

Complete Microstrip System

MST532-1



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 shortfall 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 provided at engineering education establishments.

Feedback Instruments, in conjunction with UNL Microwaves, recognising 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.

The MST532-1 comprises eighteen passive circuit components, three 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 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 0-30V dc dual power supply, both supplied with the MST532-1 but not the MST532.

The MST532-1 is complementary to the Feedback 56-200 Microwave Trainer, which uses type WG16 Waveguide. The two equipments together cover the teaching requirements for most courses in microwave engineering.

The Trainer is also available with the MIDE Design Software option. The software enables the student to investigate the principles of Microstrip transmission in greater depth and can also be used for component design (see Ordering Information for options).

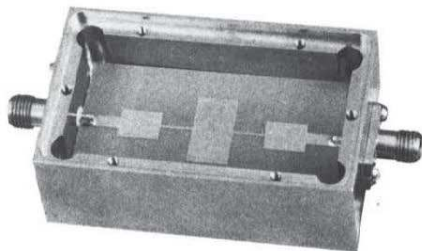
Features

- Covers the latest Microwave technology
- 2.4 to 3.7 GHz VCO
- 2 to 4 GHz PIN diode modulator
- No costly test equipment required
- Safe low power output
- Can be used with MIDE Design Software
- Modules conveniently packed for inventory control
- Modules available as individual items

The complete MST532 Microstrip Trainer consists of:

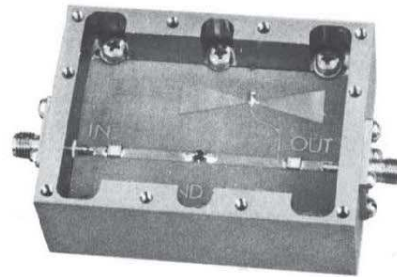
PASSIVE COMPONENTS

- 2 Patch antennas.
- 1 DC Biasing unit
- 1 Three-port circulator.
- 1 Hybrid ring (rat-race) coupler.
- 1 Ring resonator.
- 1 Low-pass filter.
- 1 Matched load.
- 1 Unmatched load.
- 1 Directional coupler.
- 1 Wilkinson power divider.
- 3 50Ω loads.
- 1 Short-circuit termination.
- 1 Open-circuit termination.
- 1 20dB attenuator.
- 1 Crystal detector.



ACTIVE COMPONENTS

- 1 Voltage Controlled Oscillator (VCO).
- 1 S-band MMIC amplifier.
- 1 PIN diode modulator.



MISCELLANEOUS

- 8 SMA plug-plug connectors.
- 1 SMA-BNC adaptor.
- 2 BNC-4mm leads.
- 5 4mm-2mm leads.
- 1 Spanner.
- VCO and Detector calibration curves.

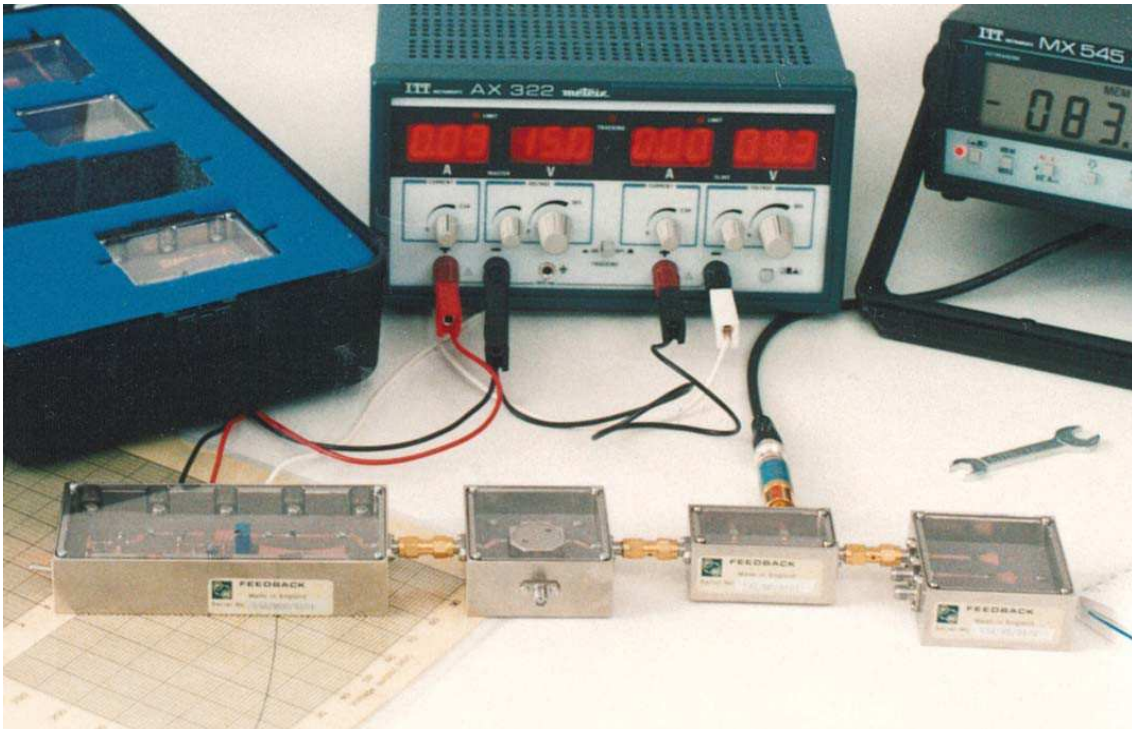
The MST532 is supplied, well protected, in a robust carrying case



Most of the components are packaged in bright nickel-plated aluminium 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 dual d.c 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 MST532 to be used with more sophisticated microwave test instruments if these are available.



The Assignments

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

The only pre-requisite information is knowledge of basic electronics, which may be acquired by using the Feedback Electrical & Electronics Constructor EEC470.

The individual units of both active and passive components are designed for compatibility and easy interconnection, 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 fuss.

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

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 a low-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 $\frac{1}{4} \lambda_g$ 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
- D.C. biasing and MMIC amplifier investigations
- Microwave radio link and antenna investigations

MST532-1 Microstrip Trainer Complete Experimental Workstation

A complete workstation is also available comprising the Microstrip Trainer together with a dual d.c. power supply and a digital multimeter.

Specification

Patch Antennas

Two microstrip patch antennas are supplied:

Centre frequency:	3.0 \pm 0.05 GHz
Gain:	8 dBi (typical)
Return loss:	-17 dB (typical at 3 GHz)
Impedance:	50 ohm (typical at centre frequency)

Bias network

This component consists of three types of 50 ohm bias lines, two a.c. and one d.c., all utilising the quarter wavelength transformer:

Bias line type	Insertion loss (dB)	
	3 GHz	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:	0.4 dB (max at 3 GHz)
Insertion loss:	0.5 dB (max 2-4 GHz)
Isolation:	16-24 dB (full band 2-4 GHz)

Hybrid ring (rat-race) filter

This is a standard 10 degree hybrid-ring (or Rat-race) coupler.

Centre frequency:	3.0 \pm 0.1 GHz
Bandwidth:	-3.2 dB
Isolation:	400 MHz
Impedance:	50 ohm

Ring resonator

A loose-coupled resonant ring designed to resonate at a fundamental frequency of approximately 3 GHz in its n=2 mode. This component is used to measure the dielectric constant of the printed circuit board.

Low-pass filter

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

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

Matched load

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

Centre frequency:	3 GHz
Return loss:	-30 dB (minimum)
Input impedance:	50 ohm

Unmatched load

Three 50 ohm input lines terminated in unknown resistive loads. One incorporates a $1/4\lambda$ transformer with a centre frequency $\cong 3$ GHz, and one uses an open-circuited shunt stub element.

Wilkinson power divider

A standard Wilkinson power divider using a standard 100 ohm chip resistance as the isolating element.

Centre frequency:	3 GHz
Operating band:	2-4 GHz
Insertion loss:	3.5 ± 0.25 dB
Isolation:	20 dB (typical)
Tracking:	0.15 dB (typical over full band)
Impedance:	50 ohm

Voltage controlled oscillator

The VCO is supplied with its own calibration curve and amplifier.

Frequency range:	2.4-3.7 GHz
Power output:	12 dBm (typical into 50 ohm)
Tuning voltage range:	2-30V
Modulated output frequency:	1 kHz (variable 900 – 1100 Hz)
Modulation waveform:	Square wave
Modulator indicator:	2 Hz flashing LED
d.c. supply voltage:	15-30 V (fully protected)
d.c. supply current:	50 mA (maximum)
Supply connectors:	4 mm sockets

S-band MMIC amplifier

Gain:	+15 dB (typical)
Compression point:	-12 dB (typical)
Frequency range:	1.5-4 GHz
Input impedance:	50 ohm
Output impedance:	50 ohm
Supply voltage:	15-30V (fully protected)
Supply current:	30 mA (typical)
Supply connectors:	2 mm sockets

PIN diode Modulator

Frequency range:	2-4 GHz
Insertion loss (ON):	-1 dB (typical)
Insertion loss (OFF):	-6dB (typical)
Bias current (ON):	28mA (typical)
Impedance:	50 ohm

Ancillary equipment

Power supply:	Dual output 30 V d.c. 0 to 30 V d.c. variable, 2.5 A Feedback dual power supply is recommended
Multimeter:	Feedback bench-top digital multimeter is recommended

Power requirements

Power supplies:	30 V dc 2.5 A
VCO input:	0 – 30 V d.c. 2.5 A

Dimensions and Weight (in protective case)

Width:	520 mm (20.5”),
Height:	380 mm (15”),
Depth:	125 mm (4.8”),
Weight:	5 kg (11lb).

Tender Specification

A Microwave integrated circuit trainer using microstrip components and operating in the 2-4 GHz band. To contain 18 passive components, three active components and all necessary connectors and leads. Complete with instruction manual providing at least ten assignments.

Ordering Information

Complete Microstrip System	MST532-1
(Consists of MST532, Dual d.c. power supply and digital multimeter)	
Microstrip Trainer	MST532

Ordering Information with optional MIDE software

MIDE Microstrip System	56-001
(Consists of Microstrip Trainer MST532, MIDE Design Software, dual d.c. power supply and digital multimeter)	
MIDE Microstrip	56-100
(Consists of Microstrip Trainer and MIDE Software)	
MIDE Microstrip Design Software	56-901


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Feedback reserves the right to change these specifications without notice.