80+ EXPERIMENTS IN MODERN COMMUNICATIONS

New Generation Single-Board Digital & Analog Telecoms Experimenter

TWO MODELS

Emona ETT-101 "BiSKIT" Standard
Emona ETT-101C "BiSKIT" PC-Enabled

BASIC EXPERIMENTS

Fundamental Signals Experiments
Analog Modulation
Basic Digital Modulation

ADVANCED EXPERIMENTS

Eye Diagrams and Noisy Channels
Signal Constellations
NEW Digital Modulations Schemes with Bit Error Rate (**BER**) Signal-to-Noise (**SNR**)
Eye Diagrams and ISI
Line Codes and Bit Clock Regeneration

FIBER OPTICS EXPERIMENTS

TX and RX of Optics Signals
FO Couplers and WDM
Physics of Fibers Experiments

NEW SOFTWARE DEFINED RADIO EXPERIMENTS

Educational GNU Radio Experiments

and much more

HIGHLY EXPANDABLE with EIGHT OPTIONAL ADD-ON BOARDS

EMONA INSTRUMENTS
www.ett101.com

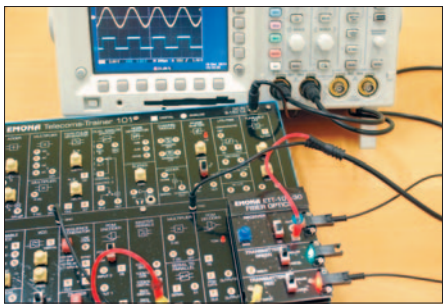
DESIGNED FOR STUDENTS TO LEARN AND EXPLORE

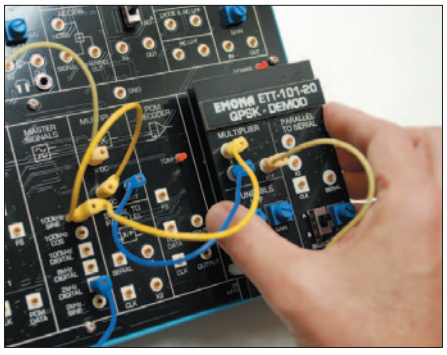
- Unrivalled with a wide range of over 80 communications and fiber optics experiments in one compact experimenter
- Educationally proven experiment method to help students see the relationship between math & the real world

biskit™ - Building Student Knowledge In Technology

COMPACT MULTI-EXPERIMENTER available in 2 models:
- **ETT-101C** with in-built scope, spectrum analyser & function generator
- **ETT-101** base unit, standard experimenter. Use with external oscilloscope

STUDENTS BUILD EXPERIMENTS BY PATCHING TOGETHER FUNCTIONAL BLOCKS





"Students patch together simple building blocks to make real communi-cations systems"

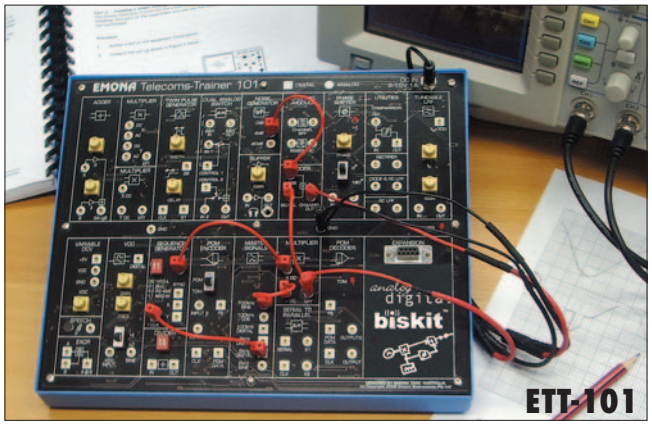
LEARNING-BY-DOING
Using the ETT-101, students learn the fundamental concepts by actually building telecommunications experiments at the block diagram level. Theory comes to life as they build the modulation and coding schemes.

With the ETT-101 students learn by trying "what-if" scenarios (and are free to make mistakes, analyse and self correct) to **investigate** the telecommunications theory they learn in class. With the ETT-101, your students will learn more, and remember more.

The ETT-101 accessories kit includes: 20 x stackable patch cords, User Manual, Experiments in Modern Analog and Digital Telecommunications Volume-1 and Volume-2, and a 12V plug pack.

FAST and SIMPLE EXPANSION
ETT-101-XX ADD-ON BOARDS simply plug into the ETT-101 EXPANSION slot.

FLEXIBLE AND EXPANDABLE, TELECOMMUNICATIONS EXPERIMENTING



ETT-101 standard EXPERIMENTER

Completely self contained within a single, low-profile case, the ETT-101 requires only a standard 12V DC plug-pack. Provides a comprehensive suite of independent functional blocks to build a wide variety of experiments. With expansion socket for a range of add-on boards.

Waveforms can be displayed on whatever equipment is available to the student, such as: a low cost lab oscilloscope, or a PC-based virtual instrument.

ETT-101C all-in-one PC-ENABLED UNIT

Includes all the experiment and expansion capabilities of the ETT-101 STANDARD EXPERIMENTER, plus an in-built PC-based multi-instrument, providing:

- OSCILLOSCOPE - 2 Channel, 100MS/s, full featured
- SPECTRUM DISPLAY - 2 Channel, 10MHz bandwidth
- FUNCTION GENERATOR with Arbitrary Waveform Generator

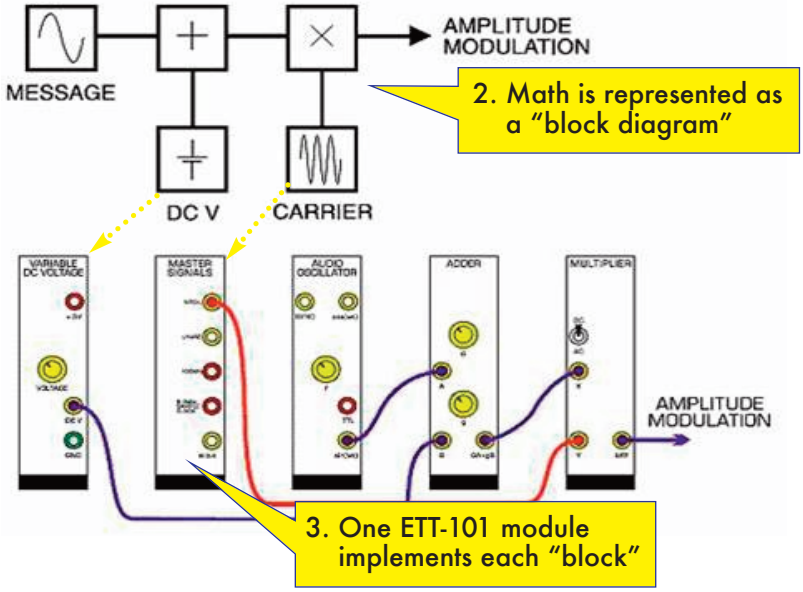
USB interface to PC, running the powerful PicoScope instrument display software.

STUDENTS APPLY THEORY TO BUILD EXPERIMENTS

ETT-101/C implements the BLOCK DIAGRAM approach to explore telecoms theory

$$A\,(1 + m.\cos\mu t)\,.\,B\cos\omega t = AM$$

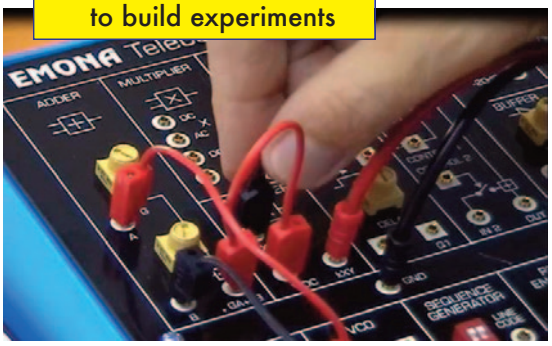
1. Telecoms theory is expressed as Math



2. Math is represented as a "block diagram"

3. One ETT-101 module implements each "block"

4. Students patch together the ETT-101 modules to build experiments



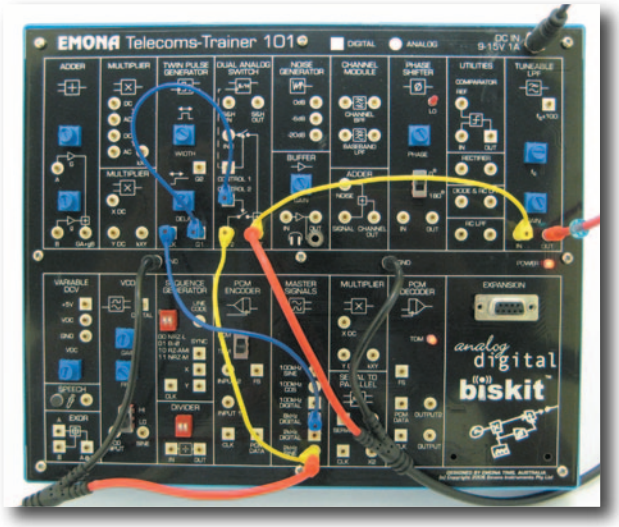
80+ DIFFERENT EXPERIMENTS CAN BE IMPLEMENTED WITH THE ETT-101

REPLACING 10 OR MORE "SINGLE PANEL" TRAINERS

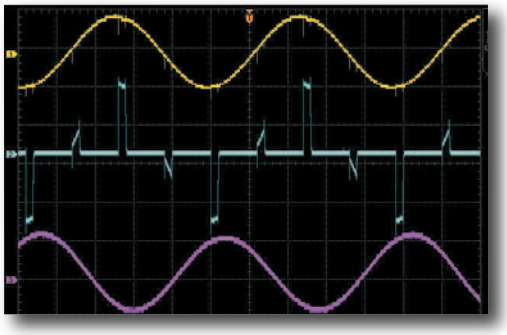
LEARNING-BY-DOING - HANDS-ON-PRACTICAL EXPERIENCES FOR STUDENTS

Following are examples of how students implement theoretical block diagrams to build each experiment by patching together functional circuit blocks.

SAMPLING and RECONSTRUCTION



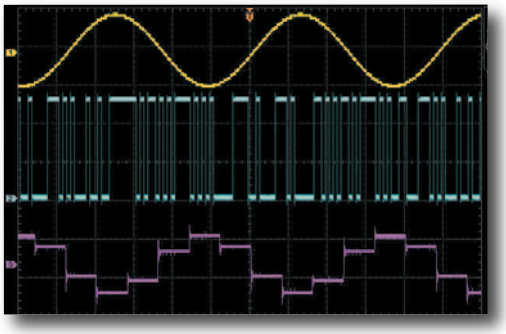
Patching a sampling & reconstruction experiment uses 4 of the ETT-101's functional blocks:
MASTER SIGNALS, TWIN PULSE GENERATOR,
DUAL ANALOG SWITCH and TUNEABLE LPF



Actual sampling & reconstruction waveforms.

PCM ENCODING and PCM DECODING

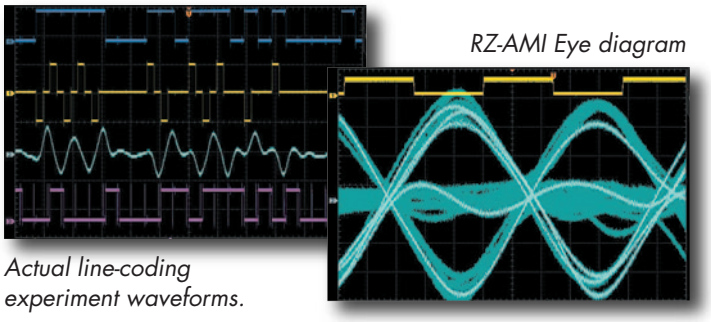
Patching a PCM encoding & decoding experiment uses 3 of the ETT-101's functional blocks:
MASTER SIGNALS, PCM ENCODER and PCM DECODER.



Actual PCM encoding & decoding waveforms.

LINE-CODE ENCODING, DECODING and EYE DIAGRAMS

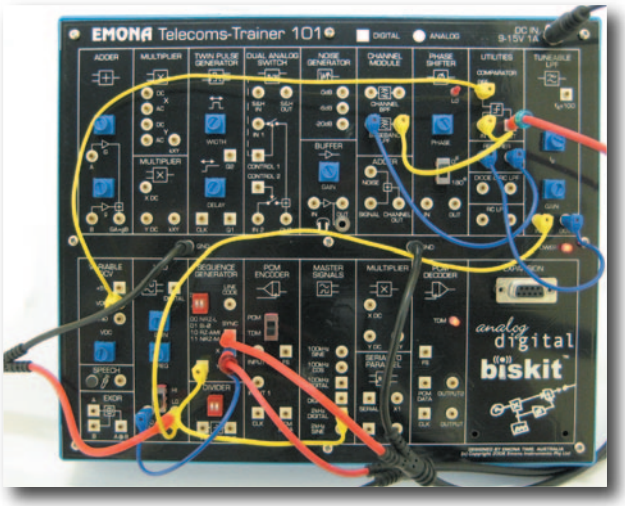
Patching a line-code encoding & decoding experiment with signals passing through a noisy bandlimited channel uses 6 of the ETT-101's functional blocks:
SEQUENCE GENERATOR/LINE-CODE ENCODER, MASTER SIGNALS, NOISE GENERATOR, CHANNEL FILTER, CHANNEL ADDER and LINE-CODE DECODER.



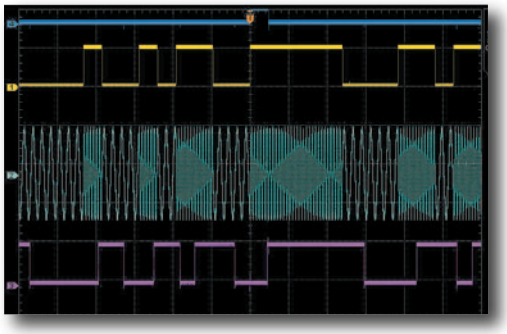
RZ-AMI Eye diagram

Actual line-coding experiment waveforms.

FSK MODULATION and FSK DEMODULATION

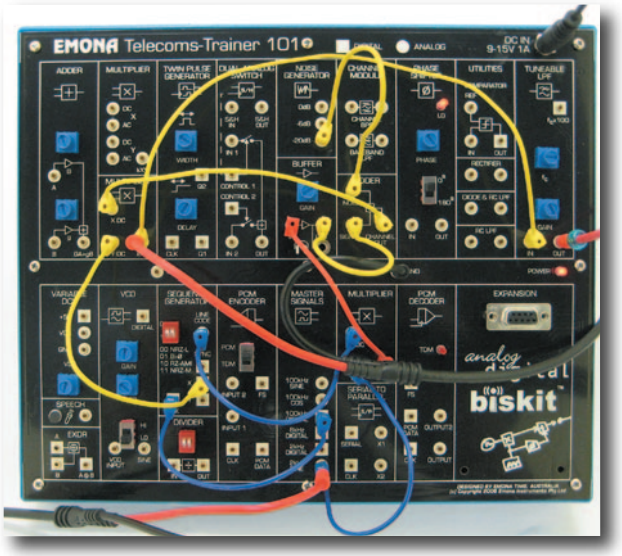


Patching an FSK modulation and demodulation experiment uses 7 of the ETT-101's functional blocks:
VCO, SEQUENCE GENERATOR, MASTER SIGNALS, BANDPASS FILTER, UTILITIES, VARIABLE DC V and TUNEABLE LPF.

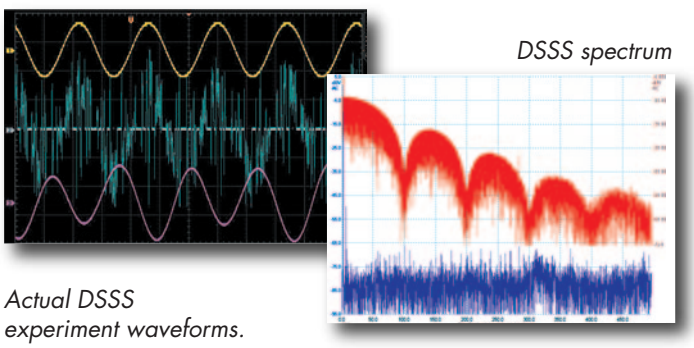


Actual FSK experiment waveforms.

DSSS SPREAD SPECTRUM MODULATION and DEMODULATION



Patching an DSSS modulation and demodulation in a noisy channel experiment uses 8 of the ETT-101's functional blocks:
SEQUENCE GENERATOR, MASTER SIGNALS, MULTIPLIER (x2), NOISE GENERATOR, ADDER, CHANNEL GAIN and TUNEABLE LPF.



DSSS spectrum

Actual DSSS experiment waveforms.

ETT-101 EXPANSION BOARDS

ETT-101-20 : QPSK EXPERIMENT BOARD

The ETT-101-20 QPSK Experiment expansion board will allow a complete QPSK modulation / QPSK IQ-branch demodulation experiment to be implemented.

Detailed experiments documented in the **ETT-101 Volume 3 Lab Manual** include:

- QPSK modulation and IQ-branch demodulation in a noisy channel;
- Signal Constellations.

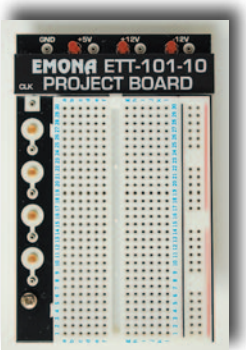
ETT-101-21 : LINE-CODING & PLL BOARD

The ETT-101-21 Line-Coding & PLL Experiments expansion board for implementing Line-Code Decoding, DPSK demodulation, and FM PLL demodulation experiments.

Detailed experiments documented in the **ETT-101 Volume 3 Lab Manual** include:

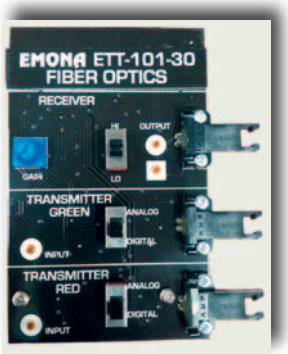
- Line-Code Decoding and decision making in a noisy baseband channel;
- DPSK in a noisy passband channel;
- FM demodulation using the PLL.

ETT-101-10 : ELECTRONIC CIRCUITS PROJECT BOARD



The ETT-101-10 Electronic Circuits Project Experiment board allows students to build their own analog and digital electronic circuits and interface them with the ETT-101 functional blocks. Example circuits include passive and active filters and oscillators.

ETT-101-30 : FIBER OPTICS BOARD

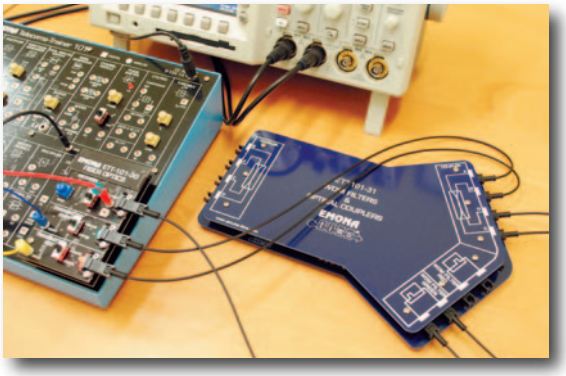


The ETT-101-30 FIBER OPTICS Experiment expansion board includes three independent functional blocks, providing an electrical-optical and optical-electrical interface for the ETT-101. When added to the ETT-101 it will allow a complete optical link to be established, for analog or digital signals.

Detailed experiments documented in the **ETT-101 Volume 4 Lab Manual** include:

- Transmission and reception of analog and digital signals;
- ETT-101 PCM-TDM implementation of a "T1" optical link.

ETT-101-31 : FIBER OPTICS COUPLER & WDM BOARD



The ETT-101-31 FIBER OPTIC COUPLERS and WDM FILTERS Experiment expansion board includes four independent functional blocks. When added to the ETT-101 and ETT-101-31 it will allow a complete bi-directional and WDM fiber optic links to be implemented.

Detailed experiments documented in the **ETT-101 Volume 4 Lab Manual** include:

- Optical signal splitting and combining;
- Fiber optic bi-directional communications;
- Wave Division Multiplexing optical link.

ETT-101-32 : PHYSICS OF FIBERS KIT

The ETT-101-32 PHYSICS OF FIBERS ACCESSORY KIT is used together with the ETT-101 and the ETT-101-30 FIBER OPTICS expansion board.

Detailed experiments documented in the **ETT-101 Volume 4 Lab Manual** include:

- Guiding Light Using Total Internal Reflection
- Losses in Fiber Optic Networks
- Polarization
- Bending Losses in Fiber Optic Systems
- Connectors

All Kit components included in a compact carry case: ETT-101-32S laser source; Fiber holder stand; Slide holder; Semicircular Perspex block; Screens; Clear plastic light guide; Clear Perspex slide; Green reflective-absorption slide; Scattering slide; Polarizer slides; Polarizer disc; Quarter-wave plate slide; Stripped optical patch lead; Adapted bulkhead connector; Spacers; Water-drops dispenser

ETT-101-22 : BER UTILITIES

NEW

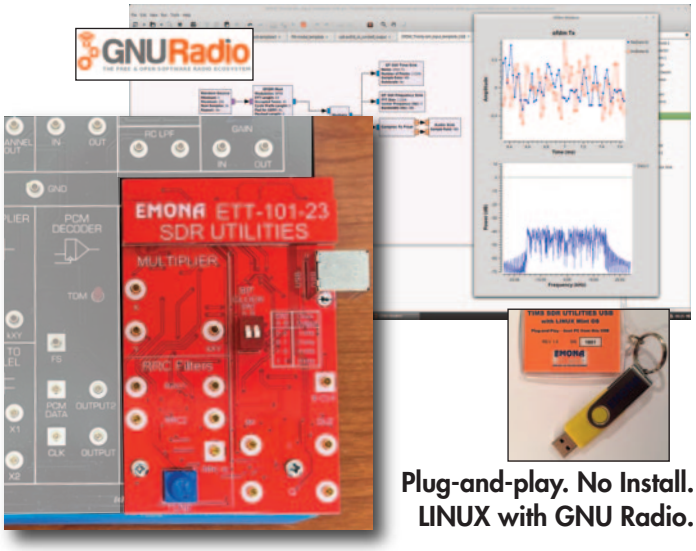
The ETT-101-22 BIT ERROR RATE COUNTER EXPERIMENTS BOARD includes four individual modules for implementing fundamental Bit Error Rate counting instrumentation.

The ETT-101-22 Board allows students to quickly and easily set-up BER instrumentation. The purpose of this add-on board is to dispel the mystery BER measurement, and examine the effect of signal-to-noise ratio (SNR) on BER.

Students are guided, step-by-step, to gain confidence and understanding in the concept of Bit Error Rate measurement by completing the Volume 3 experiment, "*Bit error rate measurements in a noisy baseband channel.*"

ETT-101-23 : SDR UTILITIES BOARD

NEW



Plug-and-play. No Install. LINUX with GNU Radio.

The ETT-101-23 SOFTWARE DEFINED RADIO BOARD is supplied as a complete, zero install solution. One step boot-and-run USB thumb drive has pre-installed LINUX with the full GNU Radio.

A simple, practical student introduction to Software Defined Radio, with experiments implemented utilizing the popular, open source GNU Radio SDR software.

Detailed experiments include:

- Familiarization with SDR software and hardware
- TX with SDR and RX with ETT-101 hardware blocks
- Exploring sampling and resampling
- TX with ETT-101 hardware blocks and RX with SDR
- Exploring digital modulation schemes in SDR

ETT-101/C LAB MANUALS
5 VOLUMES of STUDENT EXPERIMENTS

ETT-101 LAB MANUAL - Volume 1
(22 Chapters, 362 pages)

- Setting-up an Oscilloscope
- An Introduction to the ETT-101
- Modelling Equations
- Amplitude Modulation AM
- Double Sideband DSB Modulation
- AM Demodulation
- DSB Demodulation
- SSB Modulation & Demodulation
- FM Modulation
- FM Demodulation
- Sampling & Reconstruction
- PCM Encoding
- PCM Decoding
- BW Limiting & Restoring Signals
- ASK Modulation & Demodulation
- FSK Modulation & Demodulation
- BPSK Modulation & Demodulation
- QPSK Modulation & Demodulation
- Introduction to Spread Spectrum - DSSS modulation
- Undersampling in Software Defined Radio
- FM Demodulation - Discriminator Method
- QAM Modulation & Demodulation

ETT-101 LAB MANUAL - Volume 2
(23 Chapters, 476 pages)

- AM Method 2 & Product Detection
- Noise in AM Communications
- PCM and TDM
- Armstrong's Phase Modulator
- Phase Division Multiplex
- Pulse-Width Modulation & Demod.
- Message Translation & Inversion
- Carrier Acquisition using the PLL
- SNR and Eye Diagrams
- PCM and SNDR
- ASK Demod using Product Detect.
- FSK (switching method) & Demod.
- Principles of GFSK
- PN Spectra and Noise Generation
- Line Coding and Bit Clock Regen
- Delta Modulation & Demodulation
- Delta-Sigma Mod & Demod
- Observations of AM & DSBSC in the Frequency Domain
- Principles of superheterodyne
- Frequency synthesis with digital PLL
- Differential phase shift keying (DPSK)
- PAM-time division multiplexing (TDM)
- Pulse-Position Modulation & Demodulation

ETT-101 LAB MANUAL - Volume 3
(11 Chapters, 184 pages)

- Full (IQ branch) Demodulation of a QPSK Signal
- Line Code Decoding and Hard Decision Making
- DPSK Modulation and Demod with a Noisy Channel
- FM Demodulation using the Phase-Locked Loop
- Signal constellation Diagrams
- Bit error rate measurements in a noisy baseband channels
- Familiarization with SDR software and hardware
- TX with SDR and RX with ETT-101 hardware blocks
- Exploring sampling and resampling
- TX with ETT-101 hardware blocks and RX with SDR
- Exploring digital modulation schemes in SDR

Vol.3 experiments require the ETT-101-20, ETT-101-21, ETT-101-22 or ETT-101-23 boards

ETT-101 FIBER OPTICS LAB MANUAL - Volume 4
(11 Chapters, 280 pages)

- An Introduction to Fiber Optic Signal Transmission and Reception
- Guiding Light Using Total Internal Reflection *
- Losses in Fiber Optic Networks *
- Polarization *
- Bending Losses in Fiber Optic Systems *
- Connectors *
- PCM-TDM 'T1' Implementation
- Optical Signal Filtering, Splitting & Combining **
- Fiber Optic Bi-directional Communication **
- Wave Division Multiplexing (WDM) **
- Optical Losses **

* Experiments require the ETT-101-32 Physics of Fibers Accessory Kit.
** Experiments require the ETT-101-31 Coupler and Filters board.

ETT-101-10 ELECTRONIC CIRCUITS PROJECTS MANUAL
(14 Projects, 50 pages total)

- RC Circuits
- RL Circuits
- RC & RL Low-Pass Filters
- RC High -Pass Filters
- RC & RL Filters, Cut-off Frequency
- Measuring Filter Roll-off
- Measuring Filter Phase Response
- Series & Parallel RLC B-P Filters
- RLC Band-Stop Filters
- Effect of Components on Centre Freq. of Band-Pass & Band-Stop Filters
- Effect of Component Values on Bandwidth of Band-Pass Filters
- The Hartley Oscillator
- The Colpitts Oscillator
- The Clapp Oscillator

E&OE Specifications and details are subject to change without notice.

Available from:

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Email: sales@emona-tims.com