Karunya INSTITUTE OF TECHNOLOGY AND SCIENCES

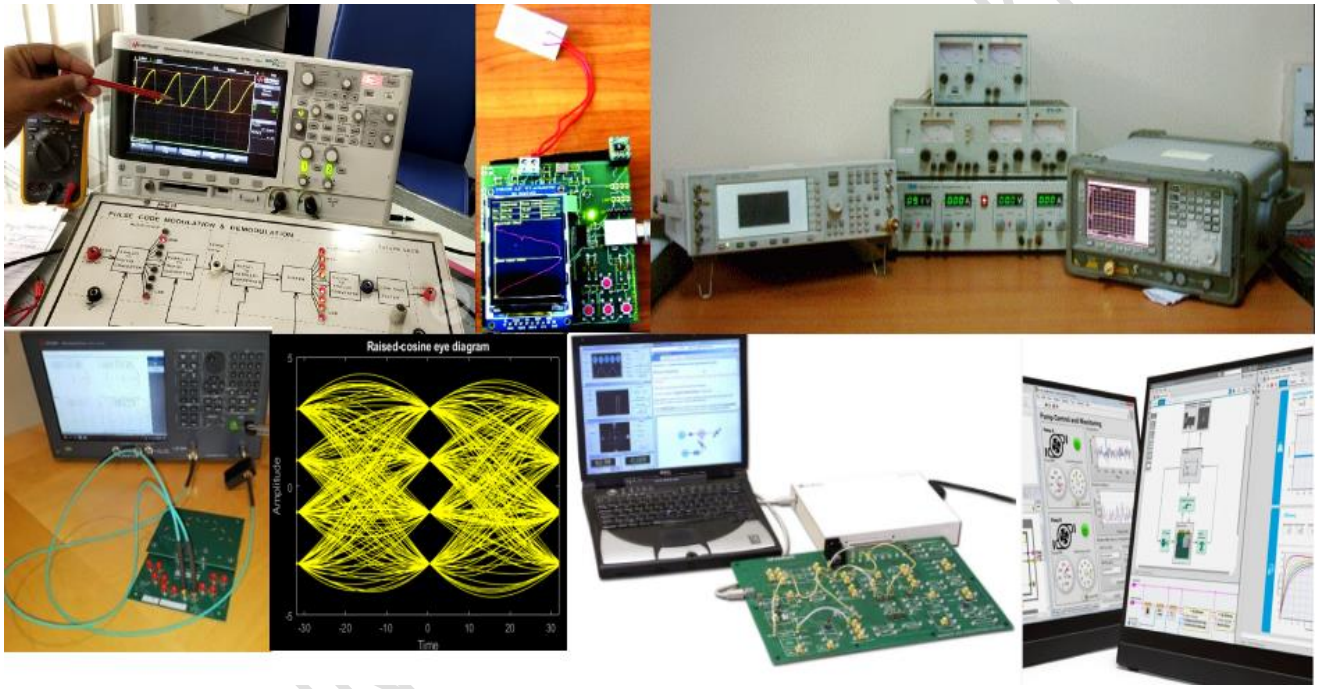
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1956)

MoE, UGC & AICTE Approved

NAAC A++ Accredited

DIVISION OF

ELECTRONICS AND COMMUNICATION ENGINEERING

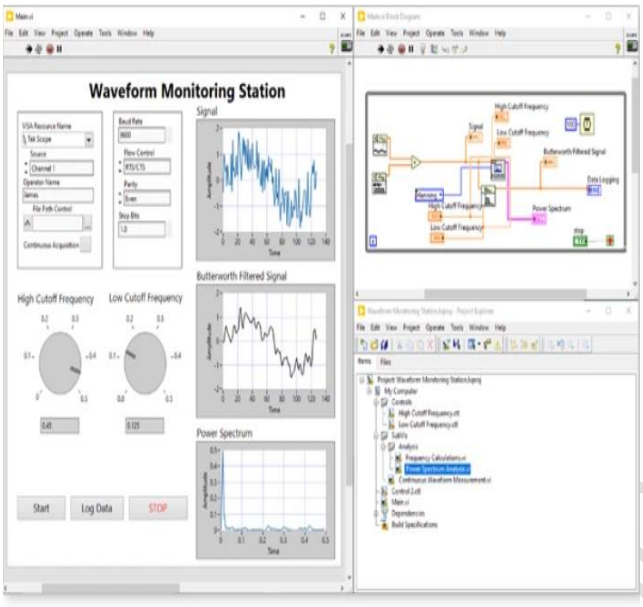


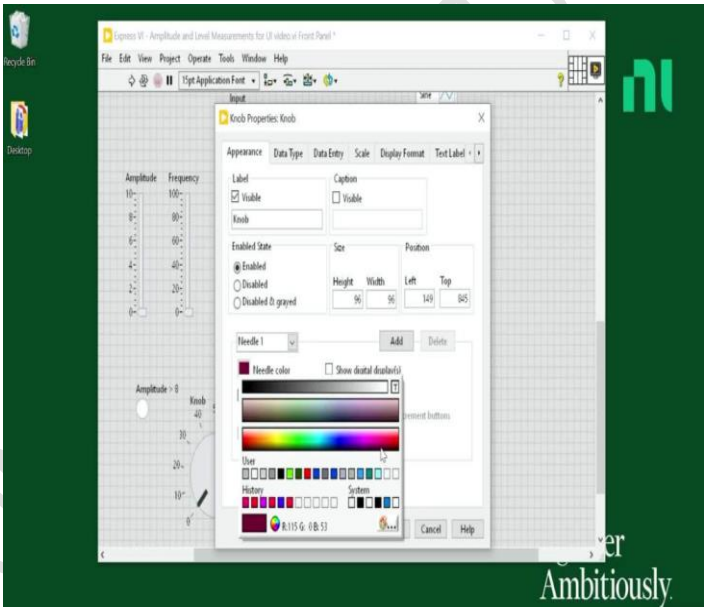
COMMUNICATION LABORATORY

KARUNYA INSTITUTE OF TECHNOLOGY & SCIENCES

National Instruments Lab VIEW Software:

LabVIEW is a graphical programming environment that provides unique productivity accelerators for test system development, such as an intuitive approach to programming, connectivity to any instrument, and fully integrated user interfaces.





License Type	Perpetual
No. of users	5
Tools Available	Communication Toolkits for USRP hardware

- **Unlike other solutions:**

- can connect to any instrument, regardless of vendor
- has a native user interface for monitoring and controlling test
- has thousands of engineering and data analysis functions
- works with popular languages, such as Python, C, and .NET
- For building a test system quickly, including a user interface and data analysis.
- To build automated test systems
- For test and measurement.
- Uses G, a graphical, high-level programming language, which aids engineers in translating their tasks to code.

USRP-2901 SOFTWARE DEFINED RADIO DEVICE

The USRP-2901 is a unable RF transceiver with full-duplex, MIMO operation. It offers bus-powered connectivity with USB 3.0 or USB 2.0. You can also use the NI USRP-2901 for the following communications applications: white space; broadcast FM; public safety; land-mobile, low-power unlicensed device (ISM) bands; sensor networks; amateur radio; or GPS.

Frequency of operation: 70MHz – 6GHz
Bandwidth: up to 56MHz
Interface to PC: USB 3.0

Applications:

- ❖ Wireless Communication Systems
- ❖ Radar Systems
- ❖ Software-Defined Radio (SDR) Applications
- ❖ Wireless Sensor Networks
- ❖ Cognitive Radio Systems
- ❖ Satellite Communication Systems
- ❖ Digital Modulation and Demodulation
- ❖ Signal Processing and Filtering
- ❖ IoT (Internet of Things) Applications
- ❖ Educational Demonstrations

- ❖ Broadcast FM
- ❖ Land-mobile
- ❖ Low-power unlicensed device (ISM) bands
- ❖ Sensor networks
- ❖ Amateur radio
- ❖ GPS

USRP-2901 SOFTWARE DEFINED RADIO DEVICE

USRP SOFTWARE DEFINED RADIO ACCESSORIES (Antennas)

1. VERT2450 Antenna

- **VERT2450 Vertical Antenna (2.4-2.5 and 4.9-5.9 GHz)**
- Dualband Includes one VERT2450 Dual Band 2.4 to 2.48 GHz and 4.9 to 5.9 GHz omni-directional vertical antenna, at 3dBi Gain.

2. VERT400 Antenna

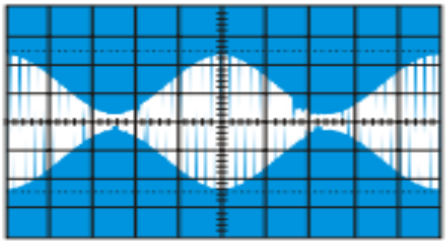
- **VERT400 Vertical Antenna (144 MHz, 400 MHz, 1200 MHz) Triband**

- Includes one VERT400 144 MHz, 400 MHz, and 1200 MHz Tri-band omni-directional vertical antenna.

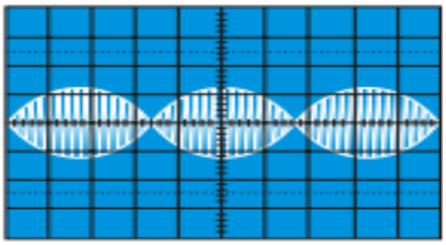
3. VERT900 Antenna

- **VERT900 Vertical Antenna (824-960 MHz, 1710-1990 MHz) Dualband**
- Includes one VERT900 824 to 960 MHz, 1710 to 1990 MHz Quad-band Cellular/PCS and ISM Band omni-directional vertical antenna, at 3dBi Gain.

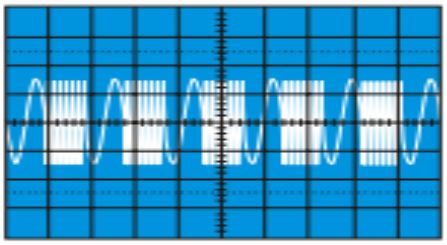
10/20 MHz AM FM Function Generator Counters:



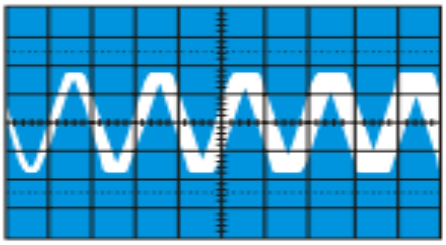
Sinewave with AM (Standard)



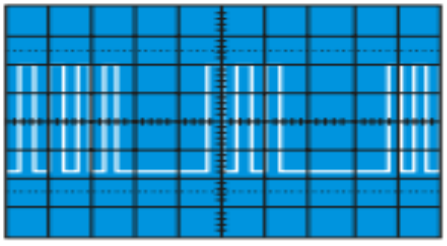
Sinewave with AM Balanced



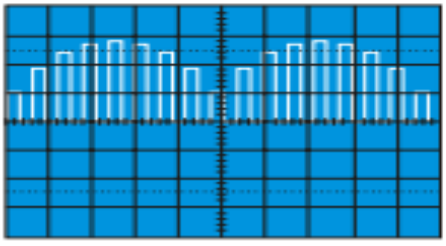
FM



Sweep Mode (FM)



FM Modulated Pulses



PAM Signal

FEATURES:

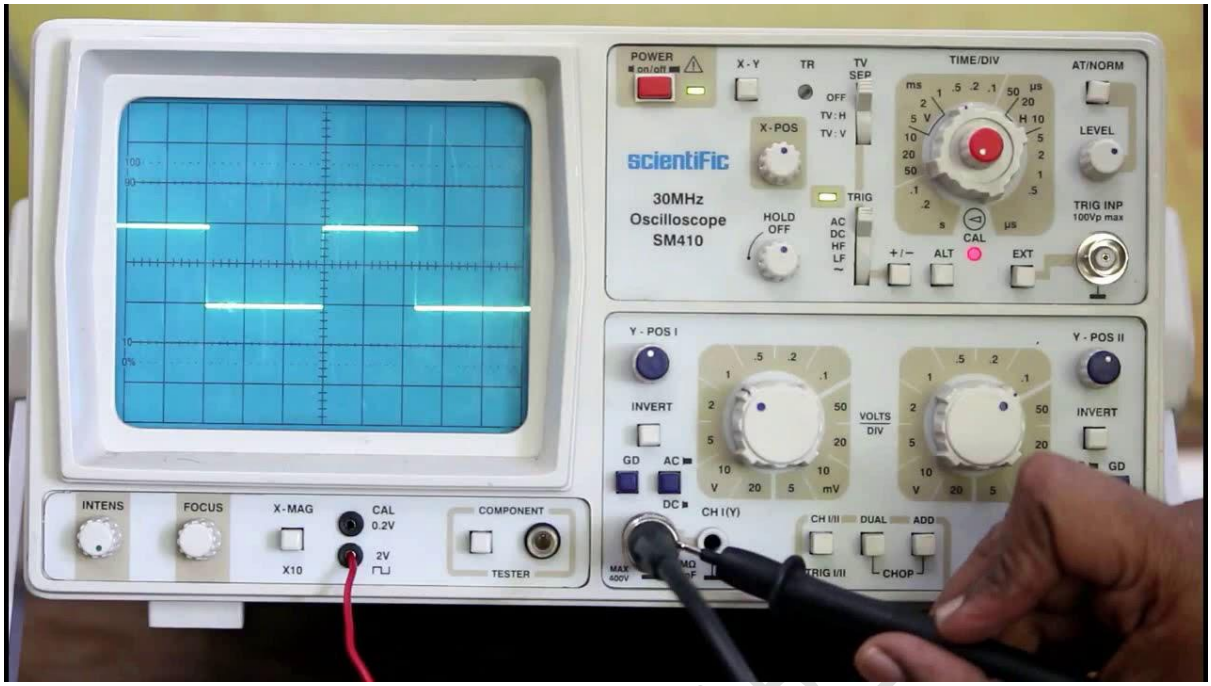
- New versatile 10 MHz function generators with Sine, Square, Triangle, Ramp, Pulse, TTL & DC.
- Modulations of any signal by AM, FM, PWM, PAM and Internal Sweep.
- Direct display of amplitude.
- High frequency stability
- Variable pulse duty cycle adjustment.
- Auto ranging 40 MHz Frequency Counter.
- Internal AM Signal generator 20 Hz-20 kHz
- Back lit LCD for display of functions, frequency, amplitude and other parameters.

DIGITAL STORAGE OSCILLOSCOPE:

Features:

- 50 MHz
- See more signal detail with 50,000 wfms/sec update rate
- Make professional measurements, including math, FFT, analog bus, and protocol triggering/decode
- Get more instrument integration with built-in 20 MHz wavegen and frequency response analysis
- Quickly learn how to use; oscilloscopes have built-in help and training signals

CATHODE RAY OSCILLOSCOPE:

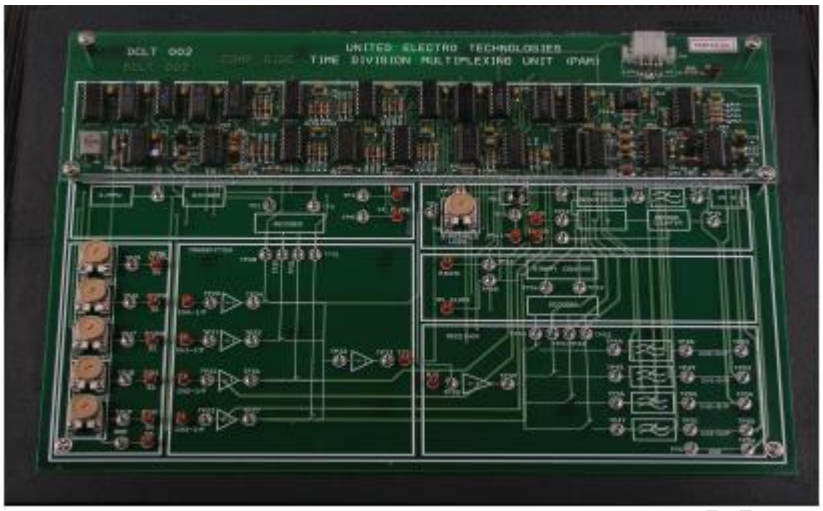


Features:

- Display: Shows electrical waveforms on a CRT screen.
- Channels: Multiple input channels for observing different signals.
- Bandwidth: Determines the frequency range the CRO can accurately measure.
- Sample Rate: Specifies how often the CRO samples the input signal.
- Vertical Resolution: Defines the precision of amplitude measurement.
- Horizontal Timebase: Adjusts the time scale of displayed waveforms.
- Triggering: Stabilizes repetitive waveforms for clear observation.
- Probe Compensation: Calibrates external probes for accuracy.
- Math Functions: Enables waveform manipulation and analysis.
- Data Storage: Some models offer storage for waveform data.
- PC Connectivity: Allows connection to a computer for data transfer or control.

DIGITAL COMMUNICATION TRAINER KIT

1. Time Division Multiplexing Unit (PAM) Model DCLT 002

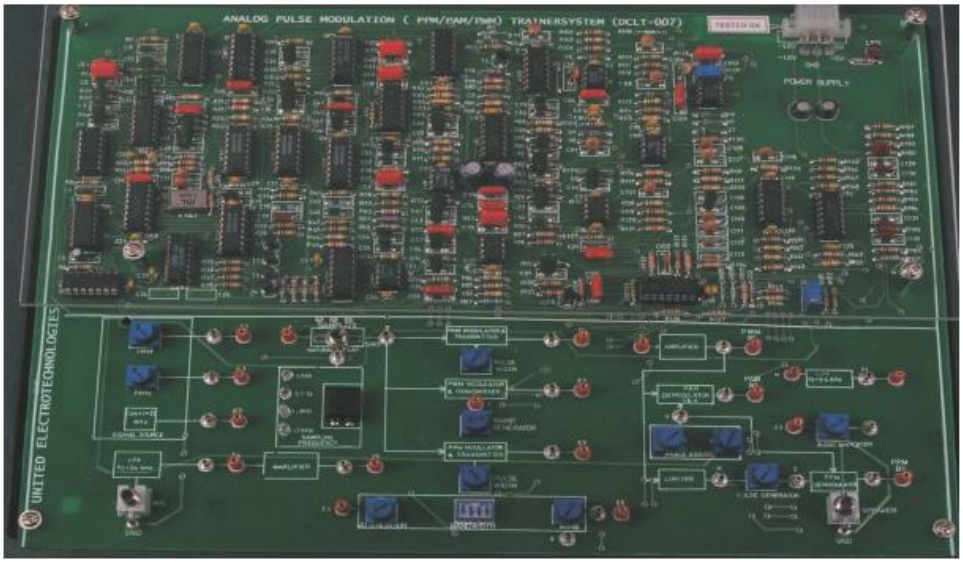


Time Division Multiplexing unit (PAM) explains experimentally that it is possible to interface samples from many different information signal in Time Known as Time Division Multiplexing "Clock Recovery" and "Synch Detect" Two of the fundamental aspects using "PLL" techniques can be experimented and learnt practically.

Experiments

- Study of Multiplexing Signal of TDM
- Study of Demultiplexing Signal of TDM
- Learn the use of PLL to extract "CHO" signal from TXD.
- Learn the use of PLL to extract "clock" and signal CHO from TXD
- Reconstruction 4^{th} Order Butter worth LPF

2. Analog Pulse Mod/De Mod (PAM, PWM, PPM) with Channel Simulator Model DCLT 007



Pulse Modulation can be used to transmit analog information. Continuous waveforms are sampled at regular intervals. Signal information is transmitted only at the sampling time, together with Synchronizing pulses. At the receiving end the original waveform will be reconstructed from the "sampled" information. PAM, PPM, PWM are the commonly used Analog pulse modulations techniques and DCLT-007 gives a practical way to learn the technique of analog pulse modulation schemes experimentally.

Technical specifications

• On board Input signal (Sinusoidal): 1khz, 2khz and Non-sinusoidal (Variable Amplitude)

• On board Sampling Frequencies: 4khz, 8khz, 16khz, 32khz (Switch able)

• Modulations & Demodulations: PAM (Natural & Flat Top), PWM and PPM

• Reconstruction of PWM using RAMP generator , Variable pulse width's

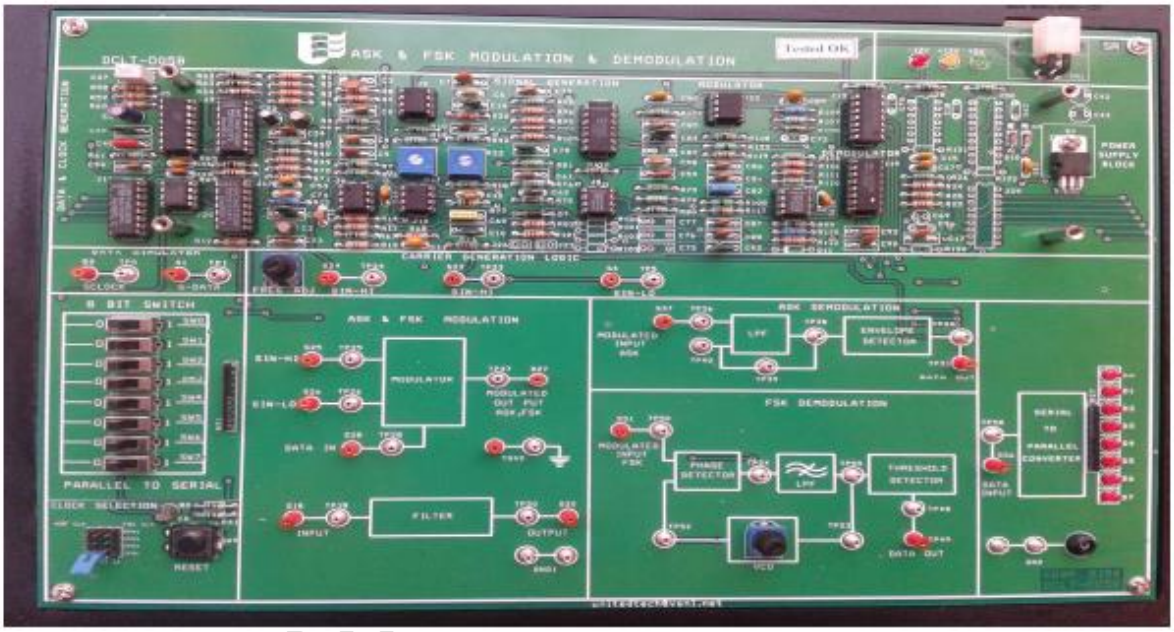
• Voice interface to study the performance of PAM,PWM,PPM Mod &Demod

• Inbuilt channel simulator to induce noise, attenuation and bandwidth

• Reconstruction using low pass filters

3. AMPLITUDE SHIFT KEYING MODULATION AND DEMODULATION TRAINER Model DCLT 005A

This trainer provides an opportunity to study carrier modulation of digital signals. There are various carrier modulation techniques required for transmission of digital information. Amplitude Shift Keying (ASK) is one such modulation scheme. Digital signal is represented by a sequence of '0's and '1's. In ASK a carrier frequency is switched On if the data bit is '1' and switched off if the data bit is '0'. This trainer provides a bit pattern generator and carrier signal required to carry out the experiment.



Technical specifications:

• On-board Data sources: 4 no.s of Data Patterns ranging from 1K Hz to 5 KHz @ 4V pk-pk

• Modulation: Amplitude Shift Keying Modulation

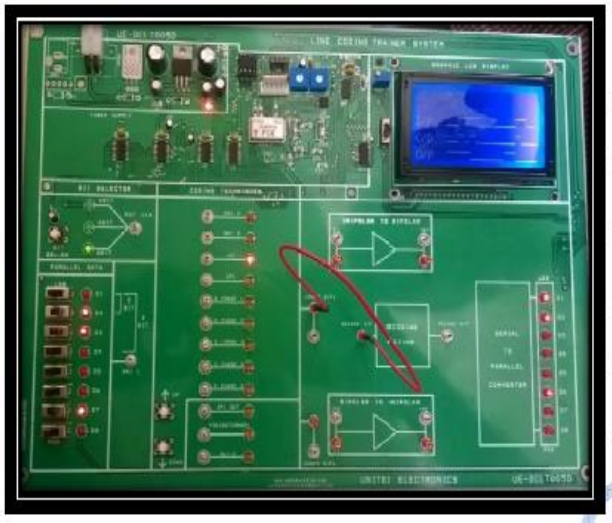
• On-board carrier frequency Range: 100KHz

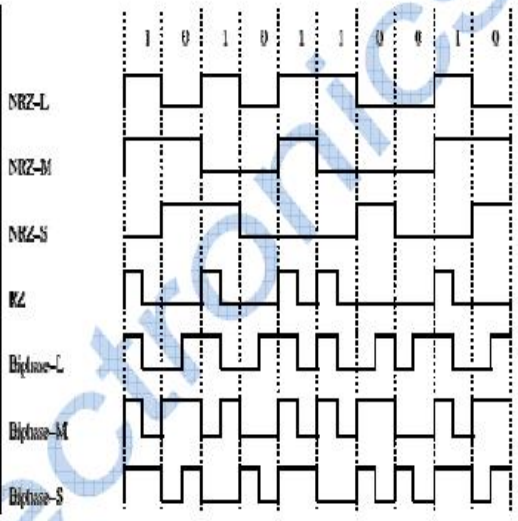
• Test Points: 7 nos.

• Interconnections: 2mm Sockets with patch cords.

• Power: External 5V,+12V and -12V

4. TRAINER SYSTEM FOR LINE CODING TECHNIQUES



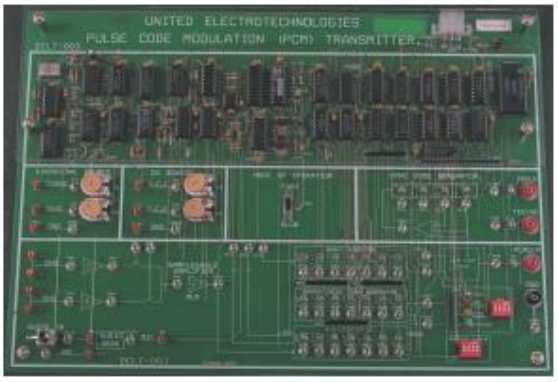


Board Features

- TTL 8 bit input bit pattern
- 12 line coding techniques
- Selectable 8 bit 4 bit and 2 bit input data with individual clocks
- On board Graphical LCD to display input, coded and decoded data
- Serial and parallel decoded data
- Different blocks for unipolar and bipolar

5. Pulse Code Modulation and Demodulation (PCM)

Pulse Code Modulation is the most widely used Technique for the coded transmission of Analog signals. Time division MULTIPLEXED PCM system is a technique used for transmitting Analog message signals over a Communication Channel, by dividing the time into slots - one time slot for each message. Frame synchronization is necessary to establish each group of samples. Bit synchronization is necessary to properly separate the samples within each frame.



Few Project Ideas:

- Implementing a simple wireless chat application using LabVIEW and USRP.
- Building a basic wireless data transmission system for IoT devices.
- Developing a Wi-Fi signal strength analyzer using USRP and LabVIEW.
- Creating a radar-based speed detection system using USRP and LabVIEW.
- Designing a radar system for wildlife monitoring and tracking.
- Building a weather radar system for precipitation detection and measurement.
- Developing a spectrum analyzer tool for analyzing RF signals.
- Implementing a digital FM radio receiver using LabVIEW and USRP.
- Building a custom wireless communication protocol using SDR technology.
- Designing a smart home automation system with wireless sensors and actuators.
- Creating a wireless environmental monitoring system for agriculture.
- Developing a real-time asset tracking system using wireless sensors.
- Building a dynamic spectrum allocation system for optimizing spectrum usage.
- Implementing a cognitive radio network for emergency communication in disaster scenarios.
- Developing a spectrum sensing application for detecting unused frequency bands.
- Creating a satellite ground station for receiving satellite telemetry data.
- Building a satellite tracking system using USRP and LabVIEW.
- Designing a satellite communication link for remote data transmission.
- Implementing an AM/FM radio transmitter and receiver using LabVIEW and USRP.
- Developing a QPSK modulation and demodulation system for digital communication.
- Building a digital audio broadcasting (DAB) system using USRP and LabVIEW.
- Designing a digital filter toolbox for signal processing applications.
- Implementing noise reduction algorithms for improving signal quality.
- Developing an adaptive equalization system for mitigating channel distortion.
- Creating a smart energy monitoring system for home automation.
- Building a remote health monitoring system using wireless sensors.
- Developing an IoT gateway for connecting sensors to the cloud.

- Creating interactive simulations for teaching wireless communication concepts.
- Designing satellite tracking system to track and receive signals from amateur radio satellites, weather satellites, or CubeSats.