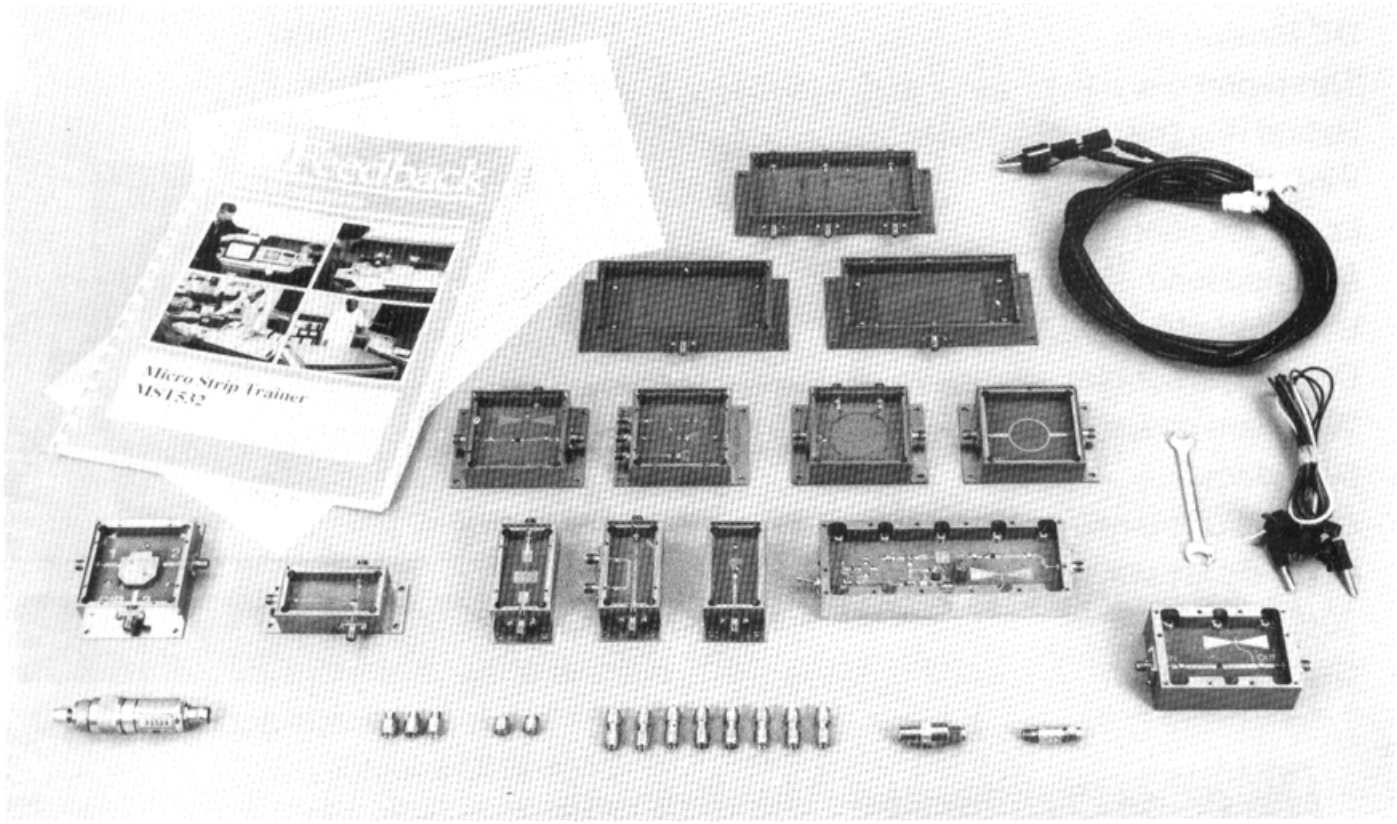
Feedback

MICROSTRIP TRAINER

MST532



Description

The increasing use of microwaves, in applications ranging from satellite and terrestrial comrnunications 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 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.

MST532 Microstrip Trainer comprises 18 passive circuit components, 3 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 MST532 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 d.c dual power supply.

MST532 is complementary to the Feedback MWT530 Microwave Trainer, which uses type WG16 Waveguide, and the two equipments together cover the teaching requirements for most courses in microwave engineering.

Features

- **Latest microwave technology**
- **2.4-3.7GHz VCO**
- **2-4GHz PIN diode modulator**
- **No costly test equipment required**
- **Safe low power output**
- **Conveniently packed for inventory control**

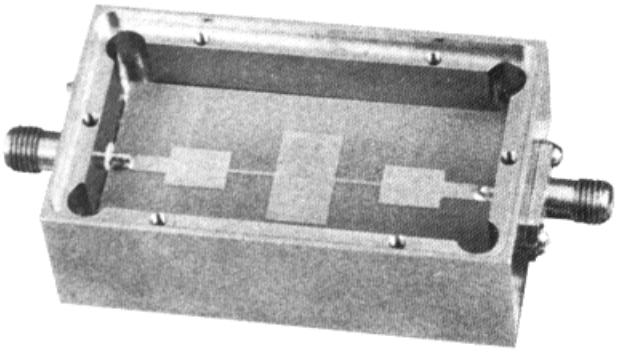
Printed in England by FI Ltd, Crowborough 1096

Telecommunications - D532

The complete MST532 Microstrip Trainer consists of:

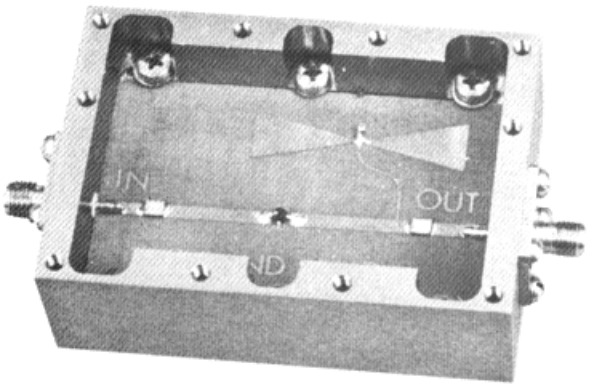
PASSIVE COMPONENTS

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

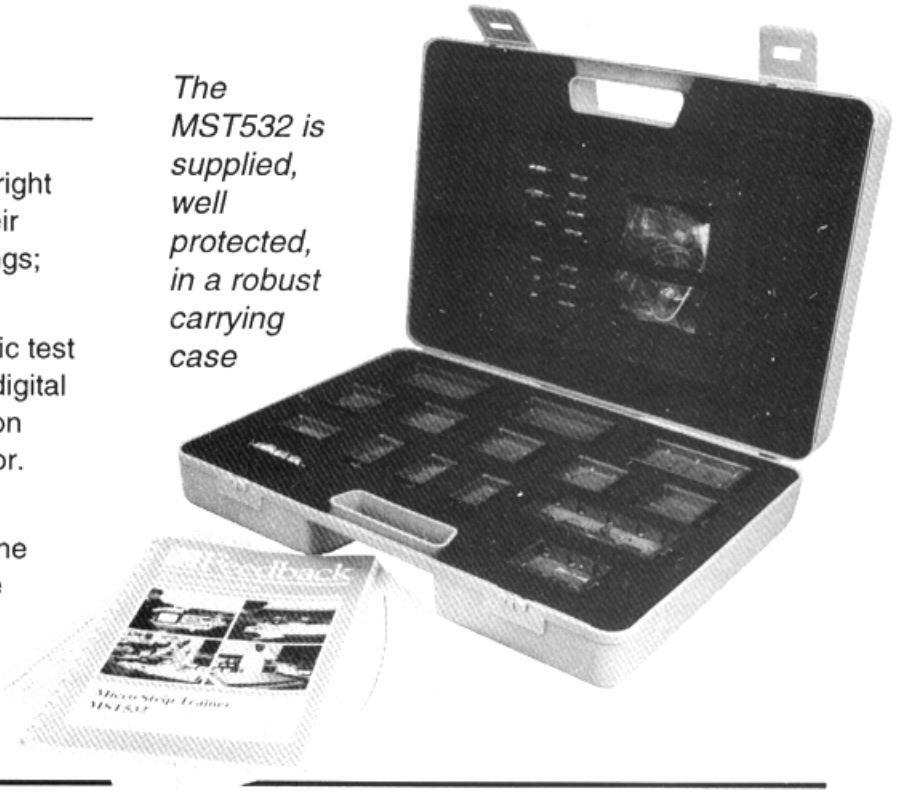
8 SMA plug-plug connectors.
1 SMA-BNC adaptor.
2 BNC-4mm leads.
5 4mm-2mm leads.
1 Spanner.
– VCO and Detector calibration curves.

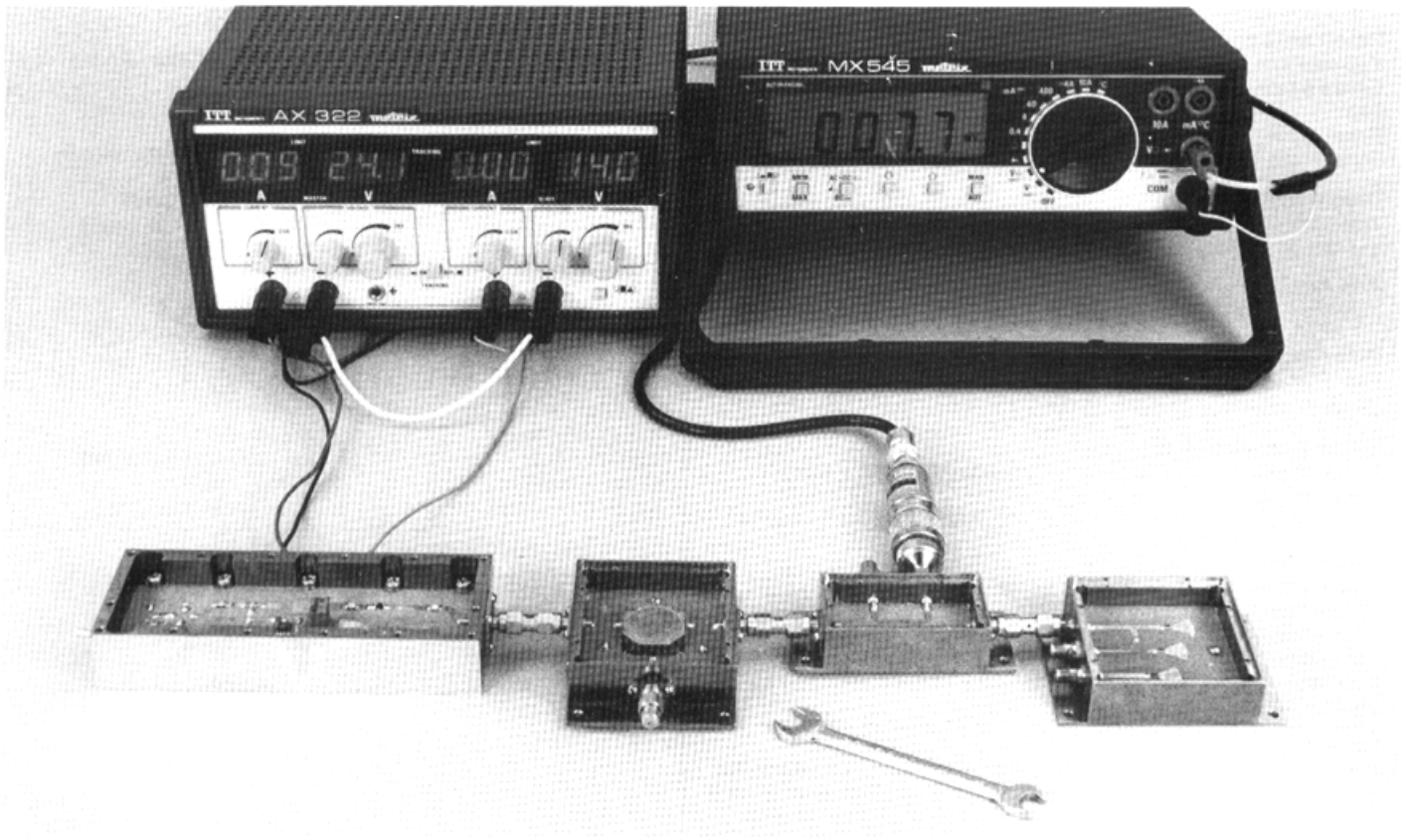
Most of the components are packaged in bright nickel-plated aluminium enclosures and their interconnection is by standard SMA couplings; providing secure but easily made joints.

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





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 prerequisite information is a 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 $^1/_4\lambda g$ 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.**
- **PIN diode modulator 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 ±0.05GHz
Gain:	8dBi (typical)
Return loss:	−17dB (typical at 3GHz)
Impedance:	50Ω (typical at centre frequency)

Bias network
This components consists of three types of 50Ω bias lines, two a.c and one d.c, all utilising the quarter wavelength transformer:

Bias line type	Insertion loss (dB)	
	3GHz	*Full band (2-4GHz)*
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 - 4GHz)
Isolation:	16 - 24dB (full band 2 - 4GHz)

Hybrid ring (rat-race) filter
This is a standard 10° hybrid-ring (or 'rat-race') coupler.

Centre frequency:	3.0 ±0.1GHz
Insertion loss (at centre frequency):	−3.2dB
Bandwidth:	400MHz
Isolation:	25dB (typical)
Impedance:	50Ω

Ring resonator
A loose-coupled resonant ring designed to resonate at a fundamental frequency of approximately 3GHz 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 - 3GHz
Stop band:	3dB point at 3GHz (approx) rising to 20dB at 20% above cut-off.
Impedance:	50Ω

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

Centre frequency:	3GHz
Return loss:	−30dB (minimum)
Input impedance:	50Ω

Unmatched load
Three 50Ω input lines terminated in unknown resistive loads. One incorporates a $^1/_4\lambda$ transformer with a centre frequency = 3GHz, and one uses an open-circuited shunt stub element.

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

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

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

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

S-band MMIC amplifier

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

PIN diode modulator

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

Ancillary equipment

Power Supply:	Dual output	30V dc 0 - 30V dc variable 2.5A Feedback Dual Power Supply 1810-00665 is recommended.
Multimeter:		Feedback Benchtop Digital Multimeter 1810-00985 is recommended.

Power requirements

Power supplies:	30V dc 2.5A
VCO input:	0 - 30V dc 2.5A

Dimensions & Weight *(in protective case)*
Width: 520mm (20.5in) **Height**: 380mm (15in) **Depth**: 125mm (4.8in)
Weight: 5kg (11 lb)

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 10 assignments.

Ordering Information

Order: 'Microstrip Trainer	MST532'
Order: 'Microstrip Trainer Complete Experimental Workstation (532, 1810-00665, 1810-00985)	MST532-1'

For further information on these & other equipments in the Telecommunications range contact. . . . . .

Feedback

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