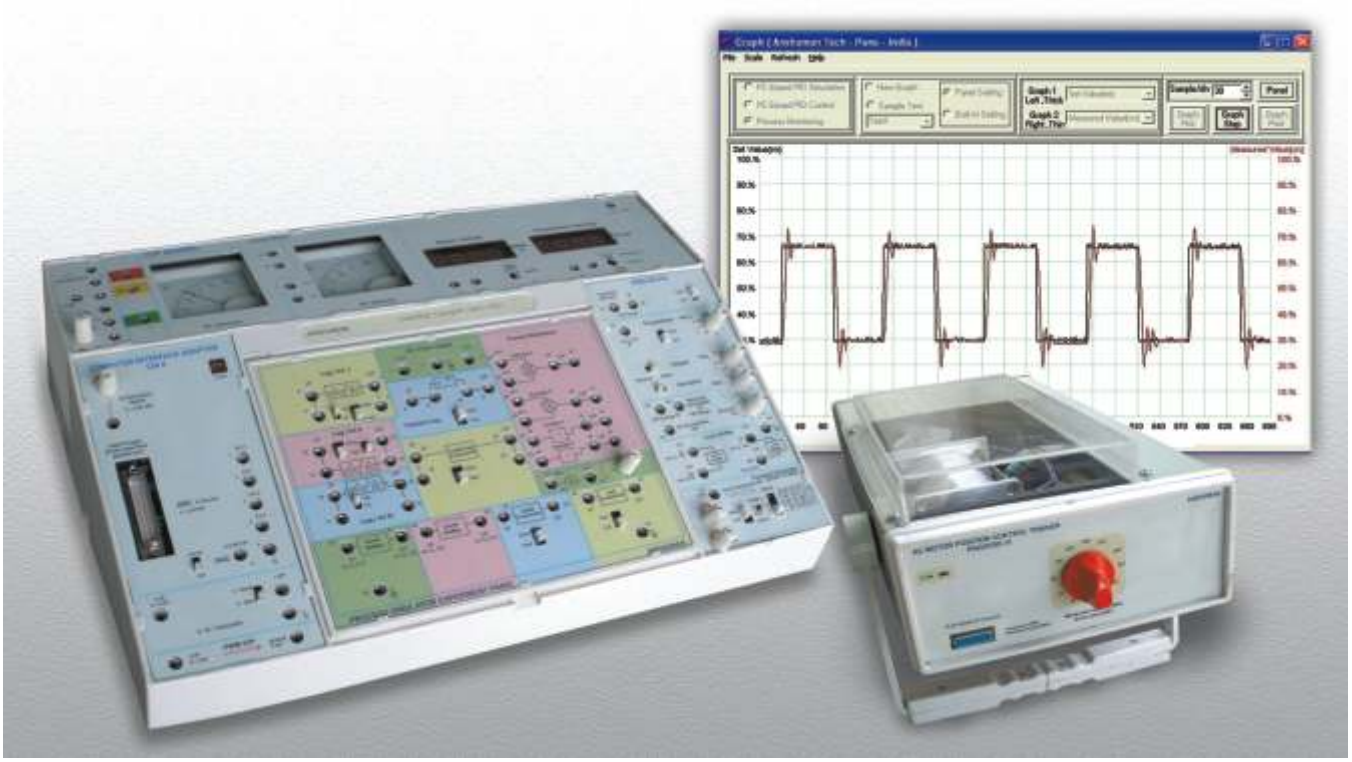
CONTROL TRAINER (Model : XPO-PID)



SPECIFICATION OF MASTER UNIT

Basic Resources on Top board

- **Built in power supply**
  DC supply ±12V,500mA.
  1f sine reference for cosine firing 30Vpp max.
  17Vdc, 500mA unregulated for driving pulse X'mer
  Variable DC power supply : 7 to 14V / 3A
- **Display**
  A) DPM - 2Nos.
  i) For Temp. upto 100°C & intensity in Lux (2000)
  ii) For Temp. upto 500°C
  B) Analog Meter - 2Nos.
  i) Centre zero for display of process error (±9V)
  ii) For MV / SP (0-2.5V)
- **Operating voltage**
  Switch selectable 220-240Vac, ±10%, 50Hz
- **Mechanical Dimensions**
  Master Unit : 400mm(W),125mm (H),270mm(D)
  Net weight : 8Kg. Gross weight : 10Kg.
  b) Panel : 215mm(W), 165mm(H), 40mm(D)
  Net weight : 700gm approx.

PC (P4/XP/ FAT32) based PID controller (Optional)

- **Online monitoring / Data acquisition / PID Software**
  : Self extracting package (CD) works under 98, 2K, XP.
- **Operating modes**
  a)Simulator Mode
  Tests data already stored in files (*.txt) & Drawing graph for all P,PI,PD & PID modes.
  b) Process Monitoring Mode
  Drawing graphs of analog data presented at CH 0 & CH 1 of Computer Interface. Cursors for X & Y axis for measurement & online graphs savings for reproduction
  c) PID controller Mode
  - PID controller with parameters like Integral Time Ti (0.01-64000), Sampling Time Ts (0- 99.9), Derivative Time Td (0.1-99.9), Proportional Band Pb(1-999), Derivative Gain Kd(1-999), Set Value Rn (0 - 99.9), PID output Upper Limit Uh (0-99.9), PID output Lower Limit Ul (0-99.9).
  - Facility to set units for output viz. Percentage (%), °C, RPM, Voltage(V), mm, LPH, kg/cm², ?si/cm, degree.
  - Optionally experiments with advance process control scheme viz; Ratio, Cascade, feedfor ward with user selectable Aux PID, Ratio station & programmable FF transfer function calculator.
- **Computer Interface Adapter / CIA**
  Optoisolated Adaptor to prevent damage to PC parallel port (25 pin LPT) due to wrong connections. Interfaces through 25 pin M to F cable 1mtr Length. P4/XP not in scope of supply. USB converter (optional).
  4 ADC channels : 0 to 2.5V full scale.
  1 DAC channel : O/p 2.5 V FS.
  V to I Function block : Input : 0-2.5Vdc
  O/p: 0-20 or 4-20mA,
  in 100E load Max

Analog PID (APID) controller

with built in low freq. function generator

- Controller selection P,PI,PD,PID with slide switch
  Parameter settings: Integral Time Ti (0.5-25Sec)
  Derivative Time Td (0-2Sec)
  Proportional Band Pb (5-200%)
  Set point (-9V- +9V)
- Operating modes : Fast (X 100/10mSec) for oscilloscope, Slow (X 0.1/1Sec) for PC interface.
- 2 No. Level shifter converting process O/p (±9V) to 0-2.5V for PC interface & Actuator panel
- Test points for Process Error, Set Point (Rn), Measured Value (Cn), Controller output (Un).

Built in function generator

- O/p waveform selectable sine, triangular & square.
- O/p freq. range from 0.016Hz to 166Hz, 4 steps & fine control pot.
- Variable amplitude control 0 to ±9V.

Modular Expt. Panels offered

(Must select atleast one of following panels to work)

- Process Simulator Panel / CE1

- Functional blocks for Lag (3No), Integrator (3No), Transport Lag (1No), Summer (2No), Gain (1No), Inverter (2No) for constructing simulated Type 0,1,2,3 & 1st,2nd,3rd Order processes to work under PID.
- Experiments with Lead / Lag / Lead - Lag compensators to control behaviour of matching processes using above function blocks.
- Open loop & close loop response of processes under different P, PI, PID - Analog or Digital controllers. Experimental varification of PID Controller settings (Pb, Ti, Td)
- Auto Tuning explained using Ziegler Nicolas I & II. Verification of PID settings.
- Fast (10mS) & slow (1sec) mode selection for all processes to observe response on either CRO or PC using CIA.
- Drawing Bode plot & Nyquist plots, transfer function determination.
- Advance process control scheme viz; Ratio, Cascade, feed forward.
- Level shifters (2No) ±9V to 0-2.5V & 0-2.5V to ±9V to match voltage levels of PC (2.5V) and opamps (±9V).

Real life process control panel

- Thyristor Actuator panel (TAP) / CE2

- Thyristor bridge based 0-200V/3A cosine firing circuit, I/P 0 to 2.5Vdc. Supports signal conditioning of RTD (PT100), Thermocouple K type & Photodiode to output 0-2.5Vdc (FS).
- Facilitates closed loop control experiments based on built in P/PI controller as well as external Analog / Digital PID controller.

- Stepper Motor Demonstrator Expt. Panel (P25) / (XPO CT) (Provided with 10 banana tags.)

Direction, speed, auto, manual operations of Stepper Motor, Position control by step operation, Position control by continuous operation , Angle control by step operation, Speed control by control switch, Angle control by software, Dynamic current / torque characteristics,. Closed loop experiment with servo pot for PID experiments.

- Servo Interface panel (SIP) / CE3

- Control Interface circuit for AC & DC servo motor, signal conditioning circuit for speed sensor to output 0 - 2.5V dc (2500RPM) with speed direction.
  Level shifter 0 - 2.5V to ± 9V (2nos).
- Relay control characteristics : Hystersis, Dead band & Relay control circuit (2term & 3 term), process block for

SALIENT FEATURES

- Learn how an Analog as well as Digital PID works.
- Facility to monitor behavior of the PID output & process variable either on PC screen or on CRO. Settable P, PI, PID
- P4/XP window based PID controller (DDC) software package with P, PI & PID control, Ratio & cascade control, three operating modes, Online graph drawing & data acquisition modes (SCADA). PC not in scope of supply
- Can learn about different processes using simulated building blocks as well as real life processes using replaceable experiment panels.
- Graph printing facility for laboratory journal entries.
- Aesthetically designed injection molded electronic desk (master unit) carrying useful experiment resources like Power supplies, DPMs, Computer Interface, Analog PID controller with central slot to hold various replaceable experiment panels.
- Connection through sturdy 4mm Banana sockets & Patch cords.
- Students workbook & Instructor's Guide provided with each unit.

Optional Process Set up

Process	I - Temp/Light	II -High Temp	III - DC servo position controll	IV- AC servo position control	V- Stepper Motor
Electrical	Process box containing 3 high wattage (60W) bulbs under aluminum plate heater. Builtin fan, lamp as disturbance generator.	Electric Bunsen burner (300W) with 50cc heating volume. (Works with DPID only as large transport lag)	PMDC motor 12Vdc, 40W, ND RPM 2000RPM with gear box (Ratio 30:1) Loading: Using Electromagnetic brake @ 12V / 3A max. Servo amplifier with builtin 12V / 3A Power Supply.	AC geared (50:1) 2 phase servo motor. Main winding 230VAC control winding 6VAC /3A O/P shaft RPM 25 (D), . ND RPM 2500 Loading: Using Electromagnetic brake @ 12V/1A max. Servo amplifier with builtin 12V/ 3A PS	Stepper (3kgcm / 12V) coupled to servo pot.
Panel	TAP	TAP	SIP	SIP	P25
Sensor	RTD for temp. control upto 100°C with built in CAL facility, Photodiode for light intensity control upto 2000lux.	K type stainless tube encapsulated TC for temp control upto 550°C.	• Photo reflective speed sensor with direction detect using 2 pairs of photo emitter detector giving quadrature O/p's • Servo pot as position feedback.	• Servo pot as position feedback.	Servo pot as position feedback.
Mechanical	280(L)x115(W)x 160(H) Powder coated.	200(L)x130(W) x 270(H)	365(L)x220(W)x95(H) Chasis mounted DC motor	365(L)x220(W)x95(H) Chasis mounted 2phase AC servo motor	220(L) x 100(W) x 92(H) Powder coated.
List of Experiments	• PID tunning by Ziegler - Nichols • Transfer function determination • Operation under various P/I/D options.		• PID tunning by Ziegler - Nichols Motor process parameter study, torque speed (optional) Dynamics measurements & transfer function determination. • DC motor : Speed, position, cascade control loops, AC motor Position control		• Study of Stepper motor behaviour under open loop & closed loop Control.

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