If you've done your homework—considered the pros and cons—and decided leasing makes more sense and added profit dollars, simply contact your nearest Eaton Corporation—Electronic Instrumentation Division sales office.

NOTES