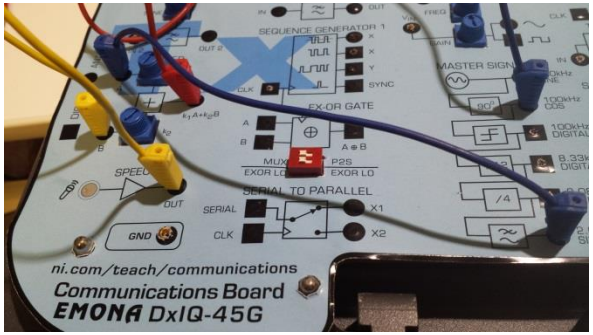
Emona Communications Board – DxIQ-45G



Close-up of the DxIQ-45G board

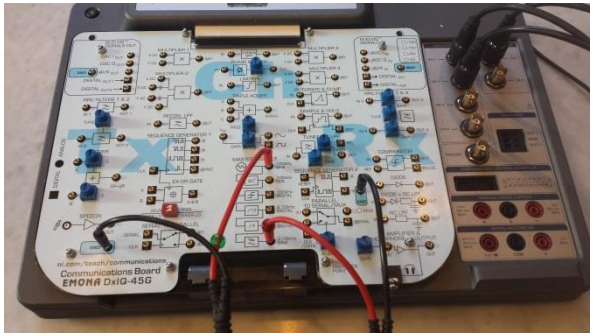


Illustration of DxIQ-45G mated with NI ELVIS

PRODUCT APPLICATION:

To provide a cost effective top-board for NI ELVIS™ III, covering the core topics in a university-level communications systems (transmission theory) lab program.

IMPLEMENTATION:

- A single panel PCB, which plugs into the NI ELVIS III.
- Many experiments implemented on ONE panel, replacing 6 or more experiment panels implemented by other “trainer” manufacturers.
- Student patches together each experiment, using Emona’s well established BLOCK DIAGRAM approach.
- DxIQ-45G will be supplied as a complete package, with all required accessories.
- Comprehensive lab manual with detailed experiments.
- Integration with NI’s web-based ThinkScape experiment delivery platform.

EXPERIMENT COVERAGE:

LAB MANUAL VOLUME 1 -
CH1 - FFT & Spectra
1.1) Spectrum of an impulse train.
1.2) Fourier series – analyzing a squarewave
1.3) Spectrum of a Sync pulse.
1.4) Spectrum of PN Sequences.
1.5) Spectrum of AWGN.
CH2 - AM
2.1) Amplitude modulation
2.2) Envelopes
2.3) Envelope recovery
2.4) DSB modulation and demodulation
2.5) SSB modulation and demodulation
2.6) AM in Noise
CH3 - SUPERHETERODYNE
3.1) Principles of superheterodyne
CH4 - FM
4.1) Analysis of the Fm spectrum
4.2) WBFM generation using the VCO
4.3) FM spectrum measurements
4.4) FM demodulation using the zero crossing detector
4.5) FM demod using discriminator
4.6) FM in Noise
CH5 - FSK
5.1) CP-FSK generation
5.2) Demodulation FK using filtering and envelope detector
5.3) Restoring recovered data
CH6 - BPSK
6.1) BPSK modulator
6.2) Phase sync in PSK schemes
6.3) BPSK demodulator
6.4) Observing eye diagram of conventional BPSK modulator/demodulator
CH7 - QPSK
7.1) QPSK modulator
7.2) Building a noisy bandpass channel for QPSK
7.3) QPSK demodulator and constellations
7.4) Effect of RRC filtering at the modulator and demodulator
CH8 - EYE, SNR, BER
8.1) QAM and introduction to orthogonality
8.2) Build BPSK mod and demod with a noisy channel
8.3) Eye Diagrams – viewed at BPSK demodulator output
8.4) SNR – measured at the output of the channel
8.5) BER – measured at the output of BPSK mod/demod through a noise channel
8.6) plotting waterfall curves, manually and automatically
CH9 - INTRO TO SDR
9.1) AM and FM implemented via SDR using IQ technique
9.2) BPSK and DPSK implemented via SDR using IQ technique
9.3) QPSK implemented via SDR using IQ technique
9.3) Other SDR multilevel modulation schemes, constellations (incl. 16QAM)
CH10 - PRINCIPLES OF OFDM
10.1) Investigating “orthogonal” sub carriers
10.2) Discrete OFDM modulator
10.3) Discrete OFDM signal demodulation
10.4) Implementation of OFDM TX by Software Defined Radio using IQ technique

LAB MANUAL VOLUME 2
CH11 - ARMSTRONG'S PM
11.1) PM modulation
CH12 - SAMPLING, RECON, PAM
12.1) Natural sampling / PAM
12.2) Sample & Hold
12.3 Reconstruction
CH13 - PLL
13.1) Carrier acquisition using the PLL
CH14 - ASK
14.1) ASK modulation
14.2) ASK demodulation
CH15 - COSTAS LOOP
15.1) Carrier regeneration using the Costas Loop
CH16 - DSSS
16.1) DSSS mod and demod with sine and voice messages
16.2) DSSS and interference

BLOCKS PROVIDED:

These are independent functional blocks, conceptually analogous to “LEGO™ building blocks”, used by the student to build the experiments listed here.

DATEx-IQ HARDWARE BLOCKS:
- 100kHz BPF
- 150kHz LPF
- ADDER x 2
- ANALOG MUX
- COMPARATOR
- I&D and I&H
- LIMITER
- MASTER SIGNALS
- MULTIPLIER x 4
- PARALLEL/SERIAL
- PHASE SHIFTER
- PRECISION RECTIFIER
- RC LPF
- RRC LPF x 4
- SAMPLE & HOLD
- SERIAL/PARALLEL
- SEQUENCE GENERATOR x 2
- SPEECH
- TLPF
- VCO
- X-OR

FUNCTIONAL BLOCKS PROVIDED THROUGH NI ELVIS III DAC and FUNCTION GENERATOR
- NOISE GENERATOR – VARIABLE DCV – AUDIO OSCILLATOR – PULSE GENERATOR – SDR IQ SIGNALS