Attenuation Measurement System

The Model 8850 Attenuation Measurement System combines the outstanding accuracy, performance, high sensitivity, and reliability of our Model VM-7 Attenuator and Signal Calibrator with our Model 8852, 0.01 to 18 GHz Frequency Converter. When combined with a suitable generator, the Model 8850 provides the user with an attenuation calibration system of high accuracy, repeatability and speed. Some other features of this system include:

**Advanced Techniques**

Advanced digital detection and processing techniques of the VM-7 means that measurements are available instantaneously, no matter what the dynamic range or resolution.

**Single Band Operation**

The system can be converted to a 0.01 to 18 GHz single port converter. This is accomplished by using the measurement accessory kit (P/N 187-4001) that is supplied as part of the system. The measurement accessory kit includes low SWR masking attenuators and a power divider to provide a measurement system as shown in Figure 1.

**Dual Band Operation**

The RF input frequency range is divided into two bands, 0.01 to 2 GHz, and 2 GHz to 18 GHz. This allows the user direct access to the RF port of either the LOW band or HIGH band mixer to make full use of the VM-7 dynamic range.

**IEEE-488 Bus Programmable**

Remote programmability over the IEEE-488 bus using an external controller or controlling the system using only the VM-7.

**Auxiliary Output**

An auxiliary output of 2 to 18 GHz synthesized continuous wave signal in 2 kHz steps at +7 dBm is available, which can be used as an RF signal source for other applications.

**Versatile and User Friendly**

This measurement system will test all types of attenuators such as fixed, manual, motorized, programmable and other coaxial components. Coaxial components can be quickly and accurately tested using the efficient, user-friendly 8850-SureCAL software.
APPLICATIONS

Attenuation Measurements (0.01-18 GHz, extendible to 40 GHz)

The figure above depicts 8850-18. This system is setup for performing component measurements across the 0.01-18 GHz frequency band without changing any connections on the Model 8850 front panel. This setup gives the user the widest measuring frequency range possible. Removing the Power Splitter and connecting the input signal directly to the desired frequency input allows the user to increase the measurement systems dynamic range with the lowest possible SWR effects. This configuration can perform measurements in either the 0.01-2 GHz band or the 2-18 GHz band, depending on the Model 8850 front panel connection.

Using the Model 8852 as a CW signal source and adding the TEGAM Model 8853 will allow the Model 8850 to process frequencies up to 40 GHz in coax. Refer to the Model 8853 data sheet for more information and actual configuration diagram. This configuration is available as a system, Model 8850-40.

Return Loss/SWR Measurements

The TEGAM SWR Measurement Kit (P/N 187-4001-1) can be used with the Model 8850 and the 8850-SureCAL Software to perform return loss measurements. The SWR Measurement Kit includes a return loss bridge with an "open" and "short." Because the Model 8850 operates as a single channel receiver, it can be used as a scalar system. The DUT’s impedance to 50 ohms can be checked as a scalar quantity by measuring return loss. The actual measured return loss can be readily converted into SWR by the system software.

Gain Measurements

Active devices having gain can also be measured by an attenuation measurement system such as the Model 8850. Extra attenuation is required for this application, because the reference level is lower than the measurement level. Depending on the frequency range of the active device, the system can be used in either single or dual band operation. Extra input attenuation will be required to decrease signal level by at least the value of the amplifiers gain so that the Model 8852 remains in its linear region. If the amplifier is to be tested at a particular level, extra attenuation may be inserted at the output of the device to achieve the correct operating levels. Uncertainty values are similar to those for attenuation measurements. However, the distortion of the active device will make measurements level sensitive, adding to the uncertainty.

SureCAL Calibration Software for the 8850 System

SureCAL was developed by calibration engineers and technicians who are determined to cut the high cost of manually calibrating and maintaining your equipment. SureCAL Software for RF Components is very flexible and easy to use and is included with every 8850 System. SureCAL is the complete TEGAM solution for all your automated attenuation testing needs.
HISTORY REPEATS ITSELF . . . . . in 30 MHz Attenuation Measurement Receiver

Twenty-six years ago, Weinschel introduced the first Model VM-3 30 MHz Attenuator Signal Calibrator, a vacuum tube design using a manually-operated waveguide-below-cutoff piston attenuator as a reference. Despite technical advances that made measurement instruments faster, smaller, and smarter, the VM-3 has remained an undisputed standard for precision attenuation measurements.

Weinschel proudly announces the new standard for the next quarter of a century, the Model VM-7 Attenuator and Signal Calibrator. Its critical application of modern analog and digital solid state technologies have resulted in a design that achieves the VM-3’s level of excellence, while surpassing it in performance. Not only has Weinschel made a compatible VM-3 replacement that is much faster and easier to operate, it keeps the VM-7’s price within the reach of the average production, laboratory, or field environment. This makes it a cost-effective alternative to today’s high-priced insertion loss measurement instrumentation.

FEATURES

- Advanced Solid State Triple Down-conversion IF Substitution
- -110 to -127 dBm Sensitivity
- Built-in 30 MHz Calibration Traceable to NBS
- Linear Over 100-dB Dynamic Range
- 0.02 dB/10 dB Accuracy
- Split Second Measurement Results
- Low cost
- 0.1, 0.01, 0.001 dB Resolution
- Compatible Replacement for Weinschel VM-3, Harris/PRD 915, Narda/Sperry 61A1, Alltech 137
- Soft Key Operation
- AFC Output Compatible with BWOs, Klystrons, and Sweepers
- ATE Ready, IEEE-488 Bus Compatible
- Built-in User-Prompted Trouble-shooting
- Designed to MIL STD 28800D Type III, Class 5, Style E

ADVANCED PERFORMANCE

The Model VM-7 30 MHz Attenuation Measurement Receiver uses advanced digital and analog technologies to enable precision insertion loss measurements by triple down conversion techniques over a 100 dB dynamic range at RF. The frequency range for these measurements is determined by selection of external mixers, local oscillators and signal sources. The IF receiver sensitivity is -110 to -127 dBm depending on the bandwidth mode selected. Bandwidth mode selection is determined by the residual FM and drift of the external LO and signal source. Maximum linear input level at 30 MHz is 0 dBm. Assuming a typical mixer conversion loss of 8 dB, measurements can be made over a 102 to 119 dB dynamic range depending on operating mode.

FULL LINEAR DYNAMIC RANGE

Unlike the VM-3 whose optimum linearity and accuracy were limited to a small portion of its dynamic range, the VM-7, using newer signal processing techniques and microprocessor control, achieves greater linearity and accuracy over an increased portion of its dynamic range. At IF the accuracy of the VM-7 is 0.02 dB/10 from 0 to -100 dBm. For single step measurements of 100 dB this translates to an accuracy of ± 0.2 dB. See Figure 1.

![Figure 1: VM-7's Excellent Linearity (0.02 dB per 10 dB typical)](image-url)
INCREASED RESOLUTION AND SPEED

The VM-3 could typically be resolved to 0.005 dB. With practice a skilled operator could improve this to a resolution of 0.0025 dB when working at high signal levels. Measurement confidence was established through the time-consuming process of averaging the results of many discrete measurements. In comparison, VM-7 measurements are almost instantaneous. With today’s VM-7 you can easily select measurement resolution of 0.1, 0.01, or 0.001 dB. The VM-7 uses its microprocessor to collect hundreds of samples per second, to calculate an average, and to update the display every 0.25 seconds. The display indicates the results according to the selected resolution and a measurement stability or confidence factor. As the measurement progresses and the sample becomes increasingly stable, the confidence factor builds.

This confidence factor indicates the probability that noise variations of the measurement are less than the selected resolution. For example, if you select a resolution of 0.001 dB and the VM-7 displays a confidence factor of 80.0%, this means that 80.0% of the data collected was within ±0.001 dB of the displayed measurement result.

Measurement results with 0.1 or 0.01 dB resolutions are displayed almost instantly regardless of signal level. The results of measurements with a 0.001 dB resolution are also instantly displayed. However, the confidence factor of a 0.001 dB measurement may take several seconds to build. Measurement time depends on the preselected bandwidth and confidence factor, the input signal level, and the extent of noise.

FUNCTIONALLY EFFICIENT CONTROLS AND DISPLAYS SIMPLIFY OPERATION

The VM-7’s front panel is dominated by a large, two-line, 40-character liquid crystal display. Back-lighting of the display and its adjustable contrast/viewing angle allow high visibility and increased flexibility in positioning the VM-7 in a crowded test environment.

Pressing the MEAS hardware key results in the display of the MEAS menu. Press the TAKE REF soft key to take a nominal reference level.

Pressing the TAKE REF soft key results in the following display. The display of the confidence is updated as the confidence builds. When the desired confidence is reached, press the SET REF soft key to store the reference data and to return to the MEAS menu.

Pressing the MEAS ATTN key upon return to the MEAS menu results in the following display. Press the STOP soft key when the desired confidence is displayed.

Figure 2: VM-7 Soft Keys Make Attenuation Measurements Simple.

Manual operations of the VM-7 are greatly simplified by employing four soft keys, situated under the display. Pressing the dedicated hard keys provide entry to operational trees, whose functions are accomplished via the soft keys. The functions related to the soft keys only appear on the screen as they become active. This scheme simplifies operations for a novice, yet offers the sophisticated user a great deal of access to the instrument’s functions. For instance, a measurement can be made with as few as four keystrokes or can be tailored to any application by redefining operational parameters. See Figure 2.

Pressing a HELP key in conjunction with any function key results in the display of a tutorial message.

Figure 3: Orientation with More Sophisticated VM-7 Functions Are Made Easy by the Display of Tutorial Messages.
explaning the selected function. This message can be scrolled on the display a line at a time. See Figure 3. The VM-7 also features self-diagnostics that assist in isolating faults.

AUTOMATIC COMPUTATION, ANOTHER TIME SAVER
Recording reference measurements and calculating resultant attenuation is unnecessary with the VM-7. The work is done by the VM-7’s 16-bit microprocessor. The VM-7 stores the reference signal level and computes the resultant attenuation. A reference offset feature represents an additional computational aid. The VM-7 also provides four non-volatile memory locations to store measurement parameters for later recall.

AFC HANDLES HIGH DRIFT AND RESIDUAL FM
Compatibility with VM-3 measurement configurations was a prime design consideration in development of the VM-7. Most attenuation measurement receivers can only work with phase locked or synthesized sources. They lack the IF bandwidth and AFC capture range necessary to track and control automatically the high characteristic incidental FM of older Klystron and BWO sources. The VM-7 was provided with a ±2 MHz tuning bandwidth and ±10 Volt AFC tracking control which comfortably handles sources with residual FM deviations up to 400 kHz! Figure 4 is a typical test configuration for either the VM-7 or VM-3 illustrating application compatibility.

ATE READY WITH THE IEEE-488 BUS
Designed with an IEEE-488 bus interface, the VM-7 can combine with an external mixer and two RF sources to form an automatic attenuation measurement system (Figure 5). Software is available to drive broadband insertion loss, return loss, and VSWR measurements from HF through the millimeter frequency range depending on the selection of mixer and RF sources.

MILLIMETER WAVE OPERATION
The introduction of the Model 1733 Multiplier/Mixer and the Model 1633 Upconverter will soon allow the use of commonly available 18 GHz synthesized generators to create an attenuation measurement system operating in the 33 to 50 GHz range. See Figure 6. Fundamental mixing enhances the dynamic range of the measurement system. Future development of other mixer/source multiplier accessories will cover other millimeter wave bands.

SELF CALIBRATION TRACEABLE AT 30 MHz!
IF substitution in the VM-7 is implemented with a series of solid-state internal attenuators, amplifiers, and a highly linear analog-to-digital converter. Under microprocessor control automatic calibration of this chain is accomplished in 10 dB steps using the internal or an externally selected 30 MHz reference signal. A 30 MHz NBC-traceable standard, such as Weinschel’s Model PA-2 waveguide-below-cutoff piston attenuator or Model 1830 Voltage Doubler, can be utilized with an externally applied 30 MHz reference signal to verify the accuracy and linearity performance of the VM-7 as shown in Figure 7. Software is available to verify the VM-7’s accuracy and linearity using the 1830 under IEEE-488 bus control.
the NEW VM-7

TECHNICAL SPECIFICATIONS

FREQUENCY RANGE:

Depends on External Mixer, Local Oscillator and Signal Source

IF INPUT FREQUENCY:

30 MHz

IF BANDPASS:

± 2 MHz, ± 0.5 MHz narrowband

SENSITIVITY:

−110 to −127 dBm depending on phase-locked LO bandwidth

DYNAMIC RANGE:

110 to 127 dB depending on operating mode

LINEAR REGION:

0 dBm to −100 dBm

INCREMENTAL ACCURACY:

0.02 dB/10 dB over full linear range * @ 25°C ± 5°C

OPERATING MODES:

PLL WIDE: 8 kHz Loop Bandwidth (typical)
PLL NARROW: 150 Hz Loop Bandwidth (typical)
AFC: Output level, ± 10V referenced to ground. Output impedance, < 200 ohms

CALIBRATION FREQUENCY:

Internal or External, 30 MHz, at -55 dBm typical

EXTERNAL REFERENCE:

10 MHz ± 0.05%

CONNECTORS:

30 MHz: Type N Female
10 MHz: BNC Female Isolated
AFC Out: BNC Female

REMOTE OPERATION:

IEEE-488 Interface bus

POWER REQUIREMENTS:

100, 120, 220, 240 VAC, 50/60 Hz 90 watts

WEIGHT:

Net 13 kg/34 lbs
Shipping 18.2 kg/40 lbs

TEMPERATURE:

Operating: 0 to 50°C
Storage: −40 to +75°C

DESIGN AND CONSTRUCTION:

Designed to the requirements of MIL STD 28800D Type III, Class 5, Style E

SIZE:

5¼ in. (13.34 cm) H, 16¾ in. (42.55 cm) W, 17½ in. (44.45 cm) D

EMI:

Meets MIL STD 461 for radiated and conducted emission

*exclusive of signal source effects

With compliments
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Feldchen 16-24   D-52070 Aachen    Germany

TAKING THE VM-7 INTO THE FUTURE...

WEINSCHHEL ENGINEERING
EXCELLENT RELIABILITY AND MAINTAINABILITY
The VM-7 is an all solid state design without electromechanical devices except for the cooling fan. Alignment controls have also been kept to a minimum to simplify maintenance. Should service be required in the field, the five modules and power supply are directly accessible from the rear panel. See Figure 8. Accessory board extenders are available for trouble shooting.

Down time can be minimized using Weinschel’s convenient board exchange program. Replacement modules are stocked and can normally be shipped within 48 hours with special handling. In multi-installation support applications on-site availability of a VM-7 calibration kit is recommended (WE P/N 187-1030). Packaged in a convenient transit case, the calibration kit contains a full complement of modules, power supply P.C. assemblies, and board extenders.

A SMALL INCREMENTAL INVESTMENT IN NEW TECHNOLOGY
If your laboratory or production line or incoming inspection activity must operate with tight budget constraints, the VM-7 represents a manageable investment in the latest attenuation measurement technology.

With Weinschel mixer/source multiplier accessories currently in development, dedicated millimeter wave attenuation measurement systems can be assembled at a fraction of the costs normally associated with these higher frequencies.

Future enhancements of the VM-7 will expand its applications into absolute RF power measurements, AM, FM, and dM measurements as well as multi-channel configurations. The VM-7’s internal bus structure and software architecture allow convenient expansion of capabilities with accessory modules in a matching enclosure. Space has been reserved in the VM-7 for the inclusion of integral mixer, LO, and source modules. Such enhancements would integrate the VM-7 into dedicated system applications such as TACAN, IFF, and altimeter attenuation measurements.

FULL COMPLEMENT OF ACCESSORIES
A full line of accessories are available from Weinschel Engineering that will assist you in realizing many applications of the VM-7. Also, a calibration kit and extender cards are available to assist in the maintenance of the VM-7.

Software packages are available that accommodate the HP 85 or HP 200 Series Controllers. The software makes possible insertion loss, return loss, and VSWR measurements. Also included is a test of the VM-7 linearity with the Weinschel 1830 Voltage Doubler.

INTERESTED? Call Toll Free!
If you’re ready to take that first step in modernization of your laboratory with the VM-7, call our toll free number 800-638-2048 to arrange for a demonstration in your lab.

ORDERING INFORMATION

<table>
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<tr>
<th>W/E MODEL OR P/N</th>
<th>DESCRIPTION</th>
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<td>Attenuator Signal Calibrator</td>
<td>$15,000.00</td>
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<tr>
<td>187-1020-000</td>
<td>Calibration Kit</td>
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<td>Digital Extender Card(^1)</td>
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<td>Rack Mount Kit</td>
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<td>Rack Mount and Chassis Slide Kit</td>
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<td>SMA Power Splitter (DC-26 GHz)</td>
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<td>RF cable, N Male to N Male, 1 meter, Metal Jacket</td>
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<td>IEEE-488 Bus Cable (1 meter)</td>
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<td>IEEE-488 Bus Cable (2 meters)</td>
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\(^1\) Included in 187-1030

Prices and specifications are subject to change without notice.

With compliments

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