Microwave Technology Training System with LVDAM-MW
8091-00

LabVolt Series

Datasheet

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09/2020

Table of Contents

General Description

The Computer-Assisted Microwave Technology Training System is a complete, state-of-the-art microwave training program that includes data acquisition and instrumentation.

Specifically designed for hands-on training, this integrated package of software, hardware, and courseware contains all power supplies, high-quality microwave components, and accessories required to perform the experiments.

The experiments are performed using the Data Acquisition and Management for Microwave Systems software (LVDAM-MW®). This modern software is built around a Data Acquisition Interface (DAI) that performs 12-bit A/D acquisition on four channels. The software uses the acquired data received from the interface to calculate and display the values of power and SWR measurements on a computer screen. This approach eliminates the need for a separate power meter and standing-wave ratio (SWR) meter, thereby providing high flexibility at a reduced cost.

The software allows the display of a dual-trace oscilloscope, as well as the automatic computation of the line parameters on a Smith Chart. The Smith Chart is used to teach how to perform impedance matching by measuring the impedance of an unmatched load, and then finding the impedance and the location where the matching device must be placed to match the load.

The software also displays a data table that allows the automatic recording of the displayed power and standing-wave ratio at the click of one button. The recorded data can be saved and all the measured parameters can be plotted on the screen in the XY plane by using the included graph function. Furthermore, the software provides control and modulation of the PIN Diode and optional Voltage-Controlled RF Oscillator.

The courseware is based on the Student Manual Microwave Fundamentals, which covers the basic principles of microwave signals (X-band), propagation, components, and measurements. The courseware further expands on microwave technologies with the studying of microwave tees, PIN diodes, and applications. Students can then implement and test a wireless video transmission system, using the provided PIN diode as a microwave AM modulator and additional video Equipment.

Wireless transmission of a microwave signal [typical distance between the antennas: 40 cm (16 in)].

Features & Benefits

- Provides hands-on, system-level training in microwave technologies in the classroom
- Uses rugged, high-quality components designed for educational purposes
- Each component is identified with standard micro-wave symbol
- Microwave devices and components fabricated from electroless-plated brass to standard X-band waveguide dimensions
- Waveguide flanges joined by patented, precision quick fasteners, allowing rapid assembly and disassembly of system configurations
- USB Data Acquisition Interface (DAI) providing the following virtual instrumentation for the LVDAM®-MW software: Power Meter, SWR Meter, Oscilloscope, Ammeter, and Voltmeter
- The DAI is "stackable" and powered by the Gunn Oscillator Power Supply, Model 9501
- Comprehensive manuals with theory, step-by-step laboratory exercises, and review questions
- Meets a variety of needs and budgets because of subsystems and options
- Highly safe: low-power operation levels
- Estimated Program Duration: 55 hours

List of Available Training Systems

Qty	Description	Model number
1	Microwave Technology Training System with LVDAM-MW	582068 (8091-00)
1	Variable RF Oscillator and Resonant-Cavity Frequency Meter	582073 (8091-10)

Additional Equipment Required to Perform the Exercises

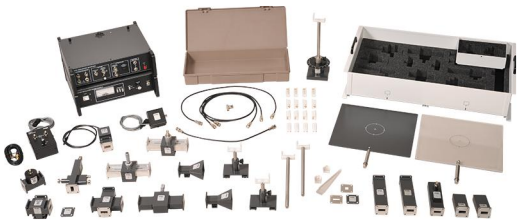
Qty	Description	Model number
1	Personal Computer	579785 (8990-00) [1]

Optional Equipment

Qty	Description	Model number
1	Power Supply / Dual Audio Amplifier	581542 (9401-00) [2]
1	Dual Function Generator	581549 (9402-10) [3]
1	FM/PM Receiver	581589 (9415-10) [4]
1	Summing Amplifier	581993 (28469-00) [5]
1	Microwave Technology Training System with LVDAM-MW (Manuals on CD-ROM)	580505 (85756-A0)

Available Training Systems

Microwave Technology Training System with LVDAM-MW 582068 (8091-00)



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The software allows the display of a dual-trace oscilloscope, as well as the automatic computation of the line parameters on a Smith Chart. The Smith Chart is used to teach how to perform impedance matching by measuring the impedance of an unmatched load, and then finding the impedance and the location where the matching device must be placed to match the load.

[2] The Power Supply / Dual Audio Amplifier, Dual Function Generator, FM/PM Receiver, and Summing Amplifier are required in order to perform the optional exercise titled "A Microwave Transmission Demonstration (Wireless)" in the Student Manual Microwave Fundamentals. Note that the Dual Function Generator and the FM/PM Receiver are powered by the Power Supply / Dual Audio Amplifier and will not function without it.

[3] The Power Supply / Dual Audio Amplifier, Dual Function Generator, FM/PM Receiver, and Summing Amplifier are required in order to perform the optional exercise titled "A Microwave Transmission Demonstration (Wireless)" in the Student Manual Microwave Fundamentals. Note that the Dual Function Generator and the FM/PM Receiver are powered by the Power Supply / Dual Audio Amplifier and will not function without it.

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[5] The Power Supply / Dual Audio Amplifier, Dual Function Generator, FM/PM Receiver, and Summing Amplifier are required in order to perform the optional exercise titled "A Microwave Transmission Demonstration (Wireless)" in the Student Manual Microwave Fundamentals.

[1] Refer to the Computer Requirements in the System Specifications section of this datasheet if the computer is to be provided by the end-user.

The software also displays a data table that allows the automatic recording of the displayed power and standing-wave ratio at the click of one button. The recorded data can be saved and all the measured parameters can be plotted on the screen in the XY plane by using the included graph function. Furthermore, the software provides control and modulation of the PIN Diode and optional Voltage-Controlled RF Oscillator.

Features & Benefits

- High-quality microwave components and accessories:
  - A Gunn diode oscillator running at 10.5 GHz in continuous wave (CW) mode or modulated by a 1-kHz square wave.
  - A Crystal Detector, a Thermistor Mount, and a Slotted Line used with the LVDAM-MW software to detect microwave signals and power, and to take SWR measurements. The Gunn Oscillator Power Supply provides power to the Data Acquisition Interface through a connector that aligns when this interface is stacked on top of the power supply.
  - An Antenna Azimuth Indicator for accurate plotting of antenna field patterns.
  - Inductive and capacitive irises used to measure reactive impedances.
  - Three lenses, a metal plate, and a dielectric plate for microwave optics experiments.
  - A PIN Diode to teach microwave switching, variable attenuation, and amplitude modulation of microwave signals
  - A Hybrid Tee to teach microwave signals' splitting and coupling.
  - An optional add-on, Model 8091-1, to teach microwave variable-frequency measurements and applications.

List of Equipment

Qty	Description	Model number
1	Gunn Oscillator Power Supply	581799 (9501-00)
1	Data Acquisition Interface	8098763 (9508-10)
1	Gunn Oscillator	581834 (9510-00)
1	Slotted Line	581836 (9520-00)
1	Thermistor Mount	581837 (9521-00)
1	Crystal Detector	581838 (9522-00)
1	Directional Coupler, 10 GHz	581839 (9523-00)
1	Slide-Screw Tuner	581842 (9530-00)
2	Matched Load	581843 (9531-00)
1	Variable Attenuator	581844 (9532-00)
1	Fixed Attenuator – 6 dB	581845 (9533-00)
1	Fixed Attenuator – 30 dB	581846 (9534-00)
2	Horn Antenna	581847 (9535-00)
1	Microwave Accessories	581849 (9536-00)
1	Hybrid Tee	581850 (9537-00)
1	PIN Diode	581851 (9538-00)
1	Video Amplifier	581904 (9587-00)
1	Leads and Accessories	581907 (9590-00)
2	Waveguide Support	581909 (9591-00)
1	Antenna Azimuth Indicator	581910 (9592-00)
1	Amplifier	581911 (9593-00)
1	Storage Tray	581919 (9599-00)
1	Storage for PIN Diode and Hybrid Tee	581920 (9599-A0)

List of Manuals

Description	Manual number
Microwave Fundamentals (Student Manual)	580503 (85756-00)
Microwave Fundamentals (Instructor Guide)	580504 (85756-10)
Microwave Data Acquisition and Management (User Guide)	580506 (85756-E0)

Table of Contents of the Manual(s)

Microwave Fundamentals (Student Manual) (580503 (85756-00))

Microwave Data Acquisition and Management (User Guide) (580506 (85756-E0))

System Specifications

Parameter	Value
Power Requirement	
Current	0.25 A
Service Installation	Standard single-phase ac outlet
Flange Type	Mates UG39/U (UBR100)
Waveguide Type	WR90 (R100, WG16)

Parameter	Value
Physical Characteristics	
Intended Location	On a table able to support the weight of the equipment
Dimensions (H x W x D)	660 x 1510 x 1190 mm (26 x 59.5 x 46.9 in)
Net Weight	23.5 kg (51.8 lb)

Variable RF Oscillator and Resonant-Cavity Frequency Meter 582073 (8091-10)

The Variable RF Oscillator and Resonant-Cavity Frequency Meter package is an add-on to the Computer-Assisted Microwave Technology Training System that contains a variable RF oscillator and a resonant-cavity frequency meter.

This add-on allows the study of variable-frequency microwave measurements and applications. It also includes the Student Manual Microwave Variable-Frequency Measurements and Applications through which students learn how to convey information over a microwave link using frequency modulation and demodulation.

List of Equipment

Qty	Description	Model number
1	Voltage-Controlled RF Oscillator	8098726 (9511-10)
1	Resonant-Cavity Frequency Meter	581840 (9524-00)
1	Storage for Frequency Measurement Devices	581921 (9599-B0)

List of Manuals

Description	Manual number
Microwave Variable-Frequency Measurements and Applications (Student Manual)	580507 (85896-00)
Microwave Variable-Frequency Measurements and Applications (Instructor Guide)	580508 (85896-10)

Table of Contents of the Manual(s)

Microwave Variable-Frequency Measurements and Applications (Student Manual) (580507 (85896-00))

- 1 Microwave Frequency Measurements
- 2 Microwave Variable-Frequency Oscillators
- 3 Microwave Frequency Modulation and Demodulation

Equipment Description

Gunn Oscillator Power Supply 581799 (9501-00)

The Gunn Oscillator Power Supply is intended for use with the Gunn Oscillator, Model 9510. The OUTPUT of the Gunn Oscillator Power Supply connects to the Gunn Oscillator, via a

power switch inside the Data Acquisition Interface.

The voltage control knob on the Gunn Oscillator Power Supply allows users to change the voltage applied to the Gunn Oscillator and so vary the output power of the Gunn Oscillator's output signal. The frequency of this signal cannot be varied and is fixed at approximately 10.5 GHz.

Specifications

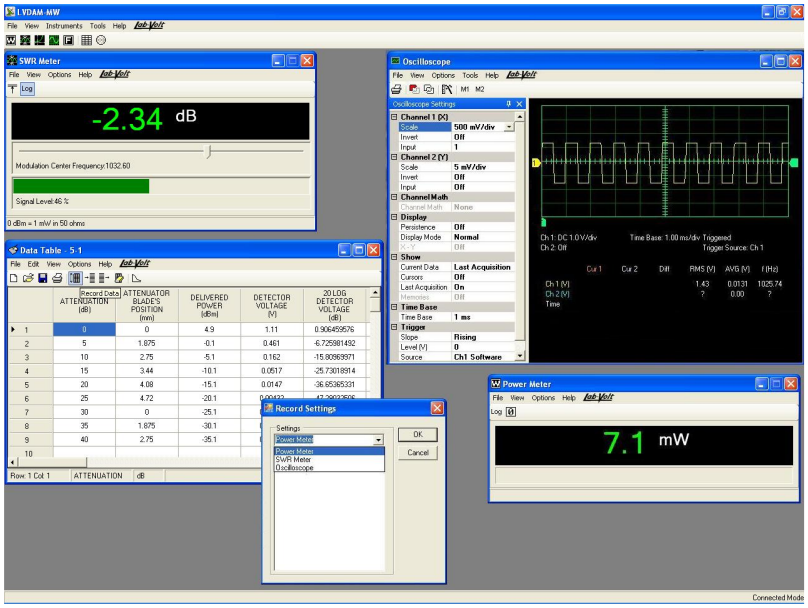
Parameter	Value
Power Requirements	
Current	0.8 A
Service Installation	Standard single-phase ac outlet
Output	0-10 V (dc or 1 kHz square wave), 500 mA

Data Acquisition Interface 8098763 (9508-10)

The Data Acquisition Interface (DAI) provides the following instrumentation for the designed LVDAM-MW software: Power Meter, SWR Meter, and Oscilloscope, thereby eliminating the need for separate instruments.

The LVDAM-MW software includes the following instrumentation: SWR Meter, Power Meter, Dual-Trace Oscilloscope, and PIN Diode Bias Meter.

- It dispenses with the need for the SWR Meter, Model 9502, Power Meter, Model 9503, or any equivalent.
- The LVDAM-MW software displays the bias voltage and current used to drive the PIN Diode, and the operating frequency of the Voltage-Controlled RF Oscillator, thereby eliminating the need for separate ammeter, voltmeter, and frequency meter.
- The software allows the user to record, save, print, import, and export data, graphs, and the Smith Chart.
- The Smith Chart has a rotatable vector and a panel that displays all the line parameter values in real-time. The user can determine the impedance of an unmatched load, as well as the impedance and the location of the device used to perform impedance matching (that is, the Slide-Screw Tuner).



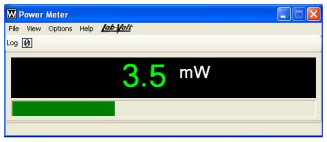
The LVDAM-MW main window shows the instrumentation and the measured values in real time. The values indicated by the Power Meter, the SWR Meter, and the Oscilloscope can be recorded in a Data Table at the click of one button. Other parameters can be entered manually in the table, such as calculated values like attenuation.

The software is built around the Data Acquisition Interface, Model 9508, that performs 12-bit A/D acquisition on four channels. The software uses the acquired data to calculate and display the values of the measured parameters. The software includes the following virtual instruments and tools:

- A Power Meter displaying either the relative power or absolute power of microwave signals.
- A SWR Meter displaying the standing-wave ratio along a waveguide or the power relative to a reference set by the user.
- A Data Table used to record and save the values of parameters measured during a work session. A Graph function allows the user to plot the relationships between the parameters.
- A Smith Chart used to evaluate the transmission line parameters: the impedance, the admittance, the SWR, the reflection coefficient, and the transmission coefficient.
- An oscilloscope displaying analog or digital waveforms.

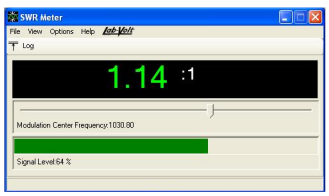
Upon launching the software, the main window appears, showing the icons of the virtual instruments (left-hand section of the toolbar) and a Settings panel in its right-hand section.

The Settings panel allows configuration of the function, the gain, and the filters of the four acquisition channels of the Data Acquisition Interface. The Settings panel aslo provide control of the PIN Diode, the power to the Gunn Oscillator Power Supply, and the optional Voltage-Controlled RF Oscillator.



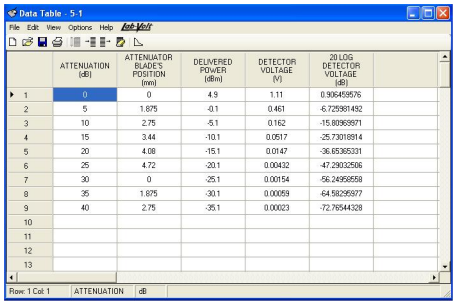
Power Meter

The Power Meter displays the relative power or absolute power of microwave signals. This meter operates with the included Thermistor Mount and a Wheatstone bridge contained in the Data Acquisition Interface.



SWR Meter

The SWR Meter displays the standing-wave ratio (SWR) in a waveguide, or the power level relative to a reference set by the user. The SWR Meter is used with the Slotted Line to measure SWRs, or with the Crystal Detector to measure relative power levels.

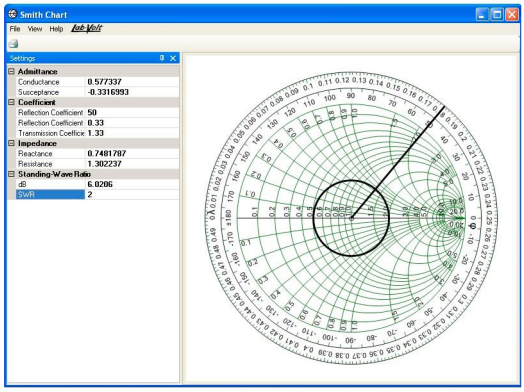


Data Table

The Data Table allows the user to record and save all the parameter values measured during a work session and then to graph these parameters using the Graph function. The power, SWR, and voltage measured with the Power Meter, the SWR Meter, and the Oscilloscope can be automatically recorded in the table at any time by clicking on a tool button. Other values, such as calculated values, can be entered manually. The table can be exported to a spread sheet application or copied to the Windows® clipboard.

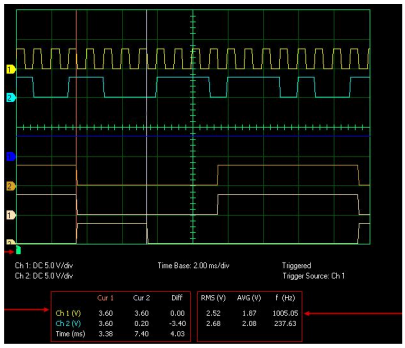
Graph

The Graph is used to plot the relationships between the parameters recorded in the Data Table. Up to three traces can be simultaneously plotted. The Graph type is selectable (linear or logarithmic). The Graph colors, the X-interval and scale, and the minimum and maximum values of the X-axis are all selectable.



Interactive Smith Chart

The Smith Chart is used to evaluate the transmission line parameters. It features a rotatable vector and a circle of constant SWR. A Settings panel indicates the line parameter values. These values are automatically computed and refreshed as the user rotates the vector, or when the user changes a parameter value. By entering the SWR of an unmatched load and moving the vector along the reflection coefficient angle scale or the wavelength scale on the outer rim of the Smith Chart, the user determines the impedance and the location of the device required to match a load.

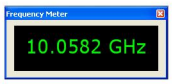


Oscilloscope

The Oscilloscope has two channels which can be associated with any of the four acquisition channels of the Data Acquisition Interface to observe the signals present on these channels. Numerical data corresponding to the displayed waveforms and to the active cursors is shown below the graticule. Two memories are used to store the traces. The display and the data can be displayed once only or continuously. A persistence function can be used to superimpose several signals on the same view. Horizontal and vertical cursors are also provided to facilitate the measurements.

PIN Diode Bias Meter

The Bias Meter of the PIN Diode allows the monitoring of the bias voltage applied to the diode and the bias current flowing through it.



Frequency Meter

The Frequency Meter displays the operating frequency of the Voltage-Controlled RF Oscillator.

Manual

Description	Manual number
Microwave Data Acquisition and Management (User Guide)	580506 (85756-E0)

Table of Contents of the Manual(s)

Microwave Data Acquisition and Management (User Guide) (580506 (85756-E0))

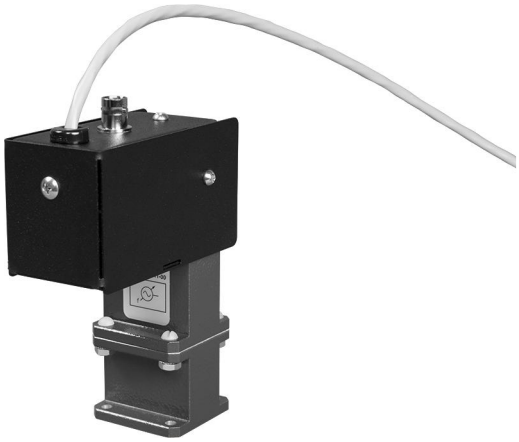
Gunn Oscillator
581834 (9510-00)

The Gunn Oscillator provides the microwave signal source used in various microwave training systems. This oscillator generates a microwave signal having a frequency of 10.525 GHz. The power of the microwave signal generated by the Gunn Oscillator can be varied by varying the voltage applied to this oscillator by the Gunn Oscillator Power Supply, Model 9501.

Specifications

Parameter	Value
Output Frequency	10.525 GHz ± 0.01 GHz
Output Power	10 mW (minimum), 25 mW (maximum)

Voltage-Controlled RF Oscillator
8098726 (9511-10)



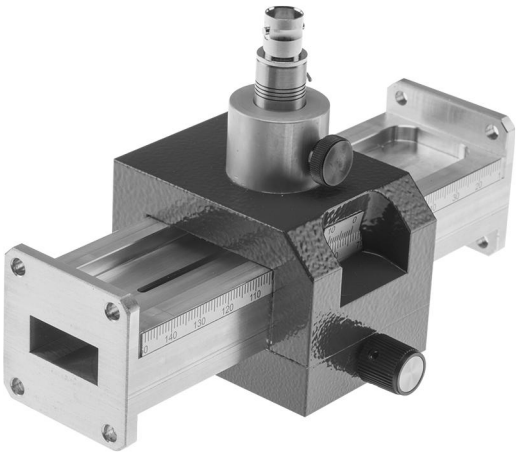
The Voltage-Controlled RF Oscillator is a module used in certain exercises of the Microwave Training System. A built-in prescaler facilitates frequency measurement of the microwave signal produced by the RF oscillator's voltage-controlled oscillator (VCO).

Specifications

Parameter	Value
Frequency Range	9.6-10.6 GHz (typical)
Control Voltage	0-10 V dc
Output Power	At least 8 dBm (6.3 mW)
Prescaler (BNC) Output	
Frequency	VCO output signal’s frequency divided by 64
Open-Circuit P-P Voltage	500 mV
Impedance	50 Ω

Parameter	Value
Modulation	Via a DB-9 connector used to apply a 1 kHz on/off modulation signal, or a frequency modulating signal.

Slotted Line
581836 (9520-00)



The Slotted Line can be used to measure the distance between the minima and the maxima of a standing wave. It consists of a low-loss waveguide section with a narrow, longitudinal slot in the top wall. A sliding carriage, containing a probe connected to a crystal detector, can be moved along the waveguide.

Specifications

Parameter	Value
Residual SWR	1.03 typical

Thermistor Mount
581837 (9521-00)

The Thermistor Mount consists of a thermistor that is permanently housed in a waveguide section. Two matching screws and a moveable short circuit are used to maximize the microwave power reaching the thermistor.

Specifications

Parameter	Value
Maximum Safe Power	50 mW

Crystal Detector
581838 (9522-00)

The Crystal Detector is required to measure power or attenuation using the SWR Meter, Model 9502.

Specifications

Parameter	Value
Tangential Sensitivity	-40 dBm (minimum)

Directional Coupler, 10 GHz
581839 (9523-00)

The Directional Coupler is of the cross-guide type and has the following characteristics:

- It is formed by the superposition of two crossed waveguides sharing a common wall.
- The waveguides are at right angles to each other.
- Two cruciform openings located a quarter wavelength (λg/4) apart are made in the common wall. These openings allow the microwave signal to couple from one guide into the other.

Specifications

Parameter	Value
Coupling Factor	20 dB ± 1 dB

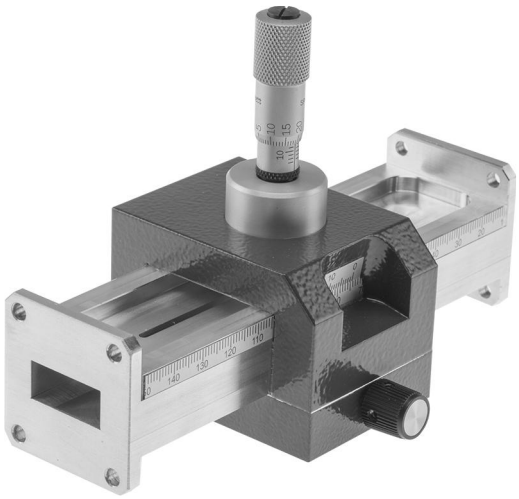
Resonant-Cavity Frequency Meter
581840 (9524-00)

The Resonant-Cavity Frequency Meter is a device used in the Microwave Training System to perform frequency measurements.

Specifications

Parameter	Value
Power Absorption Dip	0.25 dB (typical)

Slide-Screw Tuner
581842 (9530-00)



The Slide-Screw Tuner consists of a variable susceptance of adjustable position that allows the matching of a load to be carried out without calculations. The value of the reactance provided by the Slide-Screw Tuner can be varied and its position adjusted to minimize the reflection coefficient in the waveguide.

Specifications

Parameter	Value
Insertion Loss	0.2 dB

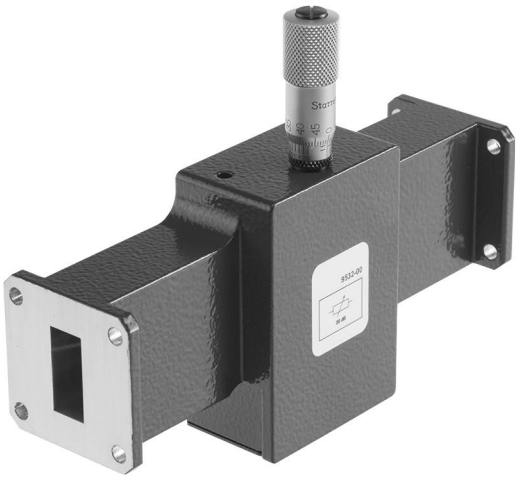
Matched Load
581843 (9531-00)

The Matched Load consists of a WR90 waveguide-type load having a standing wave ratio (SWR) of 1.03 and that operates at a frequency of 10.525 GHz (typical).

Specifications

Parameter	Value
SWR	1.03

Variable Attenuator
581844 (9532-00)



The Variable Attenuator is a device used to reduce the power level at the input of microwave components. It is of the side vane type. A plastic fiberglass blade with a resistive coating is used to produce attenuation. The blade is inserted vertically into the waveguide, parallel to the short side walls.

The attenuation produced by the attenuator depends on the position of the blade in the waveguide. The blade position can be changed by using the attenuator's micrometer. The attenuation increases as the blade is moved towards the center of the waveguide.

Specifications

Parameter	Value
Range	0 to 35 dB

Fixed Attenuator – 6 dB
581845 (9533-00)

The Fixed Attenuator – 6 dB is a WR90 waveguide-type attenuator that consists of a section of waveguide providing a fixed attenuation of 6 dB and operating at a frequency of 10.525 GHz (typical).

Specifications

Parameter	Value
Attenuation	6 dB

Fixed Attenuator – 30 dB
581846 (9534-00)

The Fixed Attenuator – 30 dB is a WR90 waveguide-type attenuator that consists of a section of waveguide providing a fixed attenuation of 30 dB and operating at a frequency of 10.525 GHz (typical).

Specifications

Parameter	Value
Attenuation	30 dB

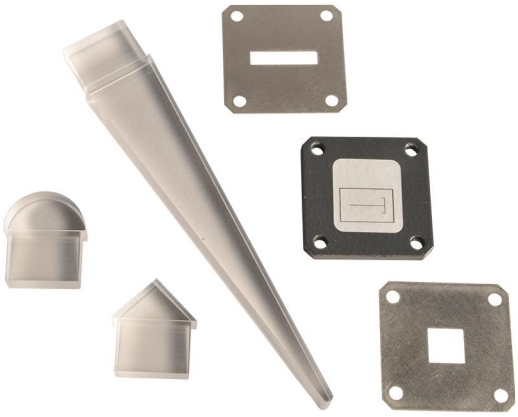
Horn Antenna
581847 (9535-00)

The Horn Antenna is used to perform experiments related to a variety of topics, such as FM-CW radar, antenna gain, and microwaves. When used in conjunction with the Radar Antenna, the Horn Antenna allows separate transmission and reception of RF signals. It is also used in certain EW demonstrations.

Specifications

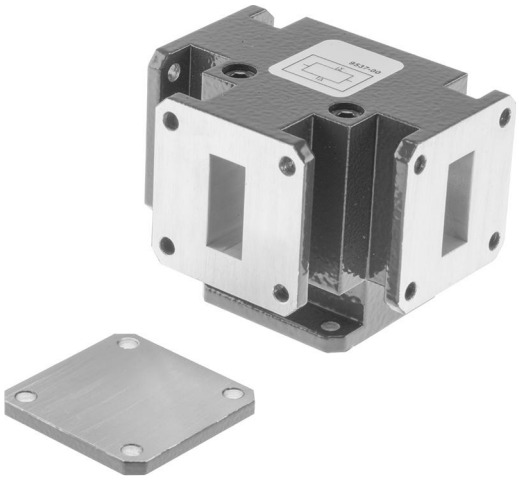
Parameter	Value
Gain	14.5 dB
Distance	Between the transmitting and receiving horn antennas: 40 cm (16 in).

Microwave Accessories
581849 (9536-00)



The Microwave Accessories is a kit of accessories that consists of a fixed short circuit, an inductive iris, and a capacitive iris used to create reactive impedance. It also contains three types of lenses (long and short triangular lenses and half-circle lens) used to change the path of microwave signals.

Hybrid Tee
581850 (9537-00)



The Hybrid Tee, also called magic tee, is a combination of a H-plane tee and a E-plane tee. It has four arms:

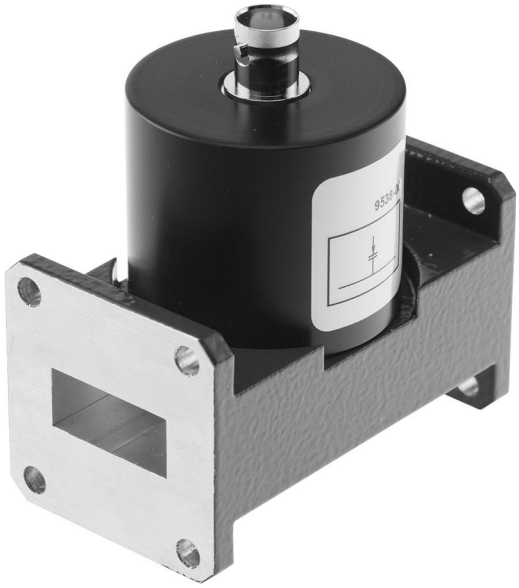
- The H-(Σ) plane arm, which is in the direction of the H (magnetic) field.
- The E-(Δ) plane arm, which is in the direction of the E (electric) field.
- Two lateral arms. The lateral arms are disposed about an imaginary plane dividing the H- and E-plane arms symmetrically.

The Hybrid Tee is used to split a microwave signal into two even signals and to combine two microwave signals into a single signal.

Specifications

Parameter	Value
Hybrid Tee	180° hybrid, 3 dB coupling

PIN Diode
581851 (9538-00)



The PIN Diode is a semiconductor device that acts like a variable resistor at microwave frequencies. The resistance of the diode is controlled by varying the dc current used to forward bias the diode.

PIN diodes are used in numerous microwave and wireless applications, including those listed below.

- Microwave switching.
- Variable attenuators. PIN diode attenuators can be designed as matched or reflective.
- Amplitude modulation and leveling of microwave signals.
- Microwave phase shifters.

Specifications

Parameter	Value
PIN Diode	
Type	GaAs
Maximum Attenuation	At approximatively 10.525 GHz
Internal Resistor	A 620 Ω resistor is internally connected between the BNC input of the PIN Diode and the diode itself.
Control Signals	The bias and modulation signals used to control the diode are provided by the Data Acquisition Interface.

Video Amplifier
581904 (9587-00)

The Video Amplifier is a video signal amplifier that has a gain adjustable up to 50 dB and a bandwidth of 5 MHz.

Specifications

Parameter	Value
Video Amplifier	
Gain	Adjustable up to 50 dB (maximum)
Input Impedance	600 Ω
Output Impedance	75 Ω
Bandwidth	5 MHz

Leads and Accessories
581907 (9590-00)

The Leads and Accessories kit contains the various cables and accessories required to perform the exercises in the program training manuals. The accessories package contains the following parts: two different lengths of coaxial cables terminated with BNC connectors, a BNC T-connector, microwave quick fasteners, a plastic reflector and a steel reflector. These accessories are provided in a convenient plastic storage case.

Waveguide Support
581909 (9591-00)

The Waveguide Support consists of a set of supports allowing the secure mounting of microwave setups at various heights.

Antenna Azimuth Indicator
581910 (9592-00)

The Antenna Azimuth Indicator is a rotating support that is used to turn the mast of an antenna over a 360° range. A graduated scale on the mast indicates the current orientation of the antenna.

Amplifier
581911 (9593-00)

The Amplifier is a low-noise, high-gain audio amplifier that is used to amplify the signals produced by the Crystal Detector, Model 9522, and the Slotted Line, Model 9520.

Storage Tray
581919 (9599-00)

The Storage Tray consists of a storage box for storing equipment included in the Microwave Technology Training System, Model 8090.

Storage for PIN Diode and Hybrid Tee
581920 (9599-A0)

The Storage for PIN Diode and Hybrid Tee consists of a small storage box for storing the PIN Diode, Model 9538, and the Hybrid Tee, Model 9537, included in the Microwave Technology Training System, Model 8090.

Storage for Frequency Measurement Devices
581921 (9599-B0)

The Storage for Frequency Measurement Devices consists of a long storage box for storing the different frequency measurement devices included in the Microwave Technology Training System, Model 8090.

Optional Equipment Description

Personal Computer (Optional)
579785 (8990-00)

The Personal Computer consists of a desktop computer running under Windows® 10. A monitor, keyboard, and mouse are included.

Specifications

Parameter	Value
Power Requirements	
Current	2 A
Service Installation	Standard single-phase ac outlet

Power Supply / Dual Audio Amplifier (Optional)
581542 (9401-00)

The Power Supply / Dual Audio Amplifier module forms the physical base for the analog and digital communications training systems, and can be used in several other training systems. It is double-width to accommodate two instructional modules or two instrument modules in a side-by-side configuration. A two-channel audio amplifier with headphone jacks and speakers accommodates FM stereo and narrowband FM and AM receiver outputs.

The power supply distributes power to the complete system and provides three regulated dc voltage outputs (15 V – 0.5 A; -15 V – 0.5 A; +5 V – 1 A) on the faceplate. Also unregulated voltages are distributed to the system modules through a connector located on each module. These unregulated voltages are regulated within each module to provide the required voltages. Each regulated supply has an LED indicator that shuts off if the supply is overloaded due to equipment malfunction or if a faulty power connection is made to external equipment.

Specifications

Parameter	Value
Power Requirement	
Current	3.5 A
Service Installation	Standard single-phase ac outlet
Power Outputs	
Unregulated Power Bus	±25 V typ. – 3 A max; -25 V typ. – 3 A max.; +11 V typ. – 5 A max.
Regulated Front Panel	±15 V – 0.5 A; + 5 V – 1 A
Dual Audio Amplifier Rating	
Bandwidth	50 Hz to 15 kHz

Parameter	Value
Input Impedance	10 kΩ
Nominal Output Power	250 mW
Sensitivity (at nominal output power)	140 mW
Output Impedance (intermediate outputs)	1 kΩ
Maximum Output Level (open-circuit)	20 V p-p
Protection	
AC Line Input	Circuit breaker
DC Regulated Outputs	Foldback current-limiting
DC Unregulated Outputs	Circuit breaker
Physical Characteristics	
Dimensions (H x W x D)	104 x 687 x 305 mm (4.1 x 27 x 12 in)
Net Weight	15.8 kg (34.8 lb)

Dual Function Generator (Optional) 581549 (9402-10)

The Dual Function Generator consists of two independent function generators (A and B), each capable of generating a sine-wave signal, a square-wave signal, a triangular-wave signal, a sawtooth-wave signal, and a pulse signal with variable pulse-width. The signal frequency can be varied from 10 Hz to 100 kHz through four ranges. A digital display is pushbutton-selectable between generators A and B to monitor the frequency of each generator. Each generator output signal level is continuously variable and may be attenuated by push button-selected switch attenuators. TTL output signals are provided to synchronize external equipment, such as an oscilloscope. Generator A may be frequency-modulated by a signal from generator B or from an external source.

The module is fully protected against short circuits and misconnections. Students use the instruments to make measurements in laboratory experiments performed on AM, FM, and digital communications systems.

Specifications

Parameter	Value
Power Requirement	±25 V typ. – 3 A max; -25 V typ. – 3 A max.; +11 V typ. – 5 A max.
Generators (A & B) Rating	
Waveforms	Sine, triangle, square, sawtooth, or pulse
Pulse Duty Cycle	10 to 90 %
Frequency Ranges	10-100 Hz, 100-1000 Hz, 1-10 kHz, 10-100 kHz
Frequency Display (switchable between A & B)	4 digits
Output Impedance	50 Ω
Output Level (open circuit)	10 mV p-p to 10 V p-p
Attenuator	0, 20, or 40 dB
Synchronization Outputs	One for each channel (SYNC/TTL)
Frequency Modulation (Channel A only)	
Input Impedance	100 kΩ
Maximum Frequency Deviation	50 % of each side of the rest frequency
Input Level for Maximum Deviation	10 V p-p
Physical Characteristics	
Dimensions (H x W x D)	162 x 330 x 300 mm (6.4 x 13 x 11.8 in)
Net Weight	4.4 kg (9.7 lb)

FM/PM Receiver (Optional)
581589 (9415-10)

The FM/PM Receiver offers training in multiplex and wideband FM (covering commercial broadcast techniques), narrowband FM (widely used in commercial and military communications systems), and PM reception. PM reception is used in such applications as satellite communications, data communications, over narrowband communications systems, telephone lines, microwave communications lines and links.

When the FM/PM Receiver is connected with the Direct FM Multiplex Generator, a complete commercial FM system is established. Students can readily see the effects of stereo signal generation, multiplexing techniques, and modulation. When the FM/PM Receiver is connected to the Indirect FM/PM Generator, a narrowband FM communications link is established, allowing the student to explore the generation and reception of narrowband FM and PM signals.

RF inputs to the receiver are between 88 and 108 MHz for stereo and wideband FM, and 10.7 MHz for narrowband FM and PM. A demodulated audio signal is available at the NBFM audio output when a signal is injected at the RF input. When the output of the crystal discriminator is connected to the input of the integrator, a demodulated audio signal is available at the PM audio output.

The WBFM section is equipped with two 50 Ω RF inputs, a balanced 300 Ω RF input for an external antenna connection, and an RF tuning knob which allows tuning across the 88- to 108-MHz band.

A 3-LED tuning indicator and a 10-LED bar graph display (indicating received signal level) facilitate accurate tuning. The presence of the 19 kHz pilot signal illuminates an LED also. A 2½ digit display can show the frequency deviation of the received WBFM or NBFM signals. These meters are often used on modern communications receivers.

Receiver outputs for FM left and right stereophonic channels, monophonic FM, NBFM, and PM are provided, as well as an SCA channel audio output, often used for background music programming.

Specifications

Parameter	Value
Power Requirements	
Power Requirements	+25 V dc - 275 mA
	+11 V dc - 200 mA
	-25 V dc - 150 mA
WBFM Section	
Input Impedance	2 inputs at 50 Ω, 1 input at 300 Ω (balanced)
50 Ω Input Sensitivity	55 µV (typical for both inputs for 10 dB S/N at baseband output)
300 kΩ Input Sensitivity	15 µV (typical for 10 dB S/N at baseband output)
AUX IF Input Impedance	50 Ω
Control	RF tuning
RF Tuning Range	88 to 108 MHz
Intermediate Outputs	IF (10.7 MHz), baseband
Indicator	Deviation (switchable between WBFM and NBFM)
PM/NBFM Section	
Input Frequency	10.7 MHz
Input Impedance	2 inputs at 50 Ω
Input Level Sensitivity	3 mV (typical for 100 mV p-p at NBFM audio output)
Audio Outputs	

Parameter	Value
L, R, L + R Bandwidth	50 Hz to 15 kHz
SCA, NBFM, PM Bandwidth	200 Hz to 3 kHz
Impedance	1 kΩ (all outputs)
Fault-Insertion Switches	12
Test Points	35
Indicators	Center tuning, signal level, pilot (19 kHz), deviation display (2½ digits), Power ON
Physical Characteristics	
Dimensions (H x W x D)	162 x 330 x 300 mm (6.4 x 13.0 x 11.8 in)
Net Weight	4.7 kg (10.3 lb)

Summing Amplifier (Optional)
581993 (28469-00)

The Summing Amplifier is an audio amplifier used for wireless microwave transmission. The amplifier adds the signal produced at the output of the Gunn Oscillator Power Supply, Model 9501, to a modulating audio signal. The resulting signal is applied to the Gunn Oscillator, Model 9510, for transmission into space.

Manual

Description	Manual number
A Microwave Transmission Demonstration (Student Manual)	583984 (28500-00)

Table of Contents of the Manual(s)

A Microwave Transmission Demonstration (Student Manual) (583984 (28500-00))

- 1 A Microwave Transmission Demonstration

Specifications

Parameter	Value
Typical input voltage	1 V peak-to-peak

Microwave Technology Training System with LVDAM-MW (Manuals on CD-ROM) (Optional)
580505 (85756-A0)

List of Manuals

Description	Manual number
Microwave Fundamentals (Student Manual)	591690 (85756-00)
Microwave Fundamentals (Instructor Guide)	591692 (85756-10)
Microwave Data Acquisition and Management (User Guide)	591694 (85756-E0)

Reflecting the commitment of Festo Didactic to high quality standards in product, design, development, production, installation, and service, our manufacturing and distribution facility has received the ISO 9001 certification.

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