Order Code - 40557
Communication System Trainer

TECHNICAL SPECIFICATIONS OF MASTER UNIT

Communication Medium	**FM (Wireless)**	**AM (Wireless)**	**Fiber Optics**
Transmitter a) Carrier b) I/P Ampl I/p Freq. c) Power O/P	Tunnable from 88 Mhz to108MHz with built in FM (VCO)	500KHz to 1.5MHz	TTL BW - 64KHz,Analog BW –Audio, Uses Red LED Emitter.
	0-5 Vpp (digital) Audio range.	0-5 Vpp (digital) Carrier modulated i/p (audio range)	0-5 Vpp (digital) Modulated i/p (audio)
		50 to 100mW	
Receiver	External 5 BS5 to connect to antenna, 2nd IF i/p, 2nd IF o/p, speaker & Audio amplifier, AM/FM Select switch, L/S impedance 8 ohm / 0.5 W		Detector (tr=8mS) Separate Bs5 socket for Digital ,AC coupled & TTL ops.
Controls(Man)	Settable 88 MHz to 108 Mhz.	Gain control Settable from 0 to 4.5V	Transmitter bias Control.
Antenna / Transmission	Telescopic antenna (3 branch antenna) (optional)		1m plastic fiber cable, CRT-1.492,NA- 0.5,λ− 660nm, step index, terminated with SMA connector.
Waveform Gen.	**Function Generator**	**Audio Oscillator**	**Sync. Sine Wave Gen.**
I/P	**AM (std)** -i/p volt-+5V, 0V-No modulation AM (**DSBSC)-**i/p volt.0-9.8 Vpp,o/p volt.0- 2.7. **FM** i/p volt. 400mV (+50%modulation) **ASK**- i/p upto 500Hz,+5V Square wave **FSK**-i/p upto 500Hz,+4.5V Square wave	Selection of Sine / Square / Triangle	32 KHz TTL I/P to Generate 4 nos. of sync. sine O/P
Waveform	SINE/TRG/TTL	SINE/TRG/SQUARE	SINE
O/p Freq	1 Hz to 1MHz in 6 ranges	50 Hz to 5KHz	250/ 500/1000/ 2000 Hz
O/p volt.	0-20Vpp max(sine/TRG) @ 100KHz.	Sine0-2Vpp, Square 0-9 Vpp TRG0-3Vpp	0-10 Vpp
Controls	Freq & Amplitude controls pots	Freq & Amplitude controls pots	Amp. Control pot.

Specification for common Resources

Power supply	5V / 1A, ± 12V/500mA, 0 to 15V DC (Variable)/100 mA, 0 to 30V DC (Variable)/100 mA	**Mechanical Dimensions** **(A) Master Unit** : 400mm(W), 125mm(H), 270mm(D) **Net weight :8Kg.** **Gross Wt : 10Kg.** **(B) Panel** : 215mm(W), 165mm(H), 40mm(D) **Net weight :** 700 gm approx
Mic with pre-Amp	Hand held Electret / dynamic microphone with preamplifier for audio range	
Audio Amplifier	Variable Gain up to 20 for Audio range, Built in Loudspeaker – 8 ohm/500mW / earphone.	
Pink Noise Gen.	Frequency response of filter for audio range.	
Buffer/AC amplifier	NIV gain amplifier 2 Nos, Gain- 0-20, Non sinusoidal Signal Generator cum INV buffer	
BNC TO Banana	Converts 1 BNC Socket to 2 Banana Sockets (4mm).	
Low pass filter	4 Nos - 2 pole/4 pole butter worth filter cutoff freq 3.4 KHz Audio range.	
PRBS	Switch settable for on/off fix 15 bit Pseudo Random Binary Sequence generator	

Note: Specifications are subject to change.

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X **Modular experiment panels offered (Atleast select one or more Panels)**

1) Fiber Optic/ Led / Laser Expt. Panel - 40558
(Provided with 16 banana + 2 TPs + 1 Led.)
Fiber optic cable (plastic)

i. Core material: PMMA (polymethyl methacylate)
ii. Cladding material: fluorinated polymer
iii. Fiber structure: step index type
iv. Core cladding diameter: 90 micron/1000 microns
v. Core refractive index: 1.492
vi. Cladding refractive index: 1.405 to 1.417
vii. Numerical aperture :0. 5(typically)
Viii. Acceptance angle: 55 to 60 degrees
ix. Attenuation (60nm):0. 3 dB/meter
x. Jacket material: polythene (black): 2.2 mm OD
xi. LENGTH=1m, 5m

Transmitter: 4 nos. LASER (780nm), IR (850nm), RED (660nm), BLUE (470nm),

- Specifications (SFH 485):
- Reverse voltage : VR =5V
- Forward Current : IF=100mA
- Power dessipation : Ptot =200mW
- Wave length at peak emission: ?peak = 880nm

Receiver: PIN photo diode (SFH 213)

- Max wave length =850 nm
- Rise time and Fall Time tr & tf=5ns
- Reverse voltage: 50V
- Total Power Dissipation: 100mW.
- Photo Current: 135(>/= 100ìA)

Modulation Techniques: Pulse Width Modulation, Frequency Modulation, Amplitude Modulation

- Drivers: analog
- AC Amplifiers: 1 nos
- Comparator: 1 nos
- Analog Bandwidth: 500KHz(except LASER) &1MHz for LASER
- Digital Bandwidth: 1 MHz (except LASER) &2MHz for LASER
- Voice link: established using microphone & speaker (Master unit [MU])
- PC –PC Communication: Using RS –232 interfaces 9 pin D – type connector
- Baud Rate: 2400
- Switched faults: 4 in transmitter 4 in receiver

High Speed Digital Link module (Optional)
Digital Band Width: 3MHz
Transmitter:

- Forward input current (IFPK): 1000 mA (IFdc)=80 mA
- Reverse input voltage: VBR= 5V
- Peak wavelength emission: 660 nm
- N.A.:0.5
- Rise time: 80 ns
- Fall time: 40 ns

Receiver:

- Supply voltage: (max) 7V
- O/p collector current: 25 mA
- O/p collector power dissipation: 40 mW
- O/P VOLTAGE: 18v
- Fan out (TTL): 5

List of experiments

a) DC Characteristics of transmitter diodes
b) SENSITIVITY of Optical Fiber
c) AC Frequency Response - Analog Link & B.W
d) Digital Frequency Response - Digital Link & B.W
e) Numerical Aperture
f) Losses in cable
  i) Bending loss
  Ii) Transmission loss
  iii) Coupling loss
g) Immunity to electrical noise interference of optical fiber
h) PC interface: using RS 232
i) Signal transmission using Pulse Width Modulation & Demodulation
j) VOICE COMMUNICATION using direct transmission as well as modulated using PWM
k) Voice transmission using Amplitude Modulation & Demodulation
l) Signal transmission using Frequency Modulation & Demodulation
m) SWITCHED FAULTS
n) High Speed Digital Link (optional)

ACCESSORIES
N.A. APPARATUS, Bending radii stack (BR), fiber optic cable: 1m, 5m with SMA CONNECTOR, Electrical Interference Experiment Apparatus, Coupling loss apparatus, Speaker and MIC (from MU).

Optional expansion modules

1) High speed digital link (B.W.=2MHz) with 1m FO cable.
2) FO emitter detector module

2) 1 channel Sampling & Reconstruction , 4 Channel TDM/PAM & PPM, PWM, PFM Expt. panel - 40559
(Provided with 20 banana + 10 TPs + 10 Leds)

1. Crystal Freq.-10 MHz, Shares common resources like sync sine wave 4 nos, microphone / loudspeaker Amplifier, Low Pass Filter (LPF 2P / 4P) etc from
2. Master unit (MU)
3. Switched faults : - 4 Nos.

1channel Sampling/ Reconstruction & 4 Channel TDM/PAM & demodulation: -

a) **Modulator :** Analog i/p channel: - 4 Nos, 10 Vpp, Bipolar. Settable Sampling Freq. (1of 7) : 64 / 32 / 16 / 8 / 4 / 2 / 1 KHz With Settable Duty Cycle 10-90 % in decade steps.
b) **De-Modulator :** Clock Regeneration using PLL, LPF, ½/3 Wire Communications.

- **PWM / PPM**

a) **Modulator :** I/P freq Audio range (Sine) @ 0-8 Vpp , Carrier Freq - 64KHz (TRG) @ 8 Vpp O/P TTL.
b) **De-Modulator :** LPF (MU), PPM is converter into PWM then Demodulated.

PFM

a) **Modulator :** Center Freq (64KHz / TTL) from Function Generator (MU) is FM modulated by audio signal generating PFM pulse train .
b) **De-Modulator :** PLL Detector followed by LPF from MU.

List of experiments

a) Single channel PAM Sampling [1CH Signal Sampling & Reconstruction (1 CH SSRC)]
i) Natural Sampling
ii) Flat Top Sampling (Sample Hold)
b) Multichannel [4 CH] PAM Sampling, multiplexing of data over single wire & demultiplexing of data at receiver to reconstruct 4 channels by various method 3 \2 \1 wires [mode 1, 2, 3 respectively.]
c) PWM \PFM \PPM Pulse modulation & demodulation as a methods of digital communication

3) Carrier modulation/ Demodulation Expt. Panel - 40560
(Provided with 38 banana + 3 Tps)

- Shares common resources like Data Bit Stream (PRBS), FSK
- Demodulated etc from Master unit (MU).
- **Carrier Sine wave**-500KHz, 250KHz(0° phase) & 250KHz(90° phase) with settable amplitude 0 to 2Vpp.
- 4 MHz Crystal Stabilized Clock.
- **On board Unipolar to Bi polar Converter, Data Squaring.**
- **Carrier Modulation Techniques** ASK, FSK, PSK & QPSK.
- **Carrier De-Modulation Techniques** ASK (Rectifier Detector), FSK (Phase Lock Loop Detector), PSK (Squaring loop Detector) and QPSK (Fourth power loop detector).
- **Low Pass Filter** 2 Nos with Cut off Frequency 340KHz.

List of experiments

a) Amplitude Shift Keying [ASK] Modulation / Demodulation.
b) Frequency Shift Keying [FSK] Modulation / Demodulation.
c) Phase Shift Keying [PSK] Modulation / Demodulation.
d) Quadrature Phase Shift Keying [QPSK] Modulation /Demodulation.

4) 2 Channel Pulse Code Modulation [PCM]/ Demodulation with frame & bit Error Detection & synchronization & Correction Expt. Panel - 40561
(Provided with 22 banana + 6 TPs + 20 Leds)
Shares common resources like sync sine wave 4 nos, microphone / loudspeaker Amplifier, Pseudo Random Binary Sequence Generator, Low Pass Filter (LPF 2P / 4P) etc from Master unit (MU)

- Switched faults: - 4 Nos. + 2 No Switches for bit error simulation
- 1 & 2 Ch TDM / PCM Mod - Demod: - 1/2/3 Wire Communications

a) Modulator : Analog i/p : - 2 Nos, 10 Vpp , onboard Two adjustable variable DC source, Sampling Freq. 16KHz per Channel for Fast mode & 0.106 Hz per Channel for Slow Mode, use of PRBs to generate frame marker useful to establish syc. in receiver during 1/2 wire communications.
b) De-Modulator : Synchronization is established by using Pseudo Random Binary Sequence, Clock Regeneration using PLL, **c) Frame & bit Error Detection :** Use of PRBs for synchronization, selectable for OFF, Even , Odd parity & Hamming check code.
d) Error Correction : Single or Double Data bit error correction using Hamming code Voice communication using wired PCM. Voice communication using Fiber optics (CM1) & PCM

- Voice communication using wired PCM.
- Voice communication using Fiber optics (CM1) & PCM

List of experiments

a) Single channel Pulse Code Modulation & Demodulation by various method 3 \2 \1 wires [mode 1, 2, 3 respectively.]
b) Two channel Pulse Code Modulation & Demodulation by various method 3 \2 \1 wires [mode 1, 2, 3 respectively.]
c) Use of PRBS for frame synchronization by adding a Bit (Marker) in 2 / 1 Wire (Mode 2, 3 respectively)
d) Study of Error Code Check Such as Even Parity, Odd Parity and 1 bit / 2 bit error simulation & correction by Hamming Code.
e) Voice and Radio communication using PCM.
f) Study of ADC / DAC [CODEC] by observing on Leds & by applying DC Levels at single or both i/ps.
g) Switched Faults.

5) Delta, adaptive delta, sigma delta modulation and demodulation Expt. Panel - 40562 (Provided with 26 banana) Shares common resources like sync sine wave 4 nos., Microphone/ Loudspeaker Amplifier Low pass filter, LPF (2P/4P) etc. From Master Unit

- Consisting of Voltage comparator, differential amplifier, TTL to Bipolar Converter.
- Switched faults. (4 Nos.)
- Delta, adaptive delta (CVSD), sigma modulation &demodulation,
- Adaptive control circuits 2Nos. each, provides 2 bit binary code,
- used to control gain of an integrator for adaptive delta modulation.
- Companding - Using compressor and expander function blocks .

List of experiments

a) Delta mod-demod
b) Adaptive (CVSD) delta mod demod
c) Sigma delta mod demod
d) Voice communication
e) Effect of companding on delta mod-demod
f) Switched faults

6) AM modulation & demodulation Expt . panel - 40563
(Provided with 26 banana)
Consisting of 3Nos. modulators, Ceramic BPF, AM Antenna buffer cum RF amplifier, envelope - diode detector.

- Switched faults - 4 Nos.
- **Modulator:** Balanced modulator (DSB SC) - 2Nos. and DSB - TC -1 No., SSB - SC - 1No.
- **Demodulator:** Envelope detector 1 No., Product detector 1No.
- Frequency division multiplexing with 2 Nos. of DSB - SC AM
- channels (Use P19 for demod of FDM - AM)

List of experiments

a) DSB modulation with transmitted carrier (TC)
b) DSB modulation with suppressed carrier (SC)
c) Ceramic filter (BPF)
d) SSB SC modulation (for upper/lower side band)
e) DSB TC demodulation
f) DSB SC demodulation
g) SSB SC demodulation
h) ASK demodulation using synchronous detector
h) QAM mod demod
i) FDM-AM using P19(AM/FM receiver kit)
j) Voice communication
k) Switched faults

CBT (Optional) Proving theory of AM (DSB-SC, SSB-SC, FDM, QAM) using numerical method on PC (Excel Graphs)

7) AM demodulator cum AM-FM Receiver Expt. Panel - 40568
(Provided with 3 banana + 20TPs)
Consisting of antenna, RF amplifier, IF amplifier, Local oscillator (455KHz), Mixer, Audio amplifier with L/S

- AM demodulator - Diode Detector for DSB
- Switched faults 16 Nos.
- Determination of Selectivity, Sensitivity.
- Sythesised Surperheterodyne Receiver - AM receiver cum tunner
- (450 to 1450KHz), FM receiver com tunner (88 to 108MHz)

List of Experiment :
AM receiver:

- DSB TC demodulation using tuning of AM receiver
- Sensitivity of radio receiver
- Signal to Noise ration
- Effect of AGC
- Selectivity of radio receiver

FM receiver:

- Signal to noise ratio,
- Effect of AGC
- Fidelity of Radio Receiver

8) FM Modulation & Demodulation Expt. Panel - 40564
(Provided with 24 banana + 2TPs)
Shares common resources like Audio FG microphone / L/S & Amp., pink noise Generator, LPF (2P / 4P) etc. from MU.
- Switched faults: - 8 Nos.
- **Mod - Demod: -**

a) Modulator : (With center frequency 455 KHz).
1) Reactance Modulator using Arm strong oscillator.
2) Varactor Modulator with center frequency adjustment.
3) Phase modulator using varactor

b) Demodulator :
1) Detuned resonant circuit detector
2) Quadrature detector.
3) Foster-Seeley discriminators
4) Ratio detector.
5) Phase-locked loop detector and determination of capture and lock range.
6) Phase De modulator using quadrature detector

List of experiments
Frequency modulation using
1) Reactance modulator
2) Varactor modulator
3) Phase modulator using varactor Frequency demodulation using
4) Detuned resonant detector
5) Foster Seeley/ratio detector
6) Study of PLL capture & lock range & its use as FM detector
7) Use of PLL as Armstrong Modulator
8) Quadrature detector
9) Phase demodulation using quadrature detector
10) Introduction of noise & its effects on frequency modulation
11) Voice communication
12) Switched faults

CBT (Optional) -Proving theory of FM, PM (using numerical method on PC (Excel Graphs)

9) Data Formatting / Reformatting Expt. Panel - 40565
(Provided with 18 banana.)
Shares common resources like Data Bit Stream (PRBS), FSK Demodulator etc from Master unit (MU)
Data Formatting and Reformatting Option NRZ (L), NRZ (M), Polar RZ (AMI) & NRZ, Bipolar RZ & NRZ, Bi-phase Manchester, Bi-phase Mark, Differential Encoded Dibit (For use with QPSK).] -8 Nos. Of encoders & 3 Nos. of bit decoders & 1 No. of dibit decoders.
Bi phase Clock Recovery - By using Phase Lock Loop (PLL) with center frequency 250KHz & 32KHz selectable.

List of experiments
a) Study of RZ, NRZ-L [Non Return To Zero – Level], NRZ-M [Non Return To Zero – Mark], Bi phase Mark, NRZ-S, Bi phase Manchester encoders & decoders
b) Study of RZ – AMI [Return To Zero – Alternate Mark Inversion] encoder & decoder
c) Study of differential DIBIT [MSB /LSB] Encoder & Decoder

10) Fourier analysis cum synthesis panel (FAS) - 40566
(Provided with 12 banana + 11 test points)
- Fundamental frequency 1KHz
- Splits 1KHz square wave into fundamental sin and 9 harmonics including DC component if any.
- Synthesis of 10 above components to generate original signal.
- Display frequency components on CRO using spectrum display controller in external trigger mode.
- Study of filters (LPF, HPF, BPF) and display characteristics curve on CRO (XY Mode) using FM sweep display.

List of experiments
a) Fourier analysis
b) Fourier synthesis
c) Spectrum Analyzer cum Fourier component display on CRO
d) Study of filters
e) Switched faults

lCBT (Optional)
Proving theory of Fourier Analysis & Synthesis (using numerical method on PC (Excel Graphs)

11) Transmission Line Expt, Panel - 40567
(Provided with 27 banana.)
- Consisting of 50 ohm, 70 ohm simulated line, pulse generator, 50 ohm line driver,BNC to banana adaptor- 2nos, Impedance matching variable resistors 2nos.
- Effect of pulse input, reactive termination, match termination, noise.
- Standing wave display on CRO in external trigger mode & VSWR determination.
- Optional Coaxial cable (RG58) x 55 meters & terminating BNC,
- Calculation of delay, impedance, speed of light, standing wave ratio.

List of experiments
a) Delay using a pulse input
b) Matching using pulse input
c) Reactive termination
d) Noise in communication
e) Matching & frequency response
f) Phase relationship
g) Standing wave ratio & Transformer matching.
h) Standing waves
i) Low pass filter effect
j) 50 ohm line as an oscillator
k) Time domain reflectometry
l) Switched Faults
m) Experiments with actual RG 58 cable used in transmission line (optional)

SALIENT FEATURES
- Can learn and experiment about variety of communication mediums (AM, FM, FO, Wired) & methods (Modulation / Demodulation Analog / Digital)
- Covers Analog communication, Digital communication, Fiber optics characteristics as well as communication, Wired communication through various modular experiment panels implemented using latest state of arts VLSI / CPLDs.
- Aesthetically designed injection molded electronic desk (master unit) carrying useful experiment resources like power supplies, Multi Function generators, FM/AM/FO/x'mitter/receiver, mic & L/S amplifier, Butterworth Filter(BWF),Sync sine waves etc while central slot will hold various replaceable experiment panels. Order 10 Master Units + 10 Panels sets or multiples.
- Connection through sturdy 4mm Banana sockets, patch cord & SMA connectors.
- Student workbook & instructor's Guide provided with each unit.