

ELECTRICAL AND ELECTRONIC SYSTEM TRAINER (Model : XPO-CT)



SPECIFICATIONS OF MASTER UNIT

◆ Built in Power Supply

DC Supply : 5V / 1A. & $\pm 12V$, 500mA. 0 to 15V
DC (Variable), 100 mA (Isolated),
0 to 30V DC (Variable), 100 mA
(Isolated),
High Volt DC 15V to 120V, 100mA
AC Supply : 12-0-12V AC, 150 mA. Short circuit
Protected.

◆ Built in Function Generator

O/p Waveform : Sine, Triangle & TTL O/Ps
Output Frequency : 1 Hz to 1MHz in 6 ranges, with
amplitude & frequency control
pots. O/P Voltage 20Vp-p max.
(Sin/TRG)
Modulation I/P: AM : - I/P voltage $\pm 5V$ (100%
modulation) O/P - For 0V (min),
+ 5V (max.) - 5V (Phase reversal of
O/P) FM : I/P voltage $\pm 400mV$
($\pm 50\%$ modulation)

- ◆ Clock Generator : 10 MHz TTL clock.
- ◆ Data Switches (10 No.) & bi-colour LED status indicators 10X2 Nos, for High/Low indication.
- ◆ Pulsar switches (2 Nos.) with four debounced outputs - 2No.
- ◆ BNC to 2 channel banana adapter - 2No.
- ◆ Logic probe to detect High/Low level pulses upto 1MHz, with bi-colour LEDs to indicate status.
- ◆ 2 / 4 digit 7 segment display with BCD to 7 segment decoder.

- ◆ Onboard DPMs provided with mode/range selection.
(A) DC volt : 2V/200V - 1No.
(B) DC current : 2mA/200mA - 1No.
(C) DC Volts/Current : 20V/200mA - 1No.
- ◆ Onboard moving iron meters provided for
(A) AC Current : 1 AMP - 1No.
(B) AC Voltage : 15V - 1No.
- ◆ Onboard speaker : 8 Ohms, 0.5 Watt (1No.)
- ◆ Onboard POTS : 1K - 1No.
1M - 1No.
- ◆ **Mechanical Dimensions**
(A) Master Unit : 460mm(W), 160mm(H), 350mm(D)
Net weight : 6.5 Kg. Gross weight : 8.5 Kg.
(B) Panel: 215mm(W), 165mm(H), 40mm(D)
Net weight: 700 gm approx.
- u Operating Voltage: 220/240Vac switch settable $\pm 10\%$,
50Hz/60VA.

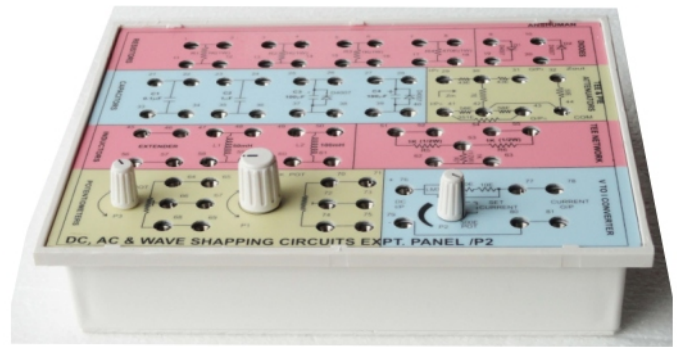
SALIENT FEATURES

- ◆ Aesthetically designed injection molded electronic desk (Master unit) carrying useful experiment resources Variable Power supplies / Status / Pulsar / Function Generator, DPMs etc. while the central slot will carry replaceable experiment panel secured in an ABS molded plastic sturdy enclosure, and has colorful screw less overlay showing circuit & its connection tag numbers for easy connectivity.
- ◆ Connection through Sturdy 4mm Banana Sockets & Patch Cords.
- ◆ Hands on learning by constructing circuits using built in power bread board panel as well as optionally using Discrete component panel.
- ◆ Set of Users Guide provided with each Unit.
- ◆ Order 10 Master units & multiples of 10 or more panels set.

MODULAR EXPERIMENT PANELS : Following experiment panels normally work in conjunction with CT Master Unit. However they can be ordered as stand alone units with built in power supply.



Discrete Component Panel [DCP] : Panel with following discrete components : 7 Resistors, 5 diodes, 1 LDR, 1 Zener, 3 NPN transistors, 1 PNP transistors, 1 UJT, 4 Capacitors, 1 HV Capacitors, 2 SCR, 2 FET & MOSFET, 1 12V RELAY, 3 Inductors, 1 Linear pot, 1 Triac, 1 Audio transformer, 1 PUT, 1 HW Resistor, 1 DIAC, 92 Banana sockets for patch cording to construct various circuits.

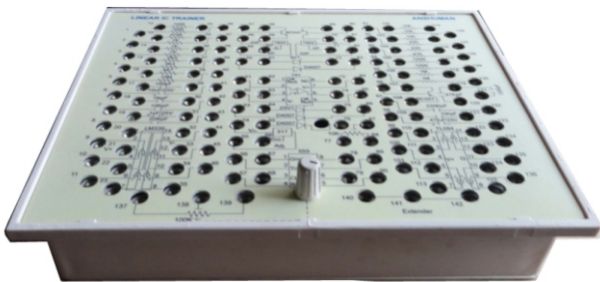


DC, AC & Wave Shaping Circuit Experiment Panel (P2)
(Provided with 81 banana tags)

DC : Resistance, current and voltage measurements, Loading of Potentiometer, Ohm's law, Power DC circuits, Series, parallel and mixed circuits, Kirchoff's law, Superposition theorem, Thevenin's & Norton's theorems, Reciprocity, Compensation, Tellegen, Millman theorems & Maximum Power transfer theorem, Voltage distribution of capacitors in series & parallel, total capacitance of capacitors in series and parallel, charging and discharging of capacitor through resistance & time constant, Wheatstone's Bridge, 2 Port Network Y, Z, h, ABCD Parameters & Star Delta Network, T & Pi attenuators.

AC : AC Voltage & Current Measurements - R-L series, R-C series, R-L-C series circuit (Series Resonance). R - L parallel, R-C parallel, R-L-C parallel (Parallel Resonance), Active, Reactive power & power factor (Vector Diagram), average & RMS Value measurement.

Wave Shaping: Differentiator, Integrator, Clipping, Clamping, Passive filters LC / RC, LPF / HPF



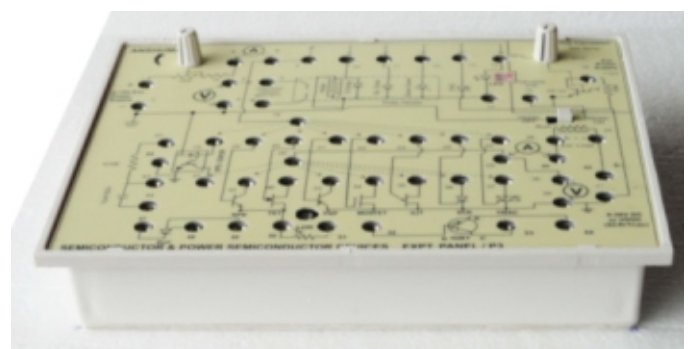
Liner IC Trainer Panel (LIT) : IC Used: LM339, TL084, 741, 555, Sockets : 142, Discrete component used: Resistors - 15 Nos, Capacitors - 15 Nos., Transistors - 2 Nos, Diode - 4 Nos Zener Diode - 1 No., Regulators - 3 Nos. Pot - 1, Experiment > 40.



Magnetism, Electromagnetism and Transformer Experiment Panel (P1) (Provided with 37 banana tags.) Faraday's law of magnetic induction, Left-hand rule for north pole of coils / conductors & Corkscrew rule for flux around current carrying conductor. Fleming's left-hand rule (motor law -force on a current carrying conductor in a magnetic field), Lenz's Law.

Transformer: BH curve, calculation of total Iron core loss (Hyst & Eddy loss) using CRO, DC-AC resistance, transformation ratio, loading of transformer, Auto transformer, self & mutual inductance calculations.

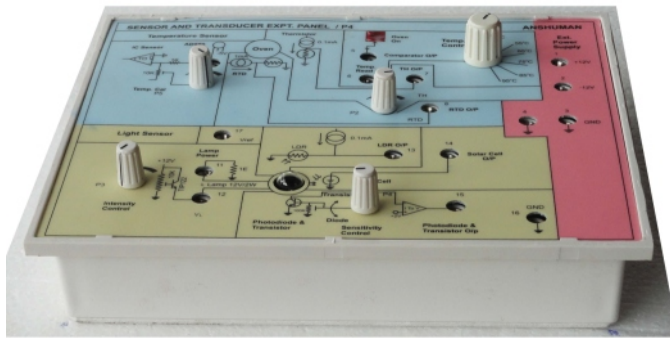
Magnetic sensor: Reed switch, Electromagnetic Relay, Hall sensor (Analog / Digital), Mag. compass needle.



Semiconductor & Power Semiconductor Devices Experiment Panel (P3) (Provided with 41 banana tags)

Characteristics of following devices : Silicon diode, Semiconductor Testing using Multimeter, Germanium diode, zener diode, LED, diac, bipolar transistor (NPN, PNP), Field Effect Transistor (FET), MOSFET, IGBT, UJT, Silicon Controlled Rectifier (SCR), Triac, Optocoupler,

Band gap energy Calculations, Thermistor, V-I Characteristics on CRO of SCR, Triac, Transistor as a Switch & MOSFET as a Switch.

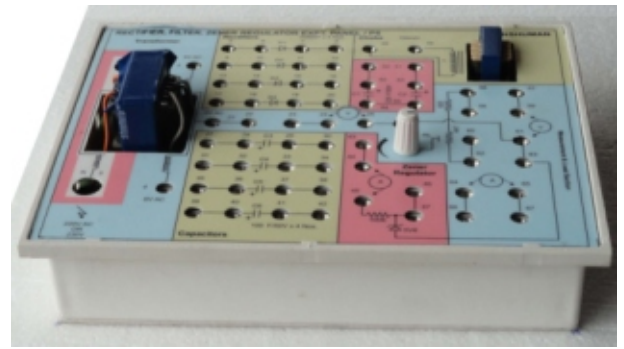


Sensors & Transducers Experiment Panel (P4)

(Provided with 17 banana tags)

Temperature Sensors: AD 590 (IC Sensor), RTD (PT100), Thermistor, (NTC).

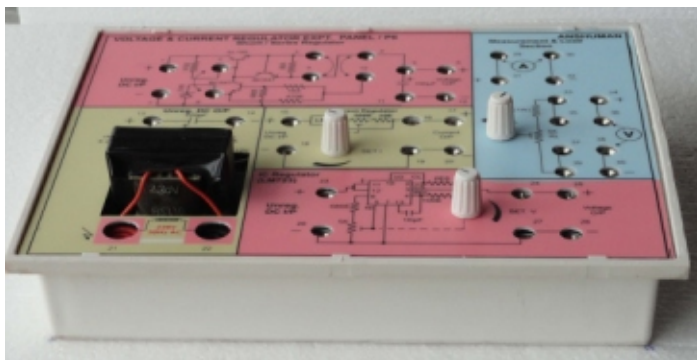
Light Sensor: Photo Transistor & Photo Diode, LDR, Photovoltaic Cell.



Rectifier, Filter, Zener Regulator Experiment Panel (P5)

(Provided with 67 banana tags)

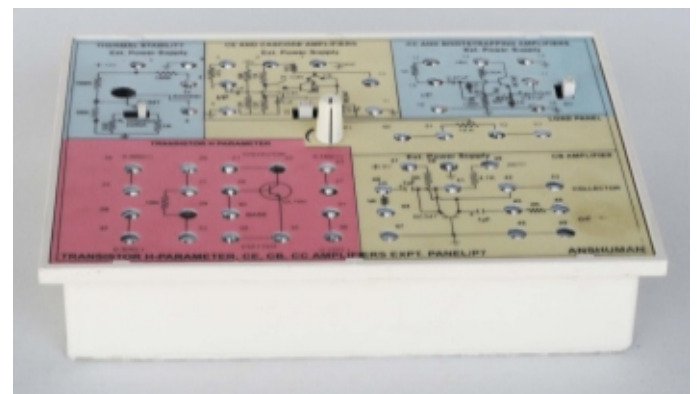
Transformer & its study (Transformer DC/AC resistance, Transformation Ratio, Electromagnetic Induction, Loading of Transformer), Half wave rectifier, Full wave rectifier, Bridge rectifier, Filter, Voltage multiplier, Zener shunt regulator



Voltage Regulator Experiment Panel (P6)

(Provided with 40 banana tags)

Zener regulator with current boost transistor, Transistorised series regulator, IC voltage (variable) regulator using IC 723 (Positive/negative voltage regulator), IC current regulator using IC LM317.



Transistor h-parameters & CB / CC / CE amplifiers experiment panel (P7)

(Provided with 53 banana tags)

Thermal stability (Transistor bias stability), Determination of h-parameters, Common base, common collector, common emitter, cascade amplifier, boot-strapping & transistor switching.



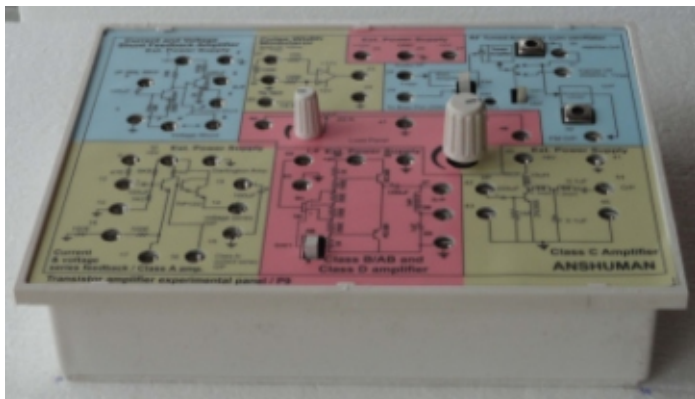
Transistor Amplifier Experiment Panel (P8)

(Provided with 48 banana tags)

Differential amplifier, 2 stage R-C coupled amplifier, Transformer coupled amplifier, common source FET amplifier, common drain FET amplifier (source follower) Push pull amplifier, Complementary symmetry amplifier, Class-D amplifier.

Technical Specifications of Standalone Power Supply

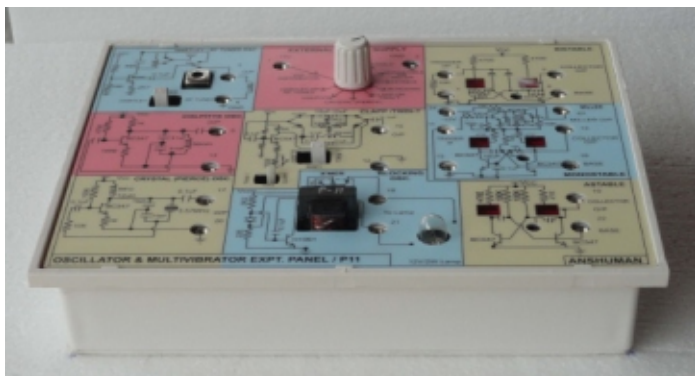
Sr. No.	Power Supplies	Current Rating	Common	Connection
1.	+12V fixed	500mA	GND	No separate sockets, but internally connected
2.	+5V fixed	300mA (shared with +12V)	GND	No separate sockets, but internally connected
3.	0-12V variable	100mA	Isolated COM1	Pot knob & 2 sockets on the front plate
4.	0-12V variable	100mA	Isolated COM2	Pot knob & 2 sockets on the front plate
5.	15-100V variable	120mA	GND but common with +5V (only for P3)	Pot knob on front plate & 2 sockets on the hind plate



Transistor Signal & Feedback Amplifiers Experiment panel (P9)

(Provided with 40 banana tags.)

Current & Voltage shunt feedback amplifier and Direct coupled Amplifier, Current & Voltage Series (Darlington Transistor Amplifier) feedback amplifier, RF tuned Amplifier / Oscillator with AM-FM facility, Class A amplifier, Class B amplifier, Class AB amplifier Class C amplifier, Class D or Switching amplifier, Pulse width modulator.



Oscillator & Multivibrator Experiment Panel (P11)

(Provided with 25 banana tags.)

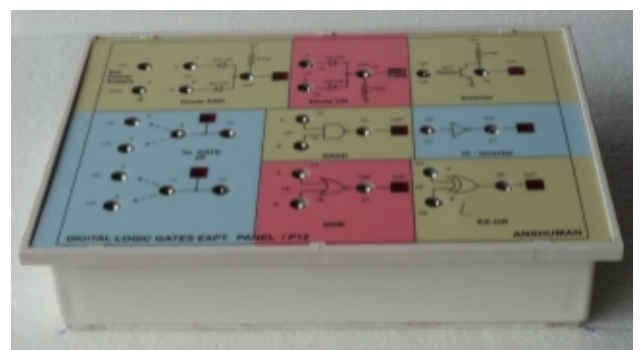
Hartley oscillator, Colpitts oscillator, Crystal oscillator, Clapp oscillator, Blocking oscillator, Astable multivibrator, Monostable multivibrator, Bistable multivibrator, Twin T Oscillator, RF tuned oscillator, Miller ramp generator.



Transistor / Diode Applications Experiment Panel (P10)

(Provided with 61 banana tags.)

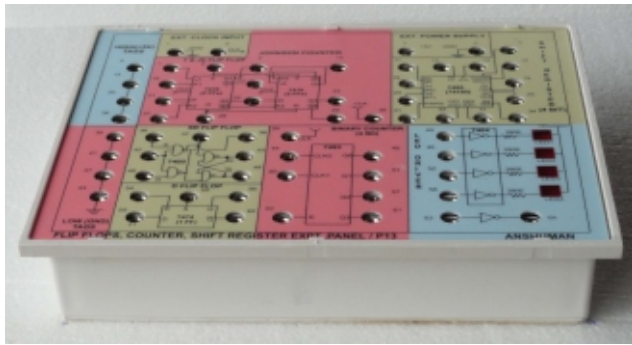
Components suitably arranged so that following 30 projects can be constructed: Electronic storage tank, One way street, "Invisible power" Radio, Transistor, Electronic trigger, Transistor and amplification, Sunrise-Sunset light, Slow -motion Sunrise-Sunset light, Secret code key, Highs & lows of oscillations, Beacon light, Music from a pencil, Leaky facet, Bee, Electronic canary, Burglar alarm, Touching light, Rain detector, Radio station, Wireless rain detector, Metal detector, Blowing 'ON' a candle, Blinker, Two transistor oscillator, Timer, Memory, AND, OR, NAND, NOR gate.



Digital Logic Gates Experiment Panel (P12)

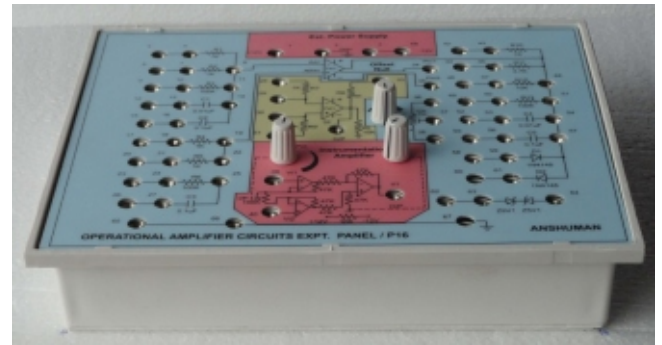
(Provided with 28 banana tags.)

AND, OR, Invertor, NAND, NOR, EX-OR, EX-NOR, Demorgan's theorems, Input / Output characteristics, propagation delay.



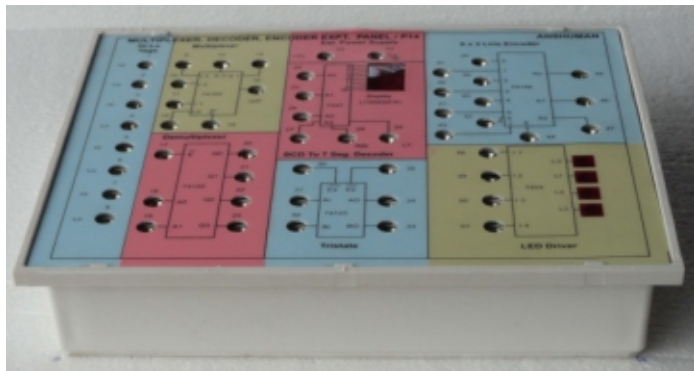
Flip Flop, Counters & Shift Register Experiment panel (P13) (Provided with 64 banana tags.)

R-S Flip-flop, 'D' flip-flop, 'T' flip-flop, 'J-K' flip-flop, Master-slave J-K flip-flop, Binary Counter, Rotary feed back application of counter, Decade counter, Shift registers: Shift left/Right/Ring counter, Parallel mode, Twisted ring counter, Johnson Counter.



Operational Amplifier Circuit Experiment panel (P16) (Provided with 68 banana tags.)

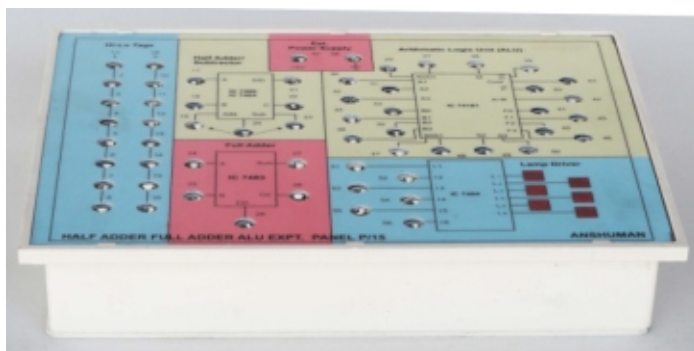
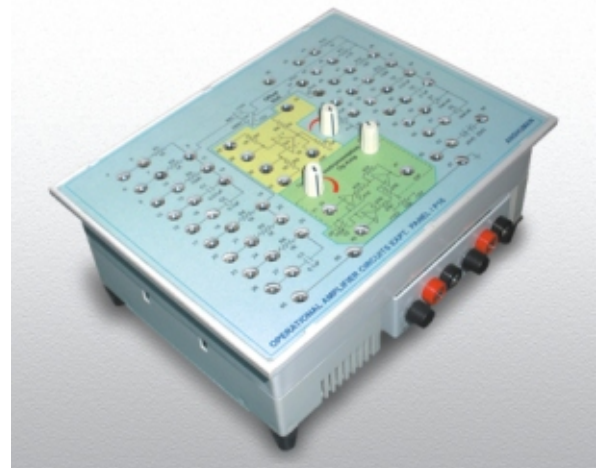
Inverting amplifier, Non-inverting amplifier, Summing amplifier, Difference amplifier, Integrator circuit, Differentiator circuit, Precision rectifier: Half wave & full -wave, Voltage to current converter, Current to voltage converter op-amplifier characteristics, Instrumentation amplifier, Schmitt trigger, Comparator, Sign Changer, Offset Null, Peak detector, Clipping circuit, Clamping circuits (DC restorer), Waveform Generator.



Multiplexer, Decoder & Encoder Experiment panel (P14) (Provided with 51 banana tags.)

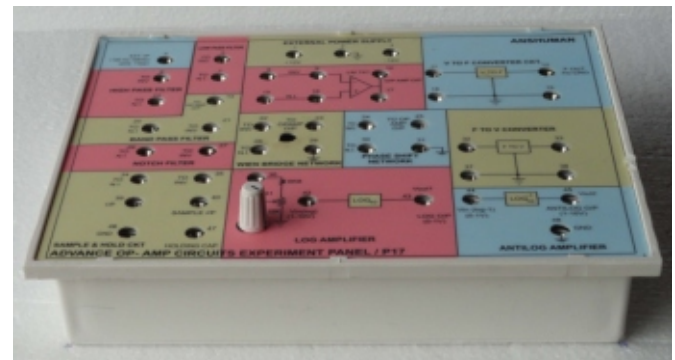
Multiplexer, Decoder / Demultiplexer, BCD to seven segment decoder driver, Tristate logic, Encoder.

Standalone Panel P16



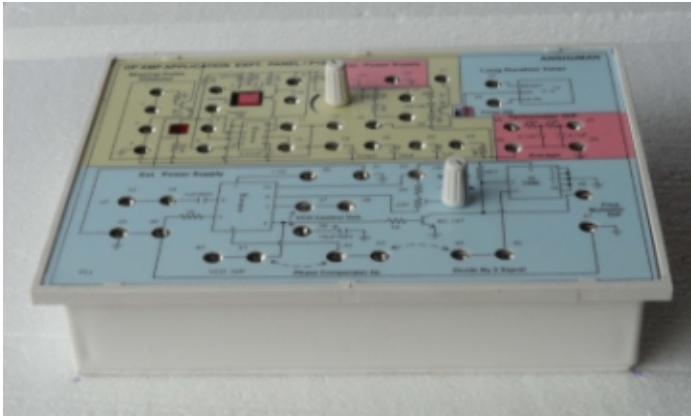
Half/Full Adder, Subtractor, ALU Experiment panel (P15) (Provided with 56 banana tags.)

Half adder, Half subtractor, Full adder, Full subtractor, ALU, Applications of ALU: Mathematical-addition, subtraction; Logical-AND, OR, EX-OR, NOT etc; Code conversion-binary to gray, gray to binary,BCD to Excess-3, Excess-3 to BCD, 9's compliment,10's compliment, Substitution of CAM for timing control.



Advance Operational Amplifier Experiment Panel (P17) (Provided with 56 banana tags.)

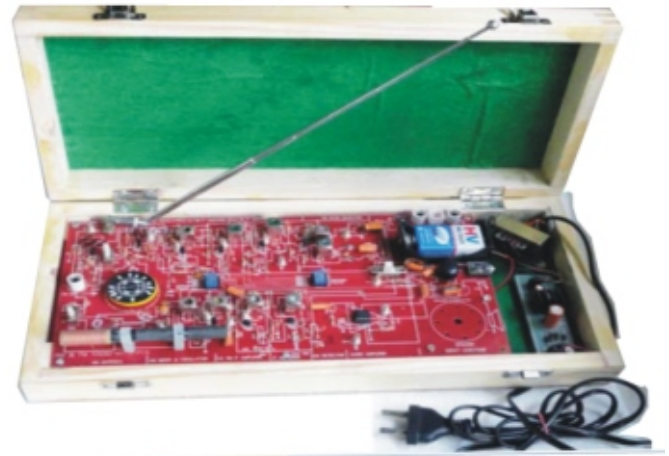
Lowpass filter, High pass filter, Bandpass filter, Band stop(Notch)filter, Wien Bridge oscillator, Phase Shift oscillator, Sample & hold circuit, Log amplifier, Antilog amplifier, Voltage to frequency converter, Frequency to voltage converter, Root extractor.



Timer (555) & Frequency (565) application Experiment Panel (P18)

(Provided with 54 banana tags.)

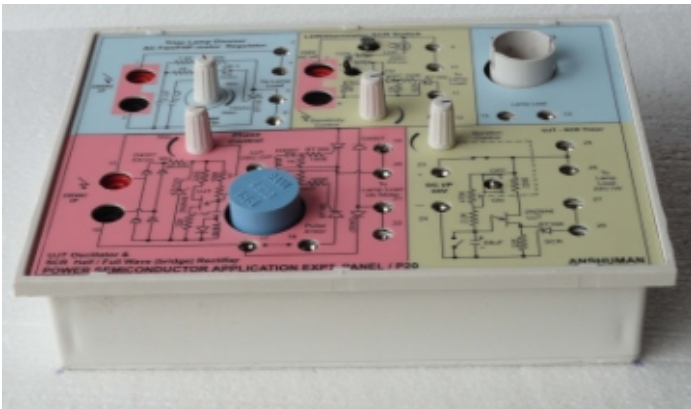
Using 555: Timer (1 shot/Monostable), Free running (Astable), Bistable. Applications of 555: PAM, PWM, PPM, Buzzer, Saw tooth generation, long duration timer, tachometer, missing pulse detector. Using PLL (IC565), VCO, Phase detector, Determination of Lock freq., Capture freq., & freq. Multiplier / Synthesizer, FM demodulation (Using PLL).



AM / FM Transistor Radio Kit (P19)

(No. of Test points = 17)

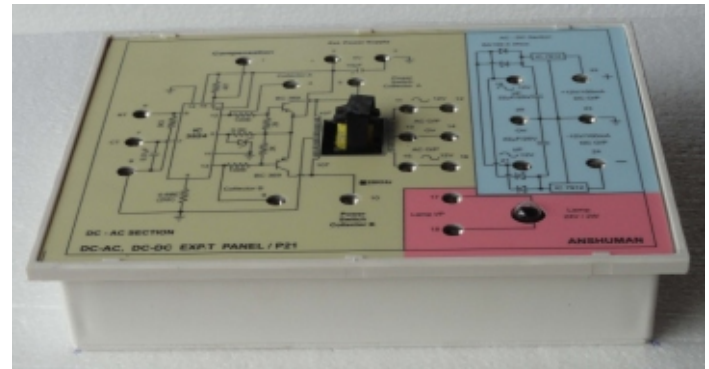
Functional study of RF amplifier, Mixer, Local oscillator, IF amplifier, Detector & Audio amplifier for both AM & FM radios. Supplied either fully assembled or CKD form. Operates from 9V built in battery. Wall transformer optional.



Power Semiconductor Application Expt. Panel (P20)

(Provided with 29 banana tags.)

Triac lamp dimmer, AC fan regulator, SCR/DIAC operated light sensitive switch using LDR, SCR/DIAC operated temperature sensitive switch using thermistor, UJT relaxation oscillator, Half and full wave (Phase shift controlled) rectifier using SCR, Timer using SCR & UJT.



DC-DC, DC-AC Experiment panel (P21)

(Provided with 14 banana tags.)

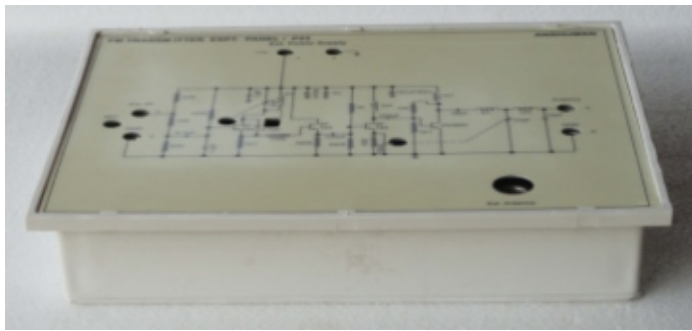
DC to AC, AC to DC, DC to DC Voltage converter circuit. DC to AC Circuit (Converts 5VDC I/P to 12-0-12VAC O/P) AC to DC circuit (Converts 12-0-12VAC I/P to ± 12 VDC O/P) DC TO DC by combining two above circuits to get (5VDC Input to ± 12 VDC O/P)

Power Semiconductor Application Expt. Panel II (P22)



(Provided with 17 banana tags & 11 TPs)

SCR phase shift controlled converter using IC555 through opto isolator (Potentiometric), Triac AC power control using IC 555 (Potentiometric) (optoisolated), SCR AC power control using UJT/PUT (Potentiometric) Triac AC power control using UJT/PUT (Potentiometric), SCR/Triac temperature control using thermistor, SCR/Triac intensity control using LDR, Opto isolated DC switch & Photo relay & thermal relay (street light control). power control using UJT/PUT (Potentiometric) Triac AC power control using UJT/PUT (Potentiometric), SCR/Triac temperature control using thermistor, SCR/Triac intensity control using LDR, Opto isolated DC switch & Photo relay & thermal relay (street light



FM Transmitter Experiment panel(P23)

(Provided with 10 banana tags.)

Single band frequency range : 88 to 108 MHz.

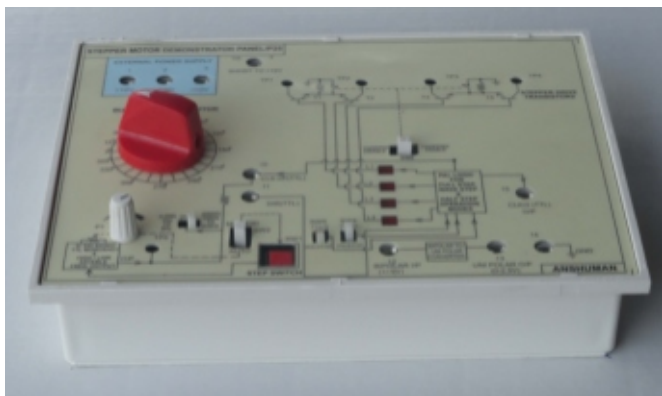
Power O/P : 100 mW.



DC/AC Bridge circuits Expt. Panel (P24)

(Provided with 52 banana tags.)

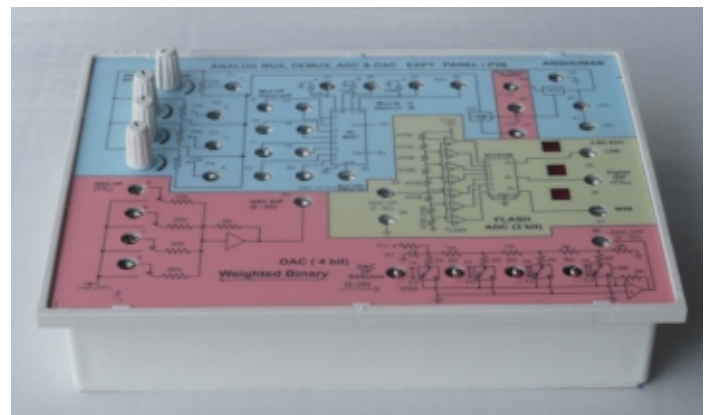
Wheatstone's Bridge, Kelvin's Bridge, Maxwell's Bridge, Hay's Bridge, Desauty's Bridge, Owen's Bridge, Anderson's Bridge, Shearing Bridge, Wien bridge. Provided with 2 capacitor decades (100pF to 100uF), 1 resistor decade (10E to 10M Ω), 1 tapped wire wound 10 taps (0.01 Ω), 10K 10T pot, 100 Ω pot, fixed resistors of 10 & 4.7 Ω , Earphone & its socket.



Stepper Motor Demonstrator Expt. Panel(P25)

(Provided with 15 banana tags.)

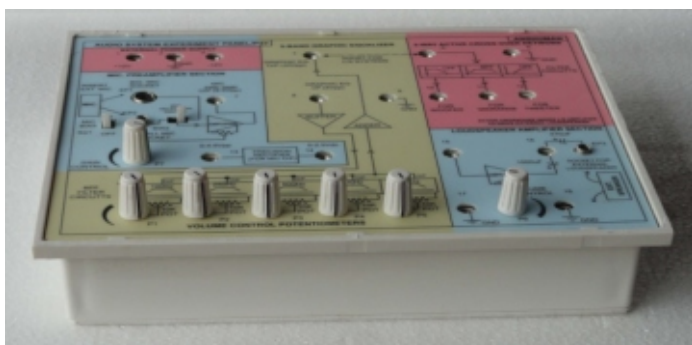
Control of direction, Step rate, Auto / Manual operation of stepper either built in 7.5 $^\circ$ step or optionally external 3 kg-cm motor (1.8 $^\circ$) in half / full / wave stepping modes / current chopper mode.



Analog Multiplexer / Demultiplexer & ADC, DAC Expt. Panel (P26)

(Provided with 40 banana tags.)

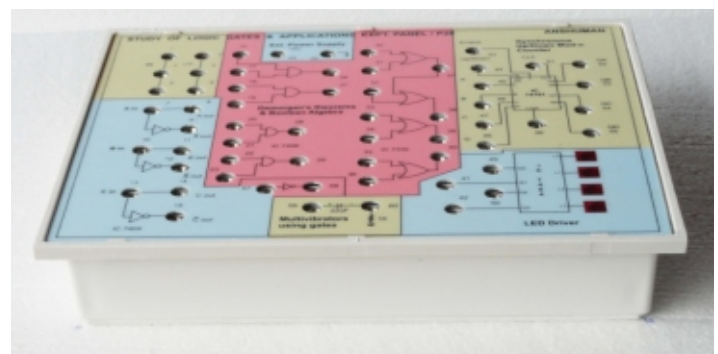
8 Channel Analog Multiplexer, 1 of 8 Analog Demultiplexer, Flash A to D Converter (3 bit), D to A Converter (4 bit), weight ed binary and R- 2R.



Audio System expt. Panel (P27)

(Provided with 18 banana tags.)

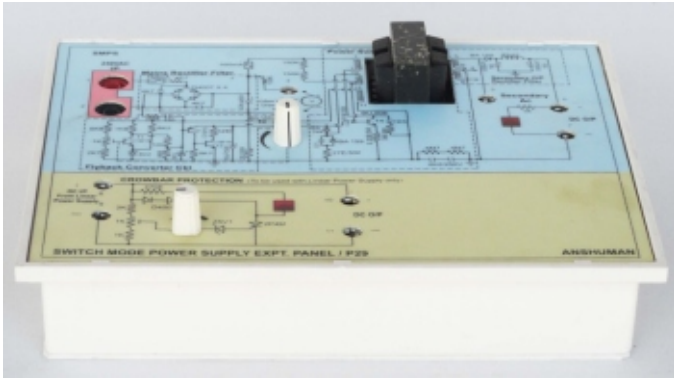
Study of mic characteristic and Polar plot (Optional PC interface graph plotting s/w), 5-band graphic equalizer, Active cross over network, Study of HPF/BPF/LPF, 3W L/S amplifier with ext. L/S box.



Study of Logic Gates & Applications Expt. Panel (P28)

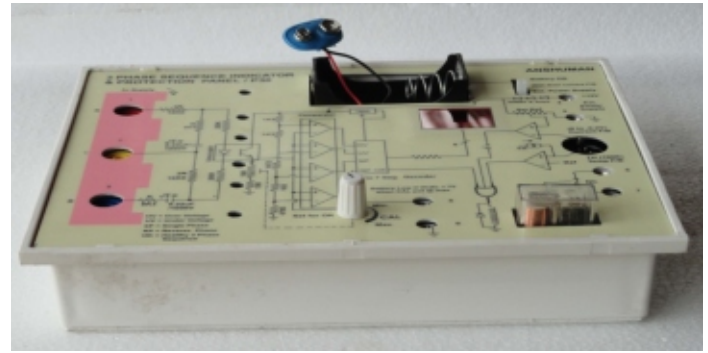
(Provided with 58 banana tags.)

Logic Gates & input output characteristics Boolean Algebra Theorems, Demorgan's Theorems, Logical equations, Digital code lock, R-S flip-flop using NOR gates, Multivibrators - Astable, Monostable & Bistable multivibrator etc., 4 bit synchronous counter, Synchronous non binary counter/Decade counter /MOD 10 counter etc.



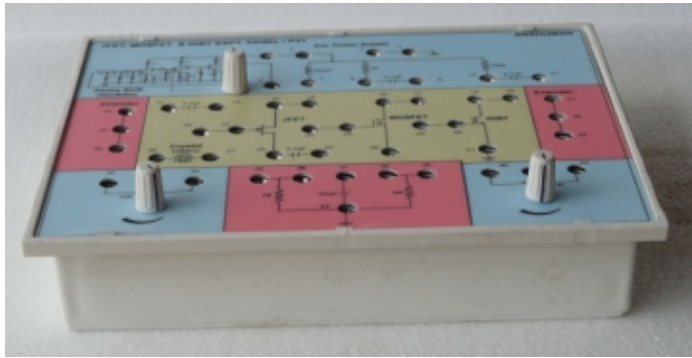
Switch Mode Power Supply Experiment Panel (P29)

(Provided with 11 banana tags.)
 SMPS (TV), To study Crow bar protection circuit



3 Phase sequence indicator and Study Experiment Panel (P30)

(Provided with 7 banana tags.)
 Study 3 phase 440V Electric utility supply - Determination of over voltage, under voltage, single phasing and reverse phasing / Displays OV,UV,SP,RP on digital display, 9V Battery / +12V supply operated.



JFET, MOSFET & IGBT Expt. Panel (P31)

(Provided with 49 banana tags]

MOSFET : Drain characteristics of MOSFET, MOSFET Amplifier, MOSFET Switch.

JFET : Characteristics of JFET, JFET amplifier, JFET crystal oscillator, Phase shift osc. Using FET, Phase splitter using FET, FET Analog switch.

IGBT : Characteristics of IGBT, IGBT as switch.



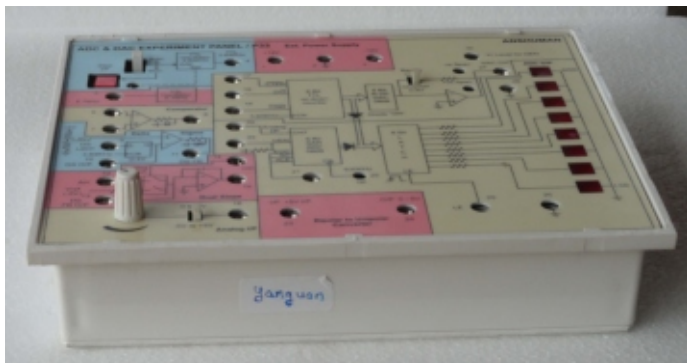
Passive / Active / M Derived Filter Panel (P32)

(Provided with 114 banana tags]

Passive (RC) filters- Low pass, High pass, Notch filter,

Active filters- Low pass, High pass, Unity gain phase shifting, Butterworth, Bessel, Chebyshev filter

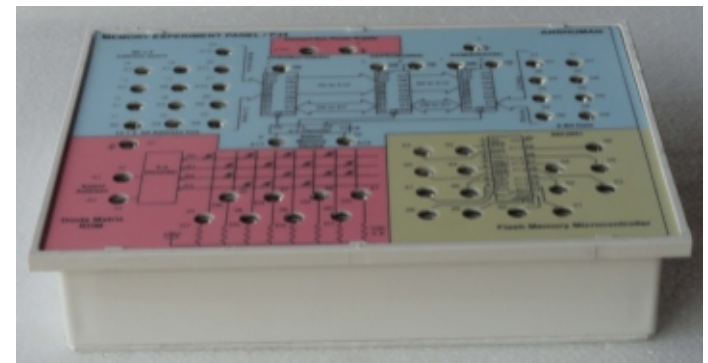
LC (M derived / constant K type filters)- T type high pass Active filters, High pass M derived, Band stop, Band pass, M derived Band pass, Constant K type pass band, Band Elimination, Composite Low/High pass filter can construct above filters & plot their characteristics.



ADC & DAC Circuits Experiment Panel (P33)

(Provided with 30 banana tags)

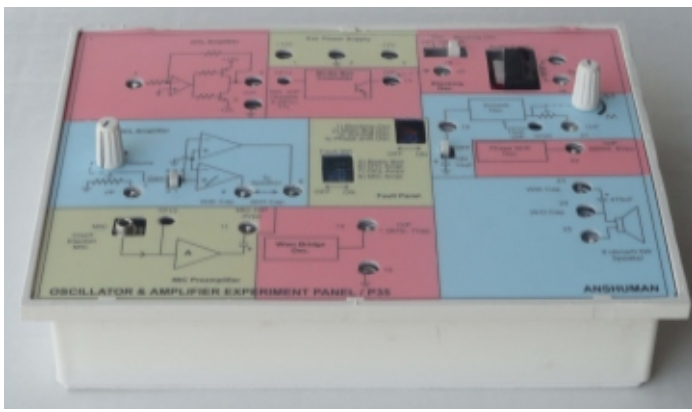
8 bit ADC, 0-5V I/P:- Dual slope ADC, Tracking ADC, SAR ADC, RAMP ADC, Bipolar ADC using level translator, Delta Sigma ADC, 8 bit DAC:- O/P Range 0-5V & +/-5V.



Memory Experiment Panel (P34)

(Provided with 55 banana tags)

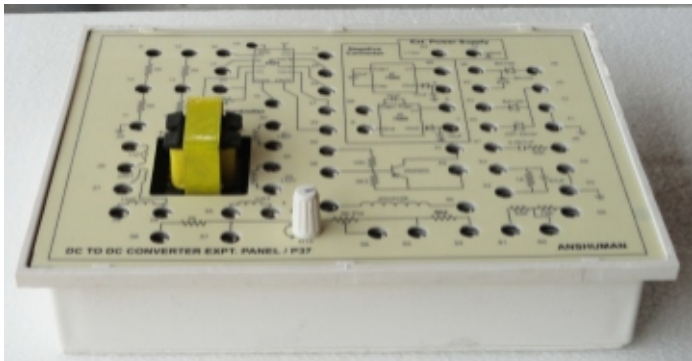
Constructing ROM with Diode Matrix (4x8 bits), RAM with D flip flop, EEPROM (28C64) - 8K x 8, EPROM (2764) 8K x 8, RAM (6264) 8K x 8. Flash memory microcontroller.



Oscillator & Amplifier Experiment Panel (P35)

(Provided with 19 banana tags)

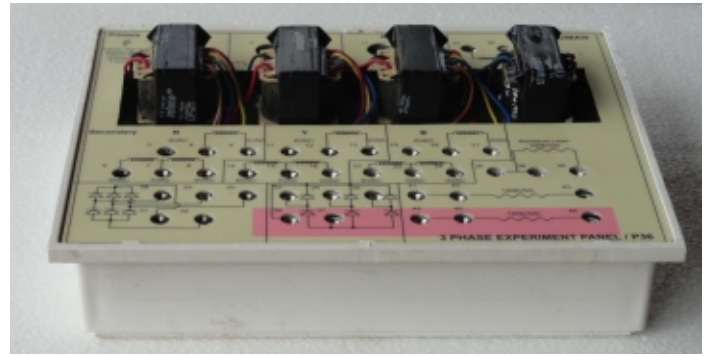
Blocking Oscillator Circuit, Schmitt Trigger / Oscillator, OTL Amplifier, OCL Amplifier, 0.5W/8 ohm Loud speaker with Audio amplifier, Mic with preamplifier, Electronic Birdcall circuit, transistorized wien bridge oscillator & phase shift oscillator. 8 bit fault switches to simulate various commonly occurring faults.



Advance DC to DC Converter Panel (P37)

(Provided with 63 banana tags)

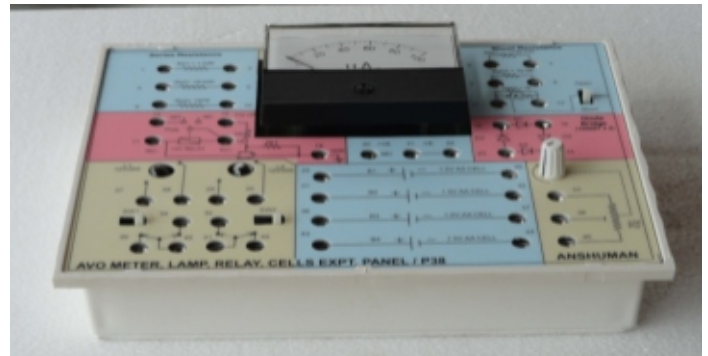
Open loop & Closed loop scheme for Step Up (Boost), Step Down (Buck), Polarity Inverter (Buckboost), Forward, Fly back, Push Pull, Negative Voltage Converter, Cascaded Negative Voltage Converter, Cuk Converter.



3 Phase Laws Experiment Panel (P36)

(Provided with 40 banana tags)

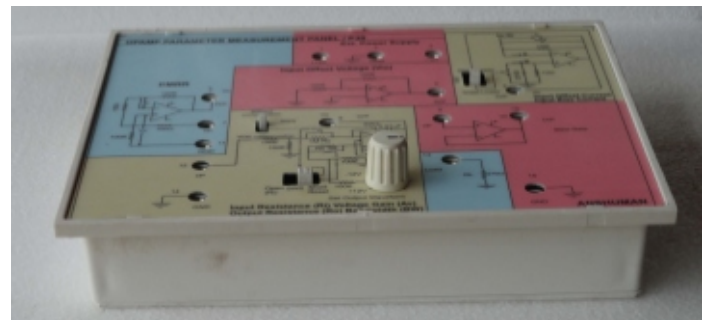
Star, Delta relationship between V.I. Use of Low voltage isolated secondaries to prevent shocks, various rectifier circuits. Need 3 phase 4 wire supply.



AVO Meter, Lamp, Relays, Cells Expt. Panel (P38)

(Provided with 45 banana tags)

1.5 x 4 No. cells for series parallel expts., moving coil meter (100 uA) to construct voltmeter, ammeter AC / DC and ohmmeter, bulbs in series parallel, Relay characteristics, staircase lamp logic, Static & Dynamic characteristics.



OP AMP Parameter Measurement Panel (P39)

(Provided with 15 banana tags)

Experimental measurement of 9 parameters-opamp input resistance, output resistance, open loop voltage gain, bandwidth, offset voltage, CMRR, input offset current, input bias current & Slew rate.

Cable Fault Locator Experiment Panel (P40)

(Provided with 47 banana tags & 8 BNC Sockets)

About panel : The panel consists of 7 step capacitor bank (100PF 100μF), 100Ω (wire wound) pot, 25Ω (wire wound) pot, 10KΩ (10 turns) pot, BNC connectors (8 nos), Banana sockets (47 nos), RG58 cables 25m x 3nos. & 1.5m x 3nos.

Function blocks - AC to DC converter for null detector, Sine generator (1KHz, 5Vp-p), Variable power supply (1.2 to 5Vdc settable). Needs +/- 12Vdc external power supply.

Experiments performed : 1) Murray loop for ground fault and short circuit fault. 2) Varley loop for ground fault and short circuit fault. 3) Fisher loop for ground fault. 4) Open circuit fault by capacitance measurement.

LABWISE EXPERIMENT PANEL SELECTION CHART

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Networks & Fields (4)	P1, P2, P36, P38
Discrete Electronics (13)	P3, P4, P5, P6, P7, P8, P9, P10, P11, P24, P31, P35, DCP
Digital Electronics(10)	DIT I, DIT II, P12, P13, P14, P15, P26, P28, P33, P34
Opamps / Linear Electronics(9)	LIT, P16, P17, P18, P26, P32, P33, P35, P39
Power Electronics(8)	P20, P21, P22, P25, P29, P30, P36, P37
Communication Electronics(5)	P18, P19, P23, P27, P32
Measurement(2)	P40