Feedback

Teknikit TELECOMMUNICATIONS WORKSTATIONS

Series 53

Telecommunications Trainers with *Discovery* Software
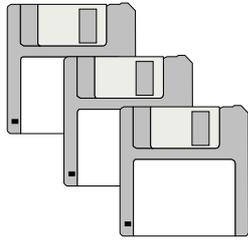
- **Analogue Communications**
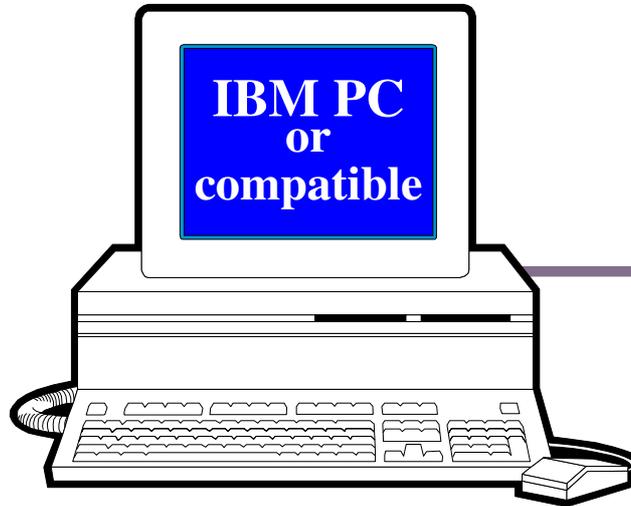- **Digital Communications**

Technology Training for tomorrow's world

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ISO 9002 Certificate No.12478

NATIONAL ACCREDITATION OF CERTIFICATION BODIES Registration Number 010

Teknikit Series 53 Range

**IBM PC
or
compatible**

Discovery
Software

MICA
PC
Card

53-100
RAT
Interface

53-110
Signal
Sources

53-120
Tuned Circuits
& Filters

53-130
Amplitude
Modulation

Workboards

53-140
Frequency
Modulation

53-150
Sampling &
Data Formatting

53-160
Modulation
& Keying

53-170
PCM & Link
Analysis

Features

- **Complete laboratory training system.**

- **Analogue and Digital Telecommunications.**

- **Suitable for both technician and undergraduate training.**

- **Integrated hardware and software.**

- *Discovery* **software for control, instrumentation and CAL.**

- **On-screen background theory and questions.**

- **No costly additional instrumentation required.**

Description

Communication is an essential part of modern living and the telecommunications industry is one of the world's fastest growing. The demand for technicians and engineers with knowledge of the principles of this area of technology must increase with this growth.

Teknikit with *Discovery* software is a modern, PC-based, computer controlled Telecommunications training system that has been designed to introduce and demonstrate the principles of modern electronic telecommunications systems.

Teknikit is a combination of hardware work-boards with innovative *Discovery* software, which together provide a totally integrated delivery system for teaching a wide spectrum of analogue and digital transmission and reception concepts and applications, from the characteristics of individual components to the use of complex systems.

Complete Systems

A **Teknikit** Workstation consists of:

- Workstation computer
- Rapid Access Terminal (RAT) interface system
- One or more **Teknikit** workboards
- **Teknikit** *Discovery* Software

Rapid Access Terminal (RAT)

The Rapid Access Terminal (RAT) is a fast Analogue to Digital converter which samples the signals at the test points on the workboards through two analogue input channels at rates from 10Hz to 100MHz.

The RAT also carries the digital signals which are used to configure the workboard switch points for each particular experiment. Two 16-bit digital input ports and two 16-bit digital output ports are provided.

The RAT is connected to the workstation computer via connecting cables and a Feedback MICA16 interface card which plugs into an expansion slot in the PC. All workboards have a multi-way connector at the rear of each board, which plugs directly into the RAT interface.

The RAT includes a power supply, which provides all necessary voltages required by the workboards.

Discovery Software

In combination with the hardware, *Discovery* Software forms an innovative and motivating teaching method, which enables a wide range of assignments to be performed. The *Discovery* Software Packs provide a complete Graphical User Interface (GUI) environment. *Discovery* supplies all the instruction and measurement requirements of the assignments: a mouse-driven menu system provides access to background theory, practical control, instructions and questions. The integrated PC-based instrumentation includes an oscilloscope, a spectrum analyser, a digital voltmeter, a frequency meter, an X-Y recorder and a bit error rate meter. Test points on each workboard to which this instrumentation may be connected are mouse-selected, the computer doing the connection automatically. These test points are also available as pins on the workboards, to which conventional instrumentation may be connected, if desired.

Computer configuration of the workboards eliminates practical set-up time, ensuring that the correct connections are automatically made. This significantly increases the time available for actual practical work and the efficiency of laboratory sessions.

Curriculum Support

In addition to the integral *Discovery* software, each Workstation is supported by two types of printed manual: workbooks and installation guides.

An Instructor's Manual and a Student Workbook are provided with each workstation. The Student Workbook has been designed to be used alongside the on-screen *Discovery* software. For each assignment, the Learning Outcomes and Competencies are listed and students demonstrate their achievement of competence by satisfactorily completing the Workbook. This involves such activities as supplying missing keywords, completing block diagrams, making measurements, sketching waveforms, etc. The Workbook has sections for answering the on-screen *Discovery* questions. In addition, the Workbook is a valuable revision aid for students, as the key points of the theoretical and background work to assignments are also included. The Instructor's Manual differs from the Student's Workbook in that specimen answers to the student activities and questions are provided.

Manuals are also provided for each Workstation which detail the hardware and software installation and operation, the editing facility, circuit diagrams, etc.

Additional packs comprising one Instructor's Manual and 15 Student Workbooks are available for class use.

PC Requirements

To operate *Discovery* software an IBM-AT, or compatible, microcomputer is required with the minimum specification as follows:

> **286-16 processor (386-25 or better preferred)**
>
> **512kB minimum base memory**
>
> **40MByte HDD**
>
> **1.44MByte 3.5in FDD**
>
> **VGA colour monitor and card (640 x 480 pixels x 16 colours)**
>
> **MS-DOS operating system, version 4, or higher**
>
> **Standard keyboard**
>
> **Mouse, Microsoft compatible, with Microsoft Mouse Driver, version 8.2, or later.**

If required, Feedback can provide a suitable computer entirely compatible with the system.

Curriculum Coverage

The Analogue Communications Workstation has been designed to provide a self-contained trainer suitable for use in courses where it is required to give students knowledge of the basic principles and techniques of Analogue Communications and the circuits and systems using them.

Wherever possible, the approach of the assignment work is essentially non-mathematical, making the workstation ideal for technician training. However, the range of assignment work allows more complex analysis to be carried out, extending the application of the trainer to undergraduate teaching.

The *Discovery* Software assignments provided with the **Teknikit** Analogue Communications Workstation are:

Wien Bridge Oscillator
- Basic Wien bridge oscillator
- Amplitude stabilisation
- Changes from standard

L-C Oscillator
- Tuned-collector oscillator
- Effect of supply variations

Crystal Oscillator
- Fundamental and overtone modes

Multivibrator
- Basic multivibrator
- Effect of supply variations
- Mark/space ratio control

Audio Low-Pass Filters
- Passive low-pass filter
- Passive low-pass filter, swept frequency
- Active low-pass filter
- Active low-pass filter, swept frequency

RF Selectivity
- Tuned circuit, sinusoidal signal
- Tuned circuit, swept frequency
- Tuned circuit, transient response
- Crystal filter
- Crystal filter, swept frequency

RF Bandpass Filters
- Coupled L-C circuits
- Coupled L-C circuits, swept frequency
- Ceramic filter
- Ceramic filter, swept frequency

Tuned Amplifier with Gain Control
- Gain control
- Automatic gain control
- Frequency response with AGC
- Decibel gain

Amplitude Modulation with Full Carrier
- A simple amplitude modulator
- Envelope detection
- Product detection

Amplitude Modulation with No Carrier
- Double sideband suppressed carrier
- Generation of single sideband (SSB)
- Demodulation of SSB

Generation of Frequency Modulation
- Concepts of frequency modulation
- Frequency modulator
- FM spectrum with large modulation index

Demodulation of FM Signals
- Quadrature detector
- Phase locked loop (PLL) detector

Limiters and Effect of Noise on FM Demodulation
- Quadrature detector with limiter
- Effect of noise on an FM detector
- Effect of a limiter on a PLL detector
- Effect of noise on a PLL detector

Description

Signal Sources
The Signal Sources workboard is an open fibreglass circuit board mounted on a moulded base which contains the following circuit blocks:

- **Wien bridge oscillator**
- **L-C oscillator**
- **Crystal oscillator**
- **Multivibrator**

With these circuits students can examine the principles of RC, LC and crystal oscillators, feedback, loop gain, amplitude stabilisation, sinusoidal oscillation, distortion and spectrum frequency stability.

Tuned Circuits & Filters
The Tuned Circuits and Filters workboard is an open fibreglass circuit board mounted on a moulded base which contains the following circuit blocks:

- **Signal generator**
- **Low pass filter**
- **Band pass filter**
- **Amplifier with AGC**

With these circuits students can examine the principles of passive filters, R-C and L-C tuned circuits, Q loading, low-pass crystal filters, active filters, tuned amplifiers, and automatic gain control (AGC).

Amplitude Modulation
The Amplitude Modulation workboard is an open fibreglass circuit board mounted on a moulded base which contains the following circuit blocks:

- **Signal generation**
- **Modulation**
- **Filters**
- **Demodulation**

With these circuits students can examine the principles of balanced modulation, carrier suppression, double sideband suppressed carrier, filters, single sideband, envelope detectors and noise effects.

Frequency Modulation
The Frequency Modulation workboard is an open fibreglass circuit board mounted on a moulded base which contains the following circuit blocks:

- **Signal generation**
- **Modulator**
- **Limiter**
- **Quadrature demodulator**
- **VCO**
- **Phase comparator**

With these circuits students can examine the principles of voltage controlled oscillators (VCOs), phase locked loops (PLLs), Bessel functions, quadrature detection and noise effects.

Curriculum Coverage

The Digital Communications Workstation provides a self-contained trainer suitable for use in courses where it is required to give students knowledge of the basic principles and techniques of Digital Communications and circuits and systems using them.

As for the Analogue Workstation, the approach is essentially non-mathematical, making the workstation ideal for technician training, but also with the ability to extend the application of the trainer to undergraduate teaching.

The *Discovery* Software assignments provided with the **Teknikit** Digital Communications Workstation are:

Sampling
- Sampling
- Sample & hold
- Aliasing
- Pulse Amplitude Modulation

A to D Conversion
- Quantisation
- Coding
- Companding
- Aliasing

A to D Conversion
- Unipolar NRZ
- Unipolar RZ
- Unipolar biphase
- Bipolar RZ
- Bipolar NRZ

- Bipolar biphase
- Ternary (Alternate Mark Inversion (AMI))
- Manchester Coding

Clock recovery
- Phase Locked Loop (PLL)
- Phase ambiguity
- Local fixed frequency

Data recovery
- Sample point
- Integrate and dump

Synchronisation
- Asynchronous
- Synchronous
- False sync suppression
- Frame Patterns

Amplitude Shift Keying (ASK)
- On-off ASK
- Production of on-off ASK Signal
- Detection of on-off ASK, diode detector
- Detection of on-off ASK, square-law detector
- Production of suppressed carrier ASK
- Demodulation of suppressed carrier ASK

Frequency Shift Keying (FSK)
- Operation and Characteristics of VCO
- Production of FSK Signal
- FSK Demodulation using a tuned circuit
- FSK with RZ data
- FSK Demodulation using a PLL

Phase Shift Keying (PSK)
- Phase shift Modulation
- PSK modulation, <90 degrees
- PSK demodulation, <90 degrees
- PSK modulation, 90 degrees
- PSK demodulation, 90 degrees

Costas Loop Demodulator
- Demodulation by Costas Loop
- Performance with respect to filters

Quadrature Phase Shift Keying (QPSK)
- Data format for QPSK
- QPSK transmission
- QPSK demodulation

Differential Phase Shift Keying (DPSK)
- Generation of DPSK
- DPSK Modulation
- DPSK Demodulation

Differential Quadrature Phase Shift Keying
- DQPSK Modulation
- DQPSK Demodulation

Digital Communications Fundamentals
- Information
- Time and frequency domain
- Spectrum of a pulse train

Multiplexing
- TDM of analogue signals
- TDM of digital signals, bit stuffing
- Intersymbol interference

PCM Encoding
- Digital codes
- Coding Efficiency
- Information transfer rate
- Signalling rate
- System capacity

Noise
- Sources of noise
- S/N ratio in AM, PM and FM
- Quantisation noise
- Companding
- Effect of S/N ratio on PCM signal

Errors
- Probability of bit errors
- Bit error rate
- Effect of data format and keying on error rate
- Error detection

Error correction
- Retransmission ARQ
- FEC Hamming code
- CRC and Polynomial codes for error bursts

Efficiency considerations
- Efficiency considerations

Time division multiplexing (TDM)
- Synchronous
- Asynchronous

Fibre Optic Link
- Fibre Optic Link

Description

Sampling and Data Formatting

The Sampling and Data Formatting workboard is an open fibreglass circuit board mounted on a moulded base which contains the circuits necessary for the study of the principles of:

- **Sampling and Aliasing**
- **Analogue to Digital Conversion**
- **Data Formatting**
  - Unipolar
  - Bipolar
  - AMI
  - NRZ
  - RZ
- **Manchester Code**
  - Data recovery techniques
  - Clock regeneration
  - Bit & frame synchronisation
  - Digital to analogue conversion

Modulation and Keying

The Modulation and Keying workboard is an open fibreglass circuit board mounted on a moulded base which contains circuits for the study of Carrier Modulation methods:

- **Amplitude shift keying (ASK)** (unipolar and bipolar biphase) including suppressed carrier
- **Frequency shift keying (FSK)** (biphase)
  - Phase shift keying (PSK)(<90°& =90°) (biphase)
- **Quadrature phase shift keying (QPSK)** (biphase)
- **Differential phase shift keying (DPSK)**
- **Differential quadrature phase shift keying (DQPSK)**
  - Demodulation methods for amplitude, frequency and phase modulated carriers
  - Phase locked loop demodulation and Costas loops.

Pulse Code Modulation and Link Analysis

The PCM and Link Analysis workboard is an open fibreglass circuit board mounted on a moulded base which contains circuits and a simplex fibre optic link to demonstrate:

- **Time Division Multiplexing (TDM)**
  - Two channel
  - Asynchronous
  - Synchronous
- **Pulse Code Modulation (PCM)**
- **Word & Frame Forms**
- **Generation and Detection of Parity**

- **Attenuation and Noise Effects**
  - Error Detection and Correction
  - Hamming code
- **CRC and error rate analysis**
- **Effects of data format and keying methods on error rate**
- **Data transmission efficiency considerations**

ANALOGUE AND DIGITAL COMMUNICATIONS WORKSTATION

53-003

The Analogue and Digital Communications Workstation provides all the equipment required to cover the studies of the Analogue Communications Workstation and of the Digital Communications Workstation training packages, without duplication of equipment.

Teknikit Tender Specifications

Teknikit Analogue Communications Workstation   53-001

A self-contained, open-board based, Analogue Telecommunications trainer using software control and computer-assisted instruction. The system should contain a 100Msample/s Rapid Access Terminal and interface to IBM, or compatible microcomputer, Signal Sources, Tuned Circuits and Filters, Amplitude Modulation and Frequency Modulation workboards and accompanying software.
The system should operate with computer aided laboratory software which provides on-screen instruction, control and instrumentation. Thirteen computer-based assignments are provided with the system.

Teknikit Digital Communications Workstation   53-002

A self-contained, open-board based, Digital Telecommunications trainer using software control and computer-assisted instruction. The system should contain a 100Msample/s Rapid Access Terminal and interface to IBM, or compatible microcomputer, Digital Data Formatting, Modulation and Keying and PCM and Link Analysis workboards and accompanying software. The system should operate with computer aided laboratory software which provides on-screen instruction, control and instrumentation. Twenty computer-based assignments are provided with the system.

Teknikit Analogue and Digital Communications Workstation   53-003

A self-contained, open-board based, Analogue and Digital Telecommunications trainer using software control and computer-assisted instruction. The system should contain a 100Msample/s Rapid Access Terminal and interface to IBM, or compatible microcomputer, Signal Sources, Tuned Circuits and Filters, Amplitude Modulation, Frequency Modulation, Digital Data Formatting, Modulation and Keying and PCM and Link Analysis workboards and accompanying software. The system should operate with computer aided laboratory software which provides on-screen instruction, control and instrumentation. Thirty three computer-based assignments are provided with the system.

Teknikit Telecommunications Workstation Product Numbers

Listed below are the product numbers of the constituent parts of the three Communications Workstations. Each of the workstations may be ordered as a complete system, using the composite order numbers given at the start of the relevant section. However, should you wish to cover only part of the described curriculum you may not need all of the modules in the workstation. In such cases you may order just the modules that you do require. Please contact either your local agent, or Feedback, if you require more information.

Equipment in Teknikit Analogue Communications Workstation Composite	53-001
Rapid Access Terminal (RAT)	53-100
Signal Sources	53-110
Tuned Circuits & Filters	53-120
Amplitude Modulation	53-130
Frequency Modulation	53-140
Discovery Analogue Communications Software	53-901

Equipment in Teknikit Digital Communications Workstation Composite	53-002
Rapid Access Terminal (RAT)	53-100
Digital Data Formatting	53-150
Modulation & Keying	53-160
PCM & Link Analysis	53-170
Discovery Digital Communications Software	53-902

Equipment in Teknikit Analogue & Digital Communications Workstation Composite	53-003
Rapid Access Terminal (RAT)	53-100
Signal Sources	53-110
Tuned Circuits & Filters	53-120
Amplitude Modulation	53-130
Frequency Modulation	53-140
Digital Data Formatting	53-150
Modulation & Keying	53-160
PCM & Link Analysis	53-170
Discovery Analogue Communications Software	53-901
Discovery Digital Communications Software	53-902

Optional Equipment

Analogue Communications Workstation Additional Manual Pack	53-801
Digital Communications Workstation Additional Manual Pack	53-802

Ordering Information

To order any of the **Teknikit** Communications Workstations simply quote the title and number of the workstation, as given at the start of each section.