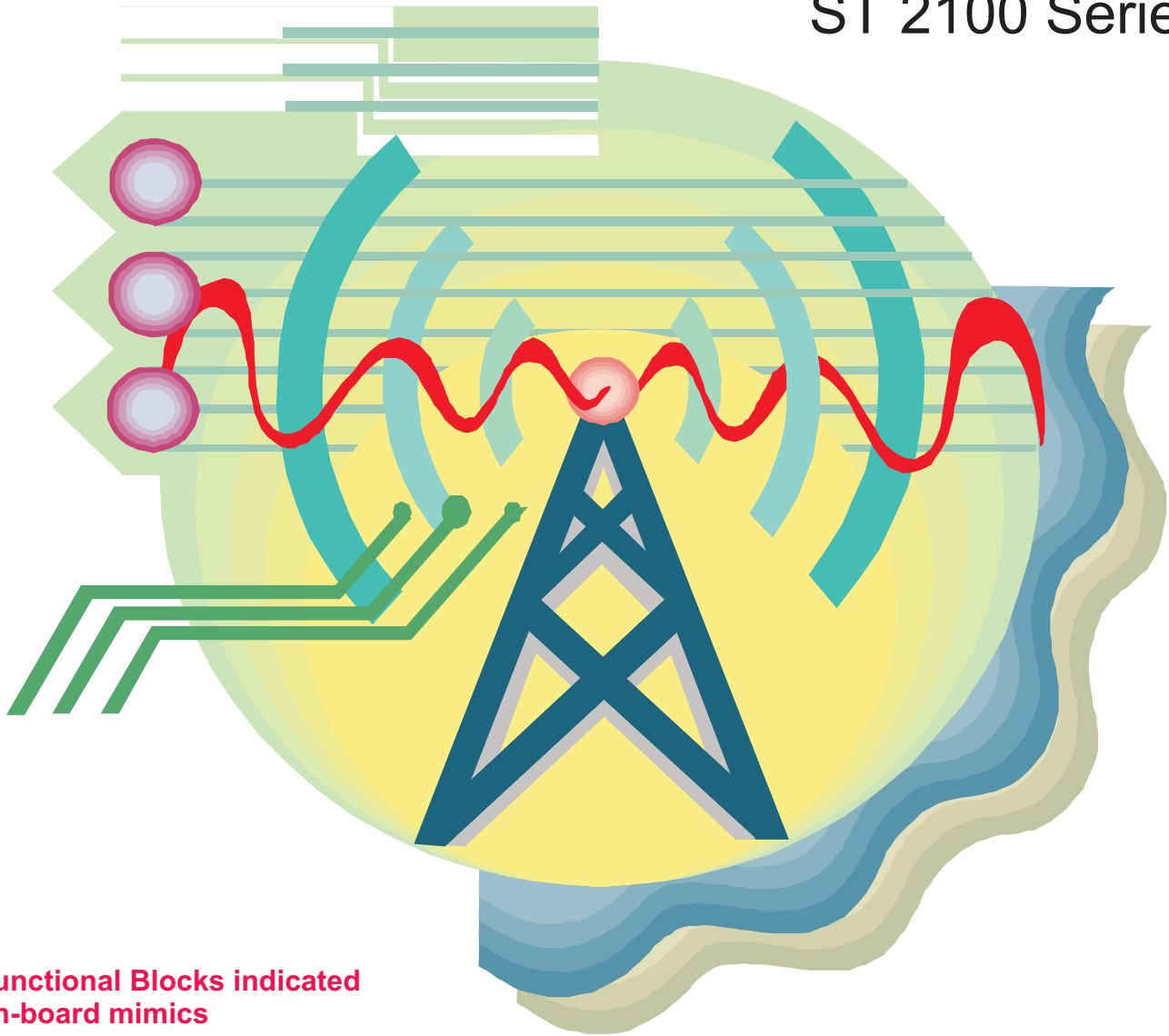# Digital Communication Trainers

ST 2100 Series
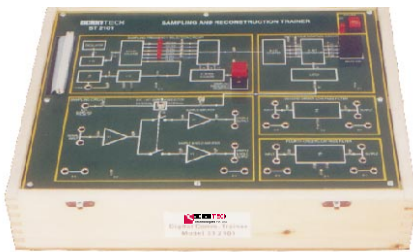
- ◆ **Functional Blocks indicated on-board mimics**

- ◆ **Input-Output and Test points provided on board**

- ◆ **On board DC Power Supply**

- ◆ **Fully documented Student Work Book**

- ◆ **Compact size**

Total training solutions

ST2101

SAMPLING AND RECONSTRUCTION TRAINER

The trainer provides all necessary inputs and connection for students to study signal Sampling and Reconstruction Techniques.

FEATURES
- Crystal controlled Pulse Generator
- Demonstrates Sampling and Reconstruction as per Nyquist criterion
- On-board Analog Generator (Synchronized)
- 5 Selectable Sampling Frequencies
- Sampling Pulse Duty Cycle selectable
- Internal / External sampling input selectable
- Separate Sample and Sample/Hold outputs
- On-board 2nd order and 4th order L. P. Filters

TECHNICAL SPECIFICATIONS
Crystal Frequency : 6.4 MHz
Sampling Frequency : 2, 4, 8, 16 & 32 KHz (Switch Selectable)
On-Board Generator : Synchronised 1KHz Sinewave (5Vpp)
Duty cycle : 0-90% in decade steps (Switch Selectable)
L. P. Filters : Butterworth 2nd & 4th order; Filter Cut-off frequency 3.4 KHz
Test Points : 51
Interconnections : 4mm Sockets
Power: 230V $\pm$ 10%, 50Hz
Dimensions (mm): W325, H90, D255
**Weight :** 2.4Kg (approx.)
Accessories included: Manuals, Set of patch cord, Line cord

EXPERIMENTS THAT CAN BE PERFORMED
- Study of Signal Sampling and Reconstruction Technique
- Study of Aliasing & Effect on Reconstruction of Signal due to various Sampling Frequencies
- Study of effect on Amplitude of Reconstructed signal by varying Sampling Pulse Duty Cycle in Sample & Sample/Hold output
- Comparison of 2nd and 4th Order Butterworth Filters
- Signal Sampling and Reconstruction using External sampling Input

ST2102

TDM PULSE AMPLITUDE MODULATION / DEMODULATION TRAINER
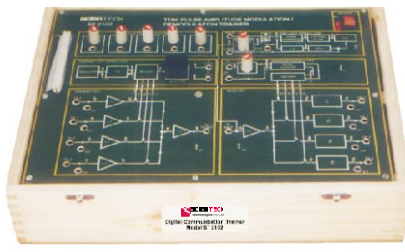
The trainer provides all necessary inputs and connections for students to study Pulse Amplitude Modulation/Demodulation techniques, Time Division Multiplexing & Demultiplexing of Signals and Signal Reconstruction.

FEATURES
- Crystal controlled Clock
- On-board Sine Generator (Synchronized)
- On-board Pulse Generator
- 4 Analog input channels samples and Time Division Multiplexed
- 5 Selectable Sampling Frequencies
- Pulse Duty Cycle Selectable
- Internal / External Sampling Selectable
- 4 channel Demultiplexer
- Generation of Clock at Receiver by PLL system
- 4th order Butterworth L. P. Filters

TECHNICAL SPECIFICATIONS
Crystal Frequency : 6.4 MHz
Analog Input Channels : 4
Multiplexing : Time Division Multiplexing
Modulation : Pulse Amplitude Modulation
On-board Analog Signal : 250 Hz, 500Hz, 1KHz, 2KHz (Sine Wave Synchronised to sampling pulse Adjustable Amplitude and separate variable DC Level)
Sampling Rate : 16 KHz/ Channel
Sampling Pulse : With Duty Cycle variable from 0-90% in decade steps
Clock Regeneration at Receiver : Using PLL
Low Pass Filter Cut-Off Frequency: 3.4KHz
Test Points : 52
Interconnections : 4mm Sockets
Power: 230V $\pm$ 10%, 50Hz
Dimensions (mm): W325, H90, D255
**Weight:** 2.4Kg (approx.)
Accessories included: Manuals, Set of patch cord, Line cord

EXPERIMENTS THAT CAN BE PERFORMED
- Study of Pulse Amplitude Modulation technique
- Study of Time Division Multiplexing and Demultiplexing
- Study of PLL as Frequency Multiplier to generate clock from sync signal
- Study of 3 modes of operation to regenerate original signal
    - a) 3 connections between transmitter & receiver (Clock, sync & information)
    - b) 2 Connections (information, sync) Clock regenerated at receiver
    - c) 1 connection (information only). Clock and sync derived at receiver
- Study of Effect of varying duty cycle of Sampling Pulse on signal reconstruction
- Signal Sampling and Reconstruction using

ST2103

TDM PULSE CODE MODULATION TRANSMITTER TRAINER
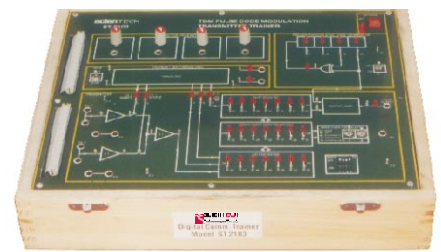
The trainer provides all necessary inputs and connection for students to study Pulse Code Modulation Transmission techniques. A communication link can be established by using PCM receiver Model ST2104.

FEATURES
- Crystal controlled Clock
- On-board Sine Generator (Synchronised)
- 2 TDM Analog Channels
- PCM Transmitter
- Fast and Slow modes for real time operation and data flow examination
- Error Check code option (Odd-even parity, Hamming code)
- 4 Switched faults allow different error check code options

TECHNICAL SPECIFICATIONS
Crystal Frequency : 12 MHz
On-board Generators :
(1) Adjustable Amplitude Sine Generator of 1&2 KHz frequency (synchronised)
(2) Variable Amplitude DC Level (2 Nos.)
Input Channels : Two
Multiplexing : Time Division Multiplexing
Modulation : Pulse Code Modulation
Sync Signal : Pseudo Random Sync. Code Generator
Error Check Code: Off-Odd-Even-Hamming
Operating Modes : Fast 16KHz/channel (approx.) Slow 68mHz / channel (approx.)
Test Points : 49
Interconnections : 4mm Sockets
Power: 230V $\pm$ 10%, 50Hz
Dimensions (mm): W325, H90, D255
**Weight :** 2.4Kg (approx.)
Accessories included: Manuals, Set of patch cord, Line cord

EXPERIMENTS THAT CAN BE PERFORMED
- Study of Pulse Code Modulation
- Study of A/D Convertor
- Study of Parallel to Serial Data conversion
- Study of Time Division Multiplexing of PCM Data
- Study of Synchronization by Pseudo random Code
- Study of Error Check Codes with switched faults operation
- Study of 3 connecting modes between transmitters & receiver
    - (1) Sync, clock, data lines connected
    - (2) Clock, data connected
    - (3) Data only
- Study of the effect of induced faults

scienTECH
Technologies Pvt. Ltd.

Digital Communication Trainers

ST2104

TDM PULSE CODE MODULATION RECEIVER TRAINER
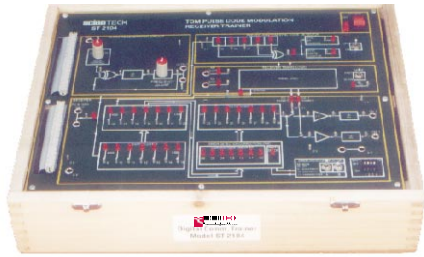
The trainer provides all necessary inputs and connection for students to study decoding and demultiplexing of data transmitted by PCM transmitter. On-Board PLL provides regeneration of Clock. Synchronization between transmitter and receiver is provided by Pseudo random code.

FEATURES

- Input accepts two channel multiplexed data
- On-board Demultiplexed PCM receiver
- On-board L. P. Filter
- Fast and Slow modes for real time operation and examination of control signal and data on LED
- On-board PLL for Clock Regeneration
- On-board Sync Code Detector
- Error Check code options
  (1) Odd or Even Parity – single bit error detection
  (2) Hamming code- single bit error detection
- 4 Switched faults allow different error check code options.

TECHNICAL SPECIFICATIONS

Input Channels : 2 TDM Serial Input
Demodulation : Pulse Code Demodulation **Clock :** Regeneration by PLL
Low Pass Filter : Butterworth- 4th order 3.4 KHz cutoff Frequency (2 no.s)
Operating Speed : Fast-16 KHz/channel; Slow 68mHz/channel (approx.)
Error Detection : Off-Odd-Even Parity Hamming Code
Error Correction: Hamming code
Test Points : 56
Interconnections : 4mm Sockets
Power: 230V + 10%, 50Hz
Dimensions (mm): W325, H90, D255
**Weight :** 2.4Kg (approx.)
Accessories included: Manuals, Set of patch cord, Line cord

EXPERIMENTS THAT CAN BE PERFORMED

- Study of PCM Demodulation Technique
- Study of Time Division Demultiplexing of PCM data
- Study of Clock Regeneration by PLL
- Study of Detection & Correction of Error induced by switched faults in the transmitter.
- Study of signal recovery in 3 connecting modes between transmitter & receiver
- Study of Importance of Clock and Frame Synchronization in PCM system
- Study of the effect of induced faults in receiver.

ST2105

DELTA, ADAPTIVE DELTA AND DELTA SIGMA MODULATION/ DEMODULATION TRAINER
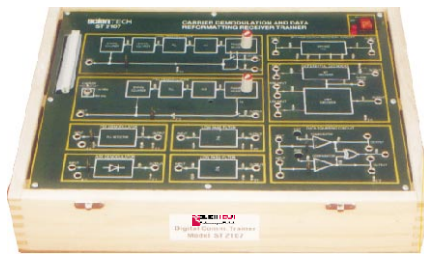
In digital communication specially operating at low frequencies or speech communications a saving in Bandwidth can be resulted using Delta Modulation and its associated techniques because this requires single encoding of sample. This Trainer covers Delta, Adaptive Delta and Delta sigma Modulation and Demodulation.

FEATURES

- Both transmitter & receiver on same board
- Clock generation from Crystal
- 4 switch selectable Sampling Rates
- 4 On-board Generators at 4 different frequencies (synchronised)
- Separate Adjustable DC level
- Selectable Integrator gain setting (by switch or control circuit)
- On-board 4th Order Butterworth L. P. Filter
- Unipolar to Bipolar conversion On-board

TECHNICAL SPECIFICATIONS

Crystal Frequency : 4.096 MHz
Sampling Frequency : 32KHz, 64KHz, 128KHz, 256KHz (Switch Selectable)
On-Board Generator : Synchronised & Adjustable Amplitude Sinewave generator at 250Hz, 500Hz, 1KHz, 2KHz. Separate variable D.C. level
Integrators: 4 integrator gain settings Norm, x2, x4, x8
L. P. Filters : 4th order Butterworth (3.4 KHz Cut Off Frequency)
Test Points : 59
Interconnections : 4mm Sockets
Power: 230V + 10%, 50Hz
Dimensions (mm): W325, H90, D255
**Weight :** 2.4Kg (approx.)
Accessories included: Manuals, Set of patch cord, Line cord

EXPERIMENTS THAT CAN BE PERFORMED

- A) Study of Delta Modulation & Demodulation
  B) Study of effect of slope overload and increased integrator gain in Delta Modulation
- Study of Adaptive Delta Modulation & Demodulation
- A) Study of Delta Sigma Modulation & Demodulation
  B) Study of amplitude overload in Delta Sigma Modulation

ST2106

DATA FORMATTING AND CARRIER MODULATION TRANSMITTER TRAINER
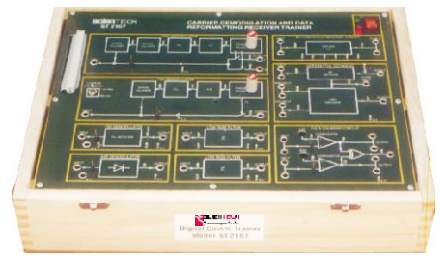
In digital communication Data Formatting is very important. The available data stream from PCM transmitter is converted into different formats best suited to individual transmission system. Various formats are covered in this trainer. Also to transmit the digital information Carrier Modulation is necessary. Various modulation techniques are also covered in this trainer.

This trainer requires TDM Pulse Modulation Transmitter Trainer (Model ST2103) for input of the digital data.

FEATURES

- On-Board carrier generation circuit (Sinewaves synchronised to transmitted data)
- On-Board Inphase and Quadrature Phase Carrier for QPSK modulation
- Different data conditioning formats – NRZ(L), NRZ(M) RZ, Biphase (Manchester), Biphase (Mark), AMI, RB, Differentially encoded dibit pair
- FSK, PSK, ASK & QPSK Carrier modulation
- Variable Carrier and Modulation Offset
- Variable carrier gain
- On-Board Unipolar to Bipolar Conversion
- On-Board data inverter

TECHNICAL SPECIFICATIONS

Input : Two channel Time Division Multiplexed Data
Data Formats : N.Z.(L), N.Z.(M) RZ,AMI, RB Biphase (Manchester), Biphase (Mark), Differentially encoded dibit pair
Carrier Modulation : FSK, PSK, ASK & QPSK
On-board carrier: Sinewave Synchronised to transmit data at 1.44 MHz, 960KHz, (0 deg. Phase) 960 KHz (90 deg. Phase)
Test Points : 38
Interconnections : 4mm Sockets
Power: 230V + 10%, 50Hz
Dimensions (mm): W325, H90, D255
Weight : 2.4Kg (approx.)
Accessories included: Manuals, Set of patch cord, Line cord

EXPERIMENTS THAT CAN BE PERFORMED

- Study of Coversion of NRZ data to other data formats NRZ(L), NRZ(M) RZ, AMI, RB, Biphase (Manchester), Biphase (Mark), Differentially encoded dibit pair
- Study of following Carrier Modulation Techniques and their comparison-ASK, FSK, PSK & QPSK

...the best learning tools !

ST2107

CARRIER DEMODULATION AND DATA REFORMATTING RECEIVER TRAINER

Data formatting and carrier modulation done in ST 2106 can be demodulated and reformatted by using this trainer.

FEATURES
- 7 Different data conditioning formats (NRZ(M) RZ, Biphase (Manchester), Biphase (Mark), AMI, RB, Differentially encoded dibit pair to NRZ data)
- FSK, PSK, ASK & QPSK Carrier Demodulation
- Output gives 2 channels TDM multiplexed data output
- On-Board Biphase clock recovery circuit
- On-board data squaring circuit and different decoder
- On-Board Butterworth Filters – 4th Order (2 Nos.)

TECHNICAL SPECIFICATIONS
Input : from Model ST2106
Ouput: 2 Channel TDM Multiplexed Data Stream
Deconditioning options : NRZ(M) RZ, AMI, RB
Biphase (Manchester), Biphase (Mark),
Differentially encoded dibit pair to NRZ(L)
Carrier Demodulation: : 1. ASK – Rectifier diode
2. FSK – PLL Detector 3. PSK – Square Loop
Detector 4. QPSK – Fourth Power Loop Detector
Biphase Clock recovery : by PLL
Test Points : 54
Interconnections : 4mm Sockets
Power: 230V + 10%, 50Hz
Dimensions (mm): W325, H90, D255
Weight : 2.4Kg (approx.)
Accessories included: Manuals, Set of patch cord, Line cord

EXPERIMENTS THAT CAN BE PERFORMED
- Study of Conversion of different data formats to NRZ data format.
- Study of various Carrier Demodulation Techniques (ASK, FSK, PSK & QPSK)

ST2108

AUDIO INPUT MODULE

The module accepts audio input signals from microphone or a tape recoder. The signal after amplification is connected to digital communication trainer (which accepts external analog signal also.

TECHNICAL SPECIFICATIONS
Input Impedance : 600Ω (Microphone Socket)
Input Impedance : 100KΩ (Tape Socket)
Voltage Gain : +1 to +107 (approx.)
L.P. Filter : 4th Order (3.4 KHz Cutoff)
Max. Output Voltage : + 5.5V
Power: 230V + 10%, 50Hz
Dimensions (mm): W196, H80, D237
Weight : 2.2Kg (approx.)
Accessories included: Manuals, Microphone

ST2109

AUDIO OUTPUT MODULE

The module accepts an audio input signal. The built-in power amplifier output drives an 2.5 inch speaker providing the audio output. A volume control is provided to adjust the volume. Headphone Socket can be used to connect headphones. The input may come from Receiver Trainer.

TECHNICAL SPECIFICATIONS
Input Impedance : 47KΩ (Microphone Socket)
Output Volume : Adjustable
Sound Speakers: 2.5', 8, 0.3W
Headphone Socket: 3.5 mm stereo jack
Power: 230V + 10%, 50Hz
Dimensions (mm): W196, H80, D237
Weight : 2.2Kg (approx.)
Accessories included: Manuals, Microphone

ST2110

PAM-PPM-PWM MODULATION AND DEMODULATION TRAINER

PAM-PPM-PWM are the basic pulse modulation techniques. The trainer provides complete set up to the students for performing experiments on these techniques. they can study Sampling, Pulse Modulation, Demodulation & Signal reconstruction process. Separate circuits are provided for each technique. The student Work-book & operating Manual provides technology details, circuit description & experiments.

FEATURES
- PAM-PPM-PWM Modulation & Demodulation techniques, using Natural & Flat-top sampling
- Analog Sample, Sample & Hold and Flat-top outputs
- Selectable 4 different sampling pulse frequencies on board
- Voice Communication using dynamic microphone & speaker
- On-board Filter and AC Amplifier
- 8 Switched Faults

TECHNICAL SPECIFICATIONS
Pulse Modulation Techniques:
(1) Pulse Amplitude Modulation
(2) Pulse Width Modulation
(3) Pulse Position Modulation
On-board Sampling Frquencies (Pulse): 8KHz, 16KHz, 32KHz, 64KHz
On-board Generators :
(1) Sinewave 1KHz & 2 KHz(Gain adjustable)
(2) Squarewave 1KHz & 2 KHz
Low Pass Filter : 4th order BW Filter
Voice Communication : Voice Link using dynamic mic & speaker
AC Amplifier : With Adjustable Gain Control
DC Output : 0-4V (Variable)
Switched Faults : 8 No.s
Interconnections : 4mm Bannana Sockets
Test Points : 29
Interconnections : 4mm Sockets
Power: 230V + 10%, 50Hz
Dimensions (mm): W419, H90, D255
Weight : 2.8Kg (approx.)
Accessories included: Manuals, Set of patch cord, Line cord, Microphone, Headphone

EXPERIMENTS THAT CAN BE PERFORMED
Study of
- PAM using Natural & Flat Top sampling
- Sample, Sample & Hold and Flat-top outputs in PAM
- PAM with Sample, Sample & Hold and Flat-top modulating outputs
- PPM using DC and AC (sine wave) modulating signals.
- Pulse Position Demodulation
- Pulse width Modulation & Demodulation using different sampling frequencies.

Cyber Nomads, Indore