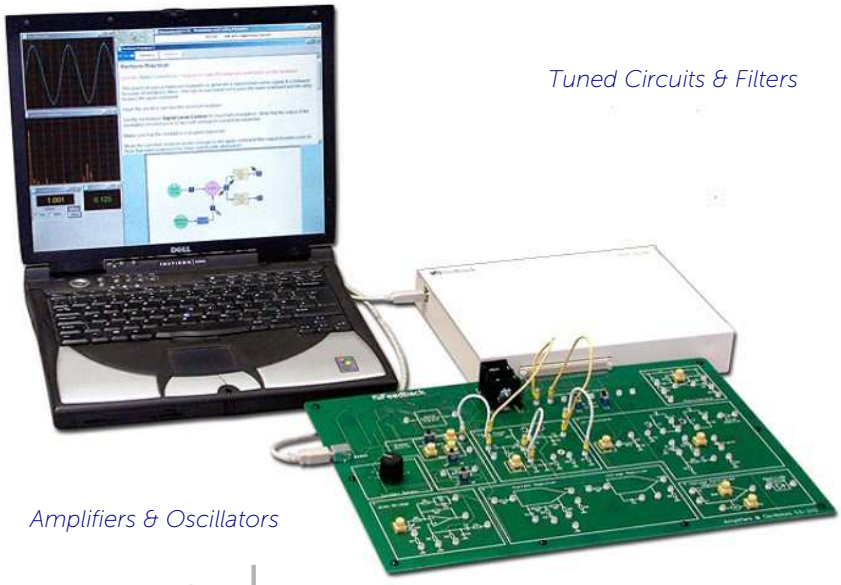
Feedback

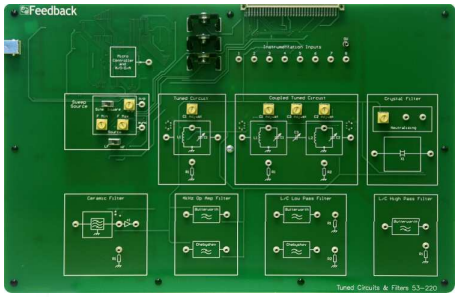
Engineering Teaching Solutions

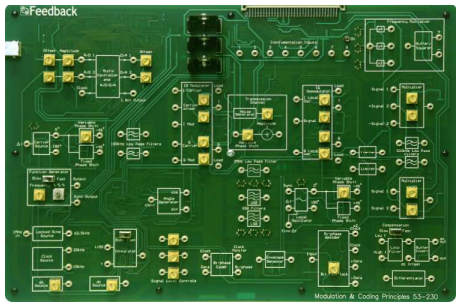
Analogue & Digital Telecommunications 53-004



Amplifiers & Oscillators

Tuned Circuits & Filters





Modulation & Coding

espial

Description

This modern training system provides a learning platform that involves the interaction between hardware, software, PC and the student. The close integration of the hardware work board with computer-based instruction and instrumentation software provides the student with a rich learning environment with all the necessary learning materials and tools available at the student's finger tips.

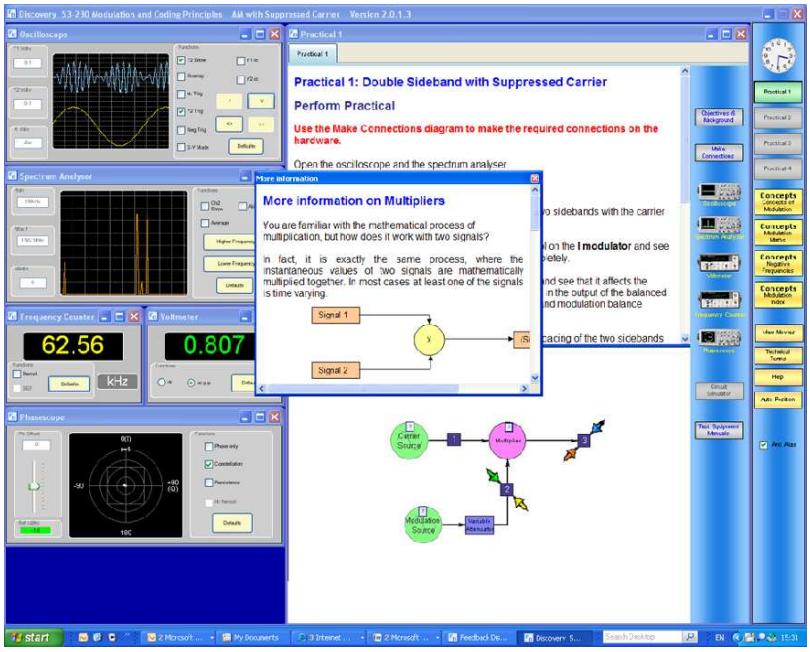
The 53-004 consists of three work boards- Amplifier and Oscillators 53-210, Tuned Circuits and Filters 53-220, Modulation and Coding 53-230 and a 92-203 USB Real-time Access Terminal (RAT) with all the necessary power supplies for the work boards included.

The Espial Software Package (93-420) is essential for use with the 53-004 (or any of the work boards 53-210, 53-220 & 53-230), but is not included so needs to be ordered separately. It comprises full student instruction for performing the many assignments and practical activities together with relevant background and theoretical information combined with editing tools.
The software also provides the instrumentation required for the monitoring and measurement of the workboard signals. Additional software is also available for adding multimedia materials, ESPIAL Course Manager (93-410 - optional). See the separate ESPIAL datasheet for a details.

Features

- Suitable for both technician and undergraduate teaching
- Complete trainer, requires only a PC
- Computer based assignments
- Covers:-
  Tuned Circuits & Filters
  Amplifiers and Oscillators
  Modulation & coding
- Integrated hardware and software environment
- On-screen background, theory and practical instructions
- Software provides embedded Instrumentation. Includes Automatic Bode & Nyquist plot and Constellation meter
- No costly additional instrumentation required
- Stand-alone workstation
- Assignment editing and creation software available

ESPIAL Courseware is supplied with a number of Feedback products with the related subject material, student assignments supporting theory and integrated instrumentation as part of the software structure. This predetermined format can be changed and tailored to specific requirements. Using the ESPIAL Software Package (93-420) and ESPIAL Course Manager (93-410), it is possible to write new student assignments, edit existing assignments, and develop new course material for products that use this version of ESPIAL Courseware.



Typical ESPIAL screen as seen by the student showing some of the software instruments:

- Oscilloscope
- Spectrum Analyser
- Voltmeter
- Frequency Counter
- Phasor Scope

The Assignment practical instruction is shown along with a block diagram for the circuit being studied and in a second window launched by the student further theoretical background information related to the subject being studied.

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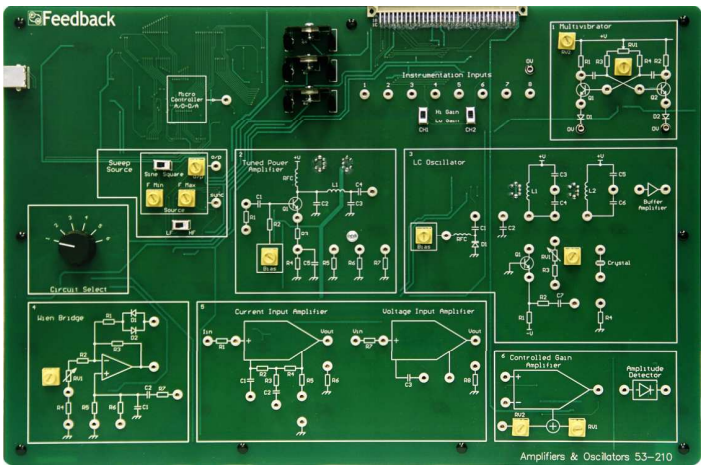
Amplifiers & Oscillators Workboard 53-210

This very important area of study forms the basis in the understanding of the many circuits that are employed to transmit and receive signals in the variety of formats used in communication systems today. The Amplifiers and Oscillators work board contains numerous circuits that are studied individually and collectively by interconnecting the circuits together. This wide range of circuits consist of a Signal source, Tuned power amplifier, LC oscillator, Multivibrator, Wein-Bridge oscillator, Current and Voltage amplifiers, Controlled gain amplifier, Amplitude detector and Buffer amplifier. Each circuit is explored to emphasise the fundamental characteristics in application using the comprehensive instrumentation provided in the software. The workboard is connected to a PC via a USB Real-time Access Terminal (92-203 RAT). The RAT also provides all the necessary power supplies for the work board to operate.



Workboard showing circuit block diagrams

Curriculum coverage

Familiarisation
Equipment connection and operation
Using ESPIAL Software

Voltage Amplifier
Amplifier gain and phase characteristic
Amplifier input resistance
Amplifier output resistance

Current Input Amplifier
Amplitude and phase response
Amplifier input resistance
Amplifier output resistance

Controlled Gain Amplifier
Gain controlled amplifier
Automatic gain control

LC Oscillator (Part 1)
The tuned amplifier Using the GPA (Gain Phase Analyser) Requirements for oscillation Oscillator stability

LC Oscillator (Part 2)
Loading and buffering
Varicap diode tuning

Crystal Oscillator
Fundamental frequency operation
Overtone operation

Wein-Bridge Oscillator
Oscillation point analysis
Amplitude Stability

Multivibrator
The basic Multivibrator Multivibrator additional components (Mark/space ratio control)

Power Amplifier (Part 1)
Tuned power amplifier
Amplifier input resistance
Effect of different load resistances

Power Amplifier (Part 2)
Variation of gain with bias voltage
Variation of efficiency with bias voltage

Multivibrator
The basic Multivibrator Multivibrator additional components (Mark/space ratio control)

LC Oscillator (Part 2)
Loading and buffering
Varicap diode tuning

Crystal Oscillator
Fundamental frequency operation
Overtone operation

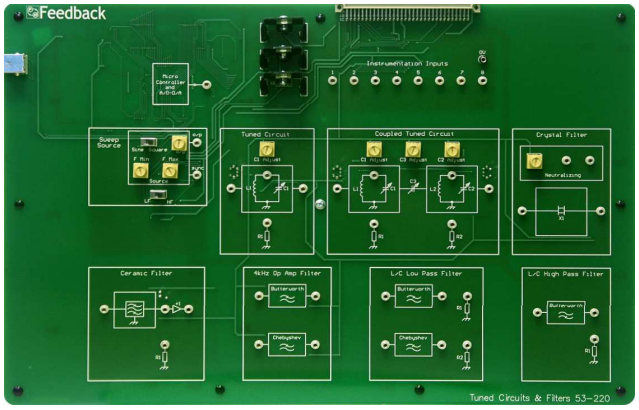
Wein-Bridge Oscillator
Oscillation point analysis
Amplitude Stability

Power Amplifier (Part 1)
Tuned power amplifier
Amplifier input resistance
Effect of different load resistances

Power Amplifier (Part 2)
Variation of gain with bias voltage
Variation of efficiency with bias voltage

Tuned Circuits and Filters Workboard 53-220

The Tuned Circuits and Filters work board covers this subject area by examining individual circuit elements in depth, utilising the extensive range of software instruments provided with the product. Subject study involves determination of fundamental operating frequencies, phase and gain relationships, cut-off frequency, pass band, roll-off, and the plotting of Bode and Nyquist responses. The imbedded software tools make the measurement and display of these characteristics very straight forward with almost instant display of the measurement results from the appropriate test instrument. These results can be displayed in a resizable instrument window to enable the detail of the characteristics to be examined if necessary. The Tuned Circuits and Filters work board contains



A variety of circuits that are studied individually and collectively by interconnecting the various circuits together. These circuits consist of a Sweep source, Tuned circuit, Coupled tuned circuit, Crystal oscillator, Ceramic filter, 4 KHz amplifier, LC low pass filter, and LC high pass filter.

Curriculum coverage

Familiarisation
Equipment connection and operation
Using ESPIAL Software

Active Filters
Butterworth active low pass filter
Chebyshev active low pass filter
Higher order active filter

LC low Pass Filters
Butterworth LC low pass filter
Chebyshev LC low pass filter
Higher order LC filter

LC High Pass Filter
Butterworth filter

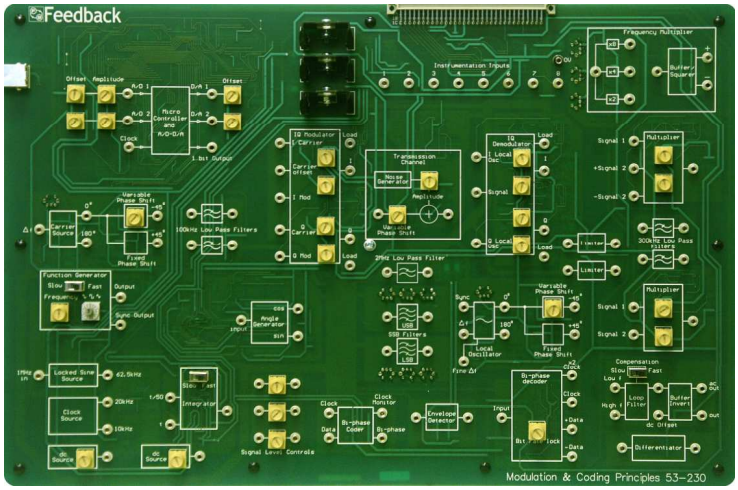
Tuned Circuit
Frequency response using the GPA (Gain Phase Analyser)
Loading the tuned circuit
Transient response

Coupled Tuned Circuit
Frequency response (single circuit)
Coupled frequency response
Loading the coupled circuit

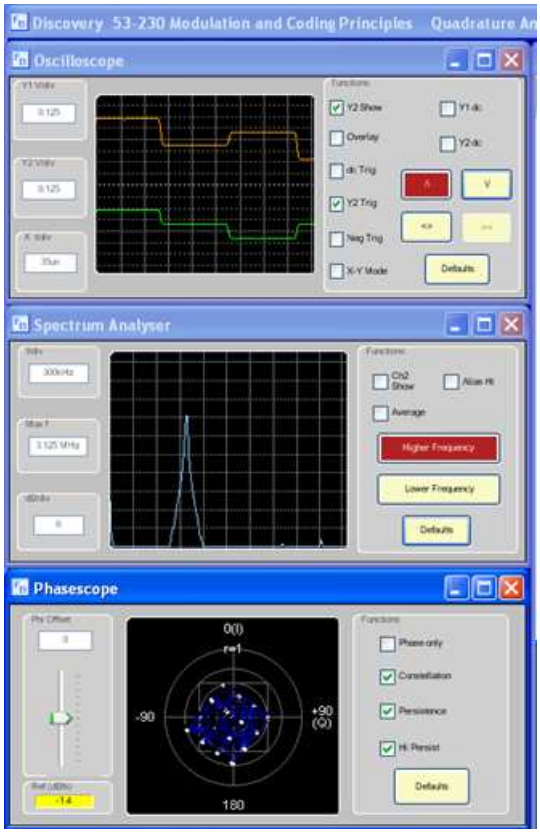
Crystal filter
Frequency response Neutralisation

Ceramic filter
Frequency response
Terminating the filter

Modulation and Coding Workboard 53-230



The broad and in-depth subject treatment covered by this work board starts with the understanding of the spectral composition of waveforms, preparing the background knowledge for the assignments that follow. The study builds progressively, dealing with conventional analogue AM and FM modulation/demodulation advancing to digital keying transmission and data recovery through to the complexity of word synchronisation and insertion. The many circuit blocks consist of a modulator, demodulator, transmission channel with noise generator, multiplier, integrator, differentiator, filters, oscillator, envelope detector, and level shifting circuits. A wide range of practical assignment work can be covered using this workboard. This includes seventeen assignments, each with up to four sub-practical's.



Embedded software instrumentation launched during the QAM 16 (16 constellations) assignment.

Curriculum coverage for Modulation and Coding Workboard 53-230

Signals in the Time and Frequency domains
Spectra of sine, triangle and square waves; filtering; noise signals

Sampling and Time Division Multiplexing
Sampling; A/D and D/A conversion; aliasing; TDM

Amplitude Modulation
Modulation and demodulation of double sideband AM with full carrier; modulation index; bandwidth; envelope detector; filtering; product detection

AM with Suppressed Carrier
DSBSC; modulation; demodulation; SSBSC; generation and demodulation

SSB Generation with an IQ Modulator
Amplitude Shift Keying (ASK)
Generating ASK; Multi-level ASK; Demodulating ASK

Frequency Modulation
Concepts of FM; generation by direct oscillator frequency shift; deviation; spectrum; bandwidth; Bessel functions; Carson's Rule; PLL demodulation

Frequency Modulation with an IQ Modulator
Frequency Shift Keying (FSK)
Generating and demodulating FSK using a PLL; minimum shift keying; multi-level FSK

Phase Modulation
Generating phase modulation using an IQ modulator; demodulation using residual carrier reference; demodulation using a frequency demodulator

Phase Shift Keying (FSK)
Generating binary phase shift keying (BPSK); Demodulation of BPSK using residual carrier; demodulation using a Costas Loop and by frequency multipliers

Multi-state Phase Shift Keying
Generation and characteristics of 4-PSK (QPSK) and 8-PSK; generating BPSK & QPSK using IQ modulator; demodulation of QPSK using Double Costas Loop; carrier recovery

Quadrature Amplitude Modulation (QAM)
Generation and characteristics of QAM; QAM 16, 64,256 constellations; effect of amplitude and phase noise on QAM; demodulation of QAM

Binary PCM
Bit error rate
Effect of noise on received data

Uncoded Binary Data Formats
NRZ and RZ in bipolar and unipolar forms

Bi-phase Data Format
Generating and decoding bi-phase data

Alternate Mark Inversion
AMI coding and its generation

Word Synchronisation
Synchronisation; sync word inserting

Ordering Information

Analogue & Digital Telecommunications (includes 53-210, 53-220, 53-230, 92-203)	53-004
ESPIAL Software Package (essential, but not included)	93-420
ESPIAL Course Manager (optional)	93-410

Feedback
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