

Description

The increasing use of microwaves, in applications ranging from satellite and terrestrial communications to high-speed computing and data transmission, has resulted in a short-fall of appropriately trained engineers and technicians.

Over three quarters of all microwave circuits are now non-waveguide. The swing towards microstrip technology must be reflected in the courses offered at engineering education institutes.

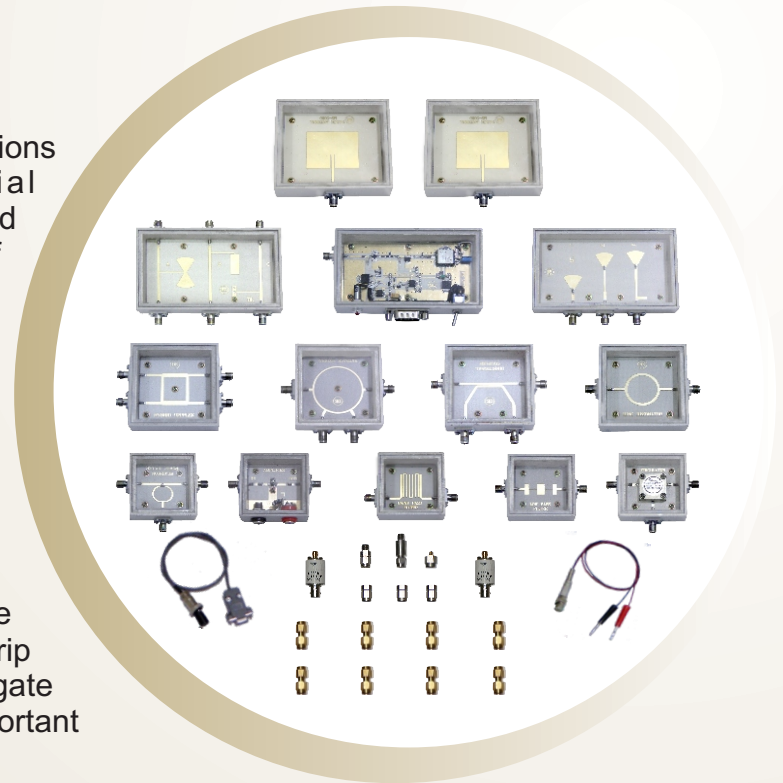
BE; recognizing the urgent need for suitable training equipment, have developed a microstrip trainer which will provide the means to investigate the technology and techniques used in this important subject area.

MS3000 Microstrip Trainer comprises 18 passive circuit components, 2 active circuits and all the leads and connectors required to construct a variety of commonly used configurations, many of which incorporate microwave integrated circuits (MICs).

The instruction manual supplied with MS3000 provides a comprehensive introduction to the subject in a manner which avoids unnecessary mathematical analysis and provides a series of structured practical assignments.

The only items of test equipment required are a digital multimeter and a 0-20V dc power supply.

Ms3000 Mircostrip Trainer covers the training requirements for most courses in microwave engineering at undergraduate level courses.



Features

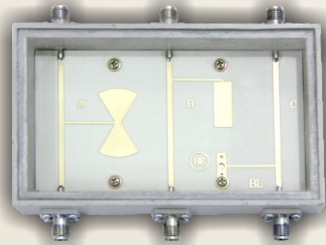
- Latest Microwave surface mount Technology
- 2.0-4.0 GHz VCO
- Gold Plated RF laminate with PTH
- No costly test equipment required
- Safe low power output
- Conveniently packed for inventory control



The complete MS-3000 Microstrip Trainer consists of :

PASSIVE COMPONENTS

- 2 Patch antenna
- 1 DC Biasing unit
- 1 Three-port circulator
- 1 Hybrid ring (rat-race) coupler
- 1 Ring resonator
- 1 Band Pass Filter
- 1 Quadrature coupler
- 1 Unmatched load
- 1 Directional coupler
- 1 Wilkinson power divider
- 3 50 ohm loads
- 1 Short-circuit termination.
- 1 10dB/5dB attenuator
- 1 Crystal detector
- 1 Low-pass filter
- 1 Matched load



Most of the components are packaged in bright aluminum enclosures and their interconnection is by standard SMA couplings; providing secure but easily made joints.

The trainer is designed to be used with basic test equipment: a DC power supply and a digital multimeter; in conjunction with the calibration curves supplied with each VCO and detector.

Realistic quantitative results can easily be achieved with this simple set-up; however the quality of construction allows MS3000 to be used with more sophisticated microwave test instruments if these are available.

ACTIVE COMPONENTS

- 1 Voltage Controlled Oscillator (VCO)
- 1 S-band MMIC amplifier
- 1 Pin Diode Modulator (Optional)

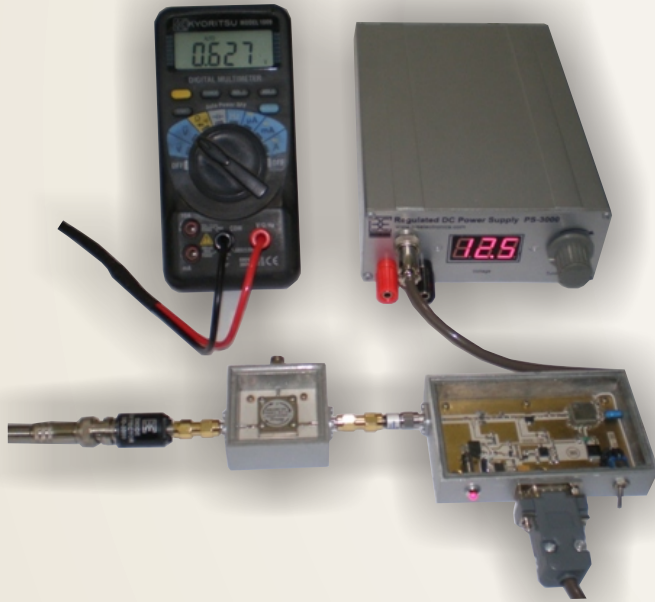


MISCELLANEOUS

- 8 SMA plug-plug connectors
- 1 BNC -dual Banana Pins
- 1 DB(9)-Circular lead
- 2 4mm Banana leads.
- 1 Spanner.
- VCO and Detector calibration curves

The MS3000 is supplied in a well protected, robust carrying Aluminum brief case.





The practical work is presented under the following general headings:

- Power Source and detector action
- Action of a 3-port circulator.
- Insertion loss measurement on low-pass filter And Band Pass Filter
- Measurement of return loss, reflection coefficient and VSWR of a filter, microstrip and commercial matched loads.
- Matching investigations: reflection coefficient of unknown resistive load and its matching by $1/4 \lambda_g$ transformer and shunt stub.
- Properties of a power divider and rat-race coupler.
- Measurement of effective dielectric constant and line loss using a ring resonator.
- DC biasing and MMIC amplifier investigations.
- Quadrature coupler investigations
- Microwave radio link and antenna investigations.

The Assignments

The manual provides a series of structured and stand alone assignment; using mostly the passive components: Introduction to microstrip, microwave integrated circuit (MIC) technology and microwave measurement techniques. Further assignments encourage the student to build up complete systems incorporating the active circuits.

The individual units of both active and passive components are designer for compatibility and easy interconnections, thus ensuring that circuits such as a Line-of-Sight Link or simple Frequency Modulated Continuous Wave (FMCW) can be built and tested with minimum difficulty.

The basic principles and techniques of microwave signal processing using microstrip are simply and comprehensively presented, so that the trainer is ideal for use by engineers and technicians working in a variety of different areas of application, including:

- **Satellite communication**
- **Radar**
- **Surveillance-Security systems**
- **Instrumentation**
- **Medical electronics**
- **Data transmission**

MS3000 Microstrip Trainer Complete Experimental Workstation

A complete workstation is also available comprising the supply and a digital multimeter.

Specification

Patch antenna

Two microstrip patch antenna supplied.

Centre frequency:	2.7 ±0.05GHz
Gain:	6dBi (typical)
Return loss:	-17dB
impedance:	50 ohm

Bias network

This components consist of three types of 50 bias lines. Two a.c and one d.c, all utilizing the quarter wavelength transformer.

Bias line type	Insertion loss (dB)	
	2.7GHz	Full band (2-4 GHz)
Butterfly	0.02	0.12
Pad	0.02	0.11
Direct d.c short	0.02	0.08

Three-port circulator

insertion loss:	0.4dB (max at 3GHz)
Insertion loss:	0.5dB (max 2.5 -2.9GHz)
Isolation:	16 - 24dB (full band 2.5 - 2.9GHz)

Hybrid ring (rat-race) filter

This is a standard hybrid-ring (or 'rat-race') coupler.

Center frequency:	2.7 +0.1GHz
Insertion loss (at center frequency):	-3.2dB
Bandwidth:	400MHz
Isolation	25dB (typical)
Impedance:	50

Ring resonator

A loose-coupled resonant ring designed to resonate at a fundamental frequency of approximately 2.7GHz in its n = 2 mode. This component is used to measure the dielectric constant of the printed circuit board.

Low-pass Filter

A 5-section, L-C type microstrip low-pass filter.

Pass band (nominal)	dc - 2.7GHz
Stop band:	3dB point at 3GHz (approx) rising to 20dB at 20% above cut-off.
Impedance:	50 ohm

Matched load

A quarter wavelength long terminated in a standard, 50 ohm, thick film, chip resistance.

Center frequency:	2.7GHz
Return loss:	-20dB
Input impedance:	50 ohm

Unmatched load

Three 50 ohm input lines terminated in unknown resistive loads. One incorporates a $\lambda/4$ transformer with a center frequency = 3GHz, and one uses an open-circuit shunt stub element.

Wilkinson power divider

Center frequency:	2.7GHz
Operating band:	2 - 4GHz
Insertion loss:	3.5 ±0.25dB
Isolation:	20dB (typical)
Tracking:	0.15dB (typical over full band)
Impedance:	50 ohm

Voltage controlled oscillator

The VCO is supplied with its own calibration curve and amplifier

Frequency range:	2.0 - 4.0GHz
Tuning voltage range:	1 - 20V
Power output:	10dBm (typical into 50 ohm)
Modulated output frequency:	1kHz ±50Hz
Modulation waveform	Square wave
Modulator indicator:	2Hz Flashing LED
DC supply voltage:	15V fix (fully protected)
DC supply current:	50mA (maximum)
Supply connectors:	DB9 connector sockets

S-band MMIC Amplifier

Gain:	+12dB (typical)
Compression point:	+12dBm (typical)
Frequency range:	2 - 4GHz
Input impedance:	50 ohm
Output impedance	50 ohm
Supply voltage:	15V (fully protected)
Supply current:	40mA (typical)
Supply connectors:	4mm sockets

Band Pass Filter

Pass band :	2.5 - 2.6GHz
Band width :	100 MHz
impedance :	50 ohm

Ancillary equipment

Power Supply:	15V dc 0 - 20V dc variable 1.0 A Regulated DC Power Supply PS-3000 is recommended
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Power requirements

power supplies:	15V dc 1.0A
VCO tuning voltage:	0 - 20V dc 1.0A

Dimensions & Weight (in protective case)

Width: 430mm (17in) Height: 310mm (12in) Depth: 89mm (3.5in)
Weight: 4.5kg (9.92 lbs)

Tender Specification

A Microwave integrated Circuit trainer using microstrip components and operating in the 2 - 4GHz band. To contain 18 passive components. 3 active components and all necessary connectors and leads. Complete with instruction manual providing at least 11 assignment.

