Analog Basics
1. Amplitude Modulation (AM)
   - modulation: 2 methods
   - envelope detection
   - product detection (coherent)
   - AM in a noisy channel
2. Double Side Band (DSB)
   - suppressed carrier
   - product detection (coherent)
   - DSB in a noisy channel
3. Single Sideband (SSB)
   - generation only (upper & lower)
4. Phase Modulation (PM)
   - Armstrong Phase modulator
5. Phase Division Modulation (PDM)
   - phase division demodulation
6. Frequency Modulation (FM)
   - generation by VCO (wideband)
   - demodulation by PLL
   - demodulation by zero crossing method
7. Pulse Amplitude Modulation (PAM)
   - sampling theorem / Nyquist
   - aliasing and reconstruction
   - time division multiplexing (TDM) only
8. Speech and Audio messages
   - message inversion
   - message translation
Intro to Advanced Analog
9. Carrier Acquisition using PLL
10. Signal to Noise Ratio (SNR) - Introduction to SNR
Digital Basics
11. AM & DSB in the Frequency Domain
12. FM Generation using the Harmonic Multiplier Method
13. Sampling and Reconstruction
14. Pulse Code Modulation (PCM)
   - encoding
   - decoding & reconstruction
   - sampling rate
   - aliasing, undersampling
   - over-sampling
   - synchronisation
   - Signal-to-Noise Ratio (SNR)
15. Time Division Multiplexing
   (PCM-TDM)
16. Amplitude Shift Keying (ASK)
   - modulation
   - envelope recovery
   - synchronous recovery
17. Binary Phase Shift Keying (BPSK)
   - modulation
   - demodulation
18. Frequency Shift Keying (FSK)
   - modulation using VCO
   - modulation using switching method
   - envelope recovery
19. Pulse Width Modulation (PWM)
20. Introduction to GFSK
21. Data recovery in a noisy channel
   - data recovery
Intro to Advanced Digital
22. Intersymbol Interference (ISI)
   - eye patterns/diagrams
   - Signal-to-Noise Ratio
23. Delta Modulation & Demodulation
24. Delta-sigma Mod and Demod
25. Quadrature Phase Shift Keying (QPSK)
   - modulation
   - demodulation
26. Spread Spectrum (SS)
   - introduction to direct sequence spread spectrum (DSSS)
27. Line coding
   - NRZ-L
   - Alternate Mark Inversion (AMI)
   - Manchester (Bi-phase)
   - Differential encoding (NRZ-M)
   - Bit Clock Regeneration
28. PN sequence spectrum display
29. Noise generation
30. Undersampling in Software Defined Radio
Additional Experiment Capabilities
- Introduction to Control Systems
- Using LabVIEW™ to control external electronic circuits
- Controlling DATEx remotely across the Internet
- Bit Block Regeneration
- PN sequence spectrum display
Emona Telecoms-Trainer
ETT-202
Multi-Experiment Single Board Telecommunications Trainer for the popular NI ELVIS™ Platform

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DATEx: Digital Analog Telecommunications Experimenter
COMPACT AND FLEXIBLE, A BREAKTHROUGH IN MODERN TELECOMMUNICATIONS EXPERIMENTING

Emona Telecoms-Trainer 202, known as DATEx
Plugs into the NI ELVIS™ platform, operating in local mode and under LabVIEW™

- An excellent “hands-on” experiment system, implementing the well established “block diagram approach” to building telecommunications experiments
- Unrivalled with a wide range of modern communications topics in one compact trainer
- Local control and also remote control via the ETT-202 SFP virtual instrument on LabVIEW™

DESIGNED FOR NI ELVIS™
The Emona Telecoms-Trainer 202 extends the functionality of your NI ELVIS™ platform and LabVIEW™ software with a plug and play telecommunications board to teach the fundamentals of modern communications theory.

ETT-202 Soft Front Panel (SFP) instrument display
Students are free to learn by trying “what-if” scenarios to investigate the telecommunications theory they learn in class. With the ETT-202, your students will learn more, and remember more.

COMPACT and EASY FOR TEACHERS
The system is completely self-contained: all that is required is the ETT-202, NI ELVIS™ and LabVIEW™ running on a PC.
The ETT-202 accessories kit includes:

ADDITIONAL EXPERIMENT CAPABILITIES
Given that the ETT-202 provides a wide array of fundamental electronic building blocks, controllable using LabVIEW™, the ETT-202 can also be used as a general purpose applications board to investigate topics such as systems control and integration of LabVIEW applications with electronic hardware.

DATEx EXPERIMENT CAPABILITIES - LABORATORY MANUALS

3 VOLUMES OF TELECOMMUNICATIONS EXPERIMENTS
The ETT-202 Laboratory Manuals, Volumes 1, 2 and 3, provide a turn-key solution for the teacher and student alike.
The first 2 Volumes are specially written to guide students through hands-on experiments and help them grasp the fundamental concepts of telecommunications.
Volume 3 introduces students to LabView programming tasks.
Each chapter includes background information which relates the experiment content to real-world applications.

ETT-202 LAB MANUAL - VOLUME 1
(22 Chapters, 406 pages)
- An introduction to the NI ELVIS™ II test equipment
- An Introduction to DATEx experimental add-in module
- An Introduction to the DATEx Soft Front Panel control
- Using DATEx to Model Equations
- Amplitude Modulation AM
- Double Sideband DSMB Modulation
- Observations of AM and DSBB signals in the frequency domain
- 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

ETT-202 LAB MANUAL - VOLUME 2
(18 Chapters, 338 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
- FM Generation using the harmonic multiplier method

ETT-202 LAB MANUAL - VOLUME 3
(11 Chapters, 64 pages)
- Programming Amplitude Control Blocks
- Programming Frequency Control Blocks
- Programming Phase Control Blocks
- Programming Timing Control Blocks
- Programming Modulation Control Blocks: PCM/TDM block, SEQUENCE GENERATOR/LINE CODE block
- Sequencing and Combining the DATEx Blocks
- Using NI ELVIS Instruments on the DATEx
- Building LabVIEW Controlled DATEx Experiments:
Automatic nulling using the PHASE SHIFTER;
Viewing filter responses using FFTs;
Analyzing noise circuit performance;
Automatic gain control;
Introducing complex I/Q modulation using LV Modulation Toolkit;
Armstrongs phase modulator using the LV Modulation Toolkit;
MSK modulation using the LV Modulation Toolkit;
Introducing complex I/Q modulation using LV Modulation Toolkit;
Armstrongs phase modulator using the LV Modulation Toolkit;
FM generation using the LV Modulation Toolkit
- Further LabVIEW Programming Tasks
- Controlling DATEx remotely across the Internet