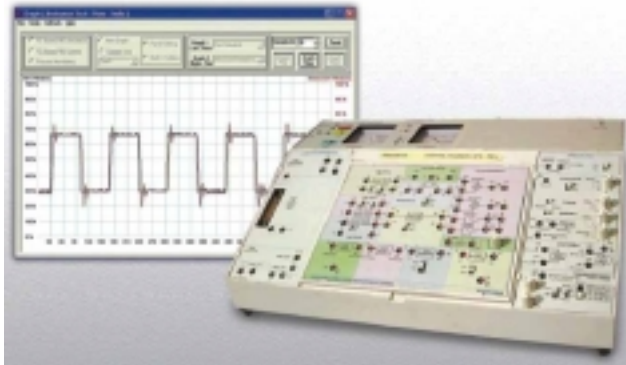


CONTROL TRAINER (XPO-PID)



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.
- User settable PID controller Parameters for P,PI,PD & PID operations.
- 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 moulded 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.



Specifications of Master Unit

Basic Resources on Top board

- **Built in power supply**
DC supply +/- 12V, 500mA.
1 ϕ sine reference for cosine firing 30Vpp max.
17Vdc 500mA unregulated for driving pulse X'mer
Variable DC power supply : 7 to 14/3A
- **Display**
 - A) DPM – 2nos.
 - I) For temp upto 100^oC & intensity in Lux (2000)
 - II) For temp upto 500^oC
 - B) Analog Meter – 2nos.
 - a) Centre zero for display of process error (\pm 9V)
 - b) For MV/SP (0-2.5V)
- **Operating voltage**
Switch selectable 220-240Vac \pm 10% 50Hz
- **Mechanical Dimensions**
 - a) 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

- **Online monitoring / Data acquisition / PID Software**
Self extracting package (CD) works under 98, 20K, 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 parameter like Integral Time Ti (0.1-64K) , Sampling Time Ts(0.1- 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), Settable PWM output Cycle Time Ct (0.1-999).
 - Facility to set units for output viz. Percentage (%), ^oC, Voltage(V) & PWM O/P.
 - Optionally experiments with advance process control scheme viz; Ratio, Cascade, feedforward with user selectable Aux PID, Ratio station & programmable FF transfer function calculator.

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 (\pm 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 using potentiometer from \pm 9V max.

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 with parallel port needed but not in scope of supply.
- 4 ADC channels : 0 to 2.5V full scale.
- 1 DAC channel : o/p 2.5 V FS.
- V to I Function block : I nput : 0-2.5Vdc,
O/P : 0-20mA or 4-20mA, in 100E load max..

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 behavior of matching processes using above function blocks.
- Open loop & close loop response of processes under different P, PI, PID - Analog or Digital controllers.
- Auto Tuning explained using ziegler Nicholas method I & II.
- Fast (10mS) & slow (1sec) mode selection for all processes to observe response on either CRO or on PC using data acquisition interface.
- Drawing Bode plot & Nyquist plots, transfer function determination.
- Optional experiments with advance process control scheme viz; Ratio, Cascade, feed forward.
- Level shifters (2No) $\pm 9V$ to 0-2.5V & 0-2.5V to $\pm 9V$ to match voltage levels of PC (2.5V) and opamps ($\pm 9V$).

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 temperature, light intensity, speed measurement using 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 and direction detection.
- Level shifter 0 - 2.5V to $\pm 9V$ (2nos).
- **Relay control characteristics** - Hysteresis, Dead band & Relay control circuit (2term & 3 term), process block for 2Nos. of 1st order lag / integral + transport lag, error and gain block for process simulation.

Optional Process Set up

Process	Temp/Light I	High Temp II	DC servo position control III	AC servo position control IV	Stepper Motor V
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 Electro magnetic loading @ 12V / 3A, Servo amplifier with builtin 12V / 3A Power Supply.	AC geared (50:1) servo motor. Main winding 230VAC control winding 6VAC/3A O/P shaft RPM 25 (D), ND RPM 2500. Loading: Using Electro magnetic loading @ 12V/3A, Servo amplifier with builtin 12V / 3A Power Supply.	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.	<ul style="list-style-type: none"> • Photo reflective speed sensor with direction detect using 2 pairs of photo emitter-detector giving quadrature O/Ps • Servo pot as position feedback. 	Servo pot as position feedback.	Servo pot as position feedback.
Mechanical	280(L)x115(W)x160(H) Powder coated.	200(L)x130(W)x270(H)	365(L)x220(W)x95(H) Chasis mounted DC motor	365(L)x220(W)x95(H) Chasis mounted 2 phase AC servo motor	220(L) x 100(W) x 92(H) Powder coated.
Experiments	<ul style="list-style-type: none"> • PID tuning by Ziegler – Nichols • Transfer function determination • Operation under various P/I/D options. 		<ul style="list-style-type: none"> • PID tuning 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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