INTRODUCTION:

This set up is designed to study performance of analog PID controller with simulated process. The board has built in signal source, building blocks for simulated process and PID controller with built in regulated dc supply to operate the system. The PID controller : The PID controller has three adjustable parameters, as P, I, D, each has 10turn potentiometers with dial knobs which are subdivided for .02 resolution. Three sockets are provided to add or out any of desired control P,I or D. At input of PID controller an adder is provided which sums the reference and feedback signals. The input and output of PID control has no phase shift.

Features:

PID Controller	: Configurable as P, PI, PD and PID
Proportional band	: 1% to 50 %(Gain 0 - 20)
Integral time	: 10 mS - 100 mS
Derivative time	: 0 - 20 mS
Signal sources	
Square wave	: 0 - 2Vpp at 10 - 40 Hz (typical) variable
Triangular wave	: 0 - 2Vpp at 10 - 40 Hz (typical) variable
Simulated blocks	: Four configurable as first, second order Type-0 &type 1 systems
Potentiometer	: Three individual ten multiturn precision potentiometer for P, I, & D
Uncommitted amplifier	: One (Av-1)
Delay	: Simulated delay circuit to observe effect of dead time.
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

Open loop response of various process configurations
Study of closed loop response with P controller
Study of closed loop response with PI controller
Study of closed loop response with PID controller
Study of open loop response of P,I & D controller

Photographs are for reference only final product may vary from it

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AUTH. DEALER

SCL 101W
P.I.D. CONTROLLER(SIMULATED)

INTRODUCTION:

Level measurements and control covers a broad spectrum of application in industrial needs. The deal with this application is called process control. The present set up has built in signal source, simulated process of water tank with valves and PID controller with inbuilt regulated dc supplies to operate the set up.

Features:

PID Controller	: Configurable as P, PI, PD and PID
Proportional band	: 1% to 50 %(Gain 0 - 20)
Integral time	: 10 mS - 100 mS
Derivative time	: 0 - 20 mS
Signal	: Square wave
Set Point	: Voltage variable
Potentiometer	: Three individual precision potentiometer for P, I, & D
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

Study Water level control using P.I.D.

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SCL 102

P.I.D. CONTROLLER(MODEL PROCESS/TEMPERATURE)

INTRODUCTION:

This set up is designed to study performance of analog PID controller with model process as temperature control system. The set up has built in signal source as reference, digital voltmeter as temperature indicator , PID controller with separate controls and a model process with built in regulated dc supply to operate the system.

The PID controller : The PID controller has three adjustable parameters, as P, I, D, each has3 potentiometers with dial knobs which are subdivided for 0.5 resolution. Switch provided to add or out ,I mode. At input of PID controller an error detector is provided which sums the reference and feedback signals. The input and output of PID control has no phase shift. An ammeter is fitted to observe the controller output

Features:

PID Controller	: Configurable as P, PI, PD and PID
Oven	: Fast compact oven upto 90°C(25W) with IC temperature sensor
Display	: Digital for Set & oven temperature
Sensor	: Solid state temperature sensor
Temperature controller	: Facilities for P, I, D and relay control Blocks
Temperature range	: Ambient to 90°C
Potentiometer	: Separate controls for P, I, D channel gains
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

Identification of the oven parameters

Study of P, PI, PD and PID controls having adjustable coefficients

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INTRODUCTION:

This set up is designed to study the time response of simu-lated linear systems. The present set up has straightforward building blocksof simulated process & signal sources. A cathode ray oscilloscope (dual trace is best option) is the only other apparatus required to carried out the most experiments. The set up consists following features. Basic building blocks : - There are some basic building blocks are givenupon the panel. A dynamic system can be configured connecting them in suitable manners. All blocks has input / output sockets with arrowhead mark and common of them is connected internally with common ground.

Features:

Amplifier gain	: Calibrated variable (Resolution 1 : 500)
Signal sources	: Square wave and Triangular
Frequency	: Square wave 20 - 80 Hz, continuously Variable Triangular wave similar to square wave both in frequency and amplitude
Amplitude	: 0-2V approximately
Uncommitted amplifier	: One for phase adjustment
System Configuration	: Sockets are provided at each block to make different order and type by connecting through patch cords
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

Open loop step response of First Order type-0 system for various values of gain
Closed loop step response of First Order type-0 system for various values of gain
Closed loop step response of Second Order type-0 and type-1 systems
Time domain study of a Linear System
Steady-State errors for closed loop configuration through triangular wave input

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INTRODUCTION:

Potentiometric transducers are used in control applications because of their simplicity. To measure output variables and made comparison between reference and feedback is quite simpler in these transducer. In a position con-trol system the potentiometer type transducer used as error senser as shown in fig 1. Any deviation in position of the motor is sensed by R2 in comparison with the reference provided by R1. It develope angular displacement voltage called error voltage, which are than fed to amplifier to recorrect the motor position. Similarly in synchro transmitter ac voltages are fed to the potentiometers to develope phase sensitive signals as error. The present set up has provide the both signals for study the response.

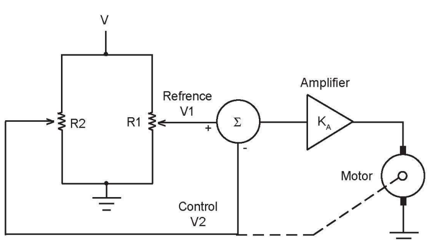

Fig 1. An application of potentiometer error detector in dc motor position control system.

Features:

Potentiometer	: Two high quality servo potentiometers 360° Mechanical, 350° Electrical span with1° resolution dials
Type of operation	: DC and AC signal operation
Display	: 3.5 Digital Panel Meter for measurements
Excitation	: IC regulated DC excitation for both potentiometers (DC operation) AC excitation at 400 Hz approx. (AC operation)
Balanced Demodulator	: Built in demodulator circuit (balanced demodulator) for C.R.O. Observation
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

Linearity study of the potentiometer
Determination of error detector E v/s θ
Use of a.c. supply for the error detector-introduction to the phase reversal of error signal
To study of potentiometer as error detector element
To study loading effect on potentiometer
Study of Error detector

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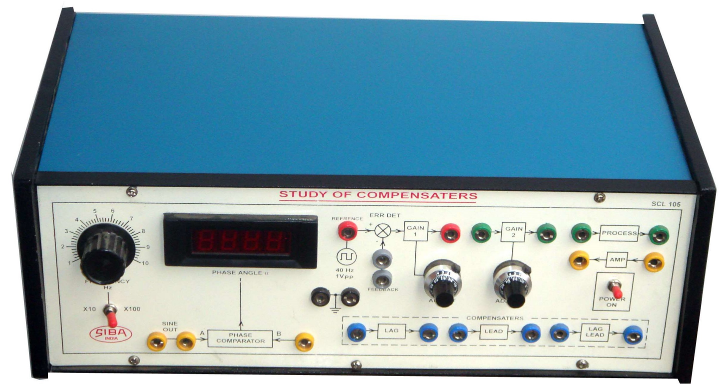
COMPENSATING CIRCUITS(LAG,LEAD AND LAG-LEAD)

INTRODUCTION:

Compensation network are oftenly used to made appreciable improvement in transient response and small change in steady state accuracy. This set up has facilitate to study and design implementation of such networks. Three of such networks are given in the set up and performance of other designed networks can be implemented using few passive components. Set up description : The set up is divided in three parts (a) the signal sources, (b) the uncompensated system and (c) compensators.



Features:

Compensators : Individual lag, lead & lag lead compensating circuits

Simulated system : Second order simulated systems,

Amplifier : One Error amplifier ,with multi turn precision potentiometer with calibrated dial

Frequency : Spot frequency square wave generator with fix frequency & amplitude

Signal sources : Sine wave continuously variable in two decades (10 - 1000 Hz) with 0 - 8Vpp amplitude

Phase angle meter : Digital Phase angle meter 0-180^0

Block : Error detector

Amplifier : Gain compensating with calibrated dial

Power supply : Built in IC regulated power supplies

Cabinate : Housed in rigid MS powder coated with moulded frame

Mains : 230V/50Hz AC

Instruction manual : One

Dimension : 410x260x160mm (approx)

EXPERIMENT COVERED

Lag, Lead compensation in the frequency domain
Lag, Lead compensation in the s-plane
Study of transient with the introduction of lag in system
Study of transient with the introduction of lead in system
Study of transient with the introduction of lag-lead in system

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INTRODUCTION:

This set up is designed to study of dc motor position control system called servo mechanism and comes first in automatic control systems. The prime advantage of this set up is near perfection to the simulated systems. The set up comprises two parts a, the motor unit and b, the control unit.

The motor unit : It consists a permanent magnet armature controlled geared servo motor. It has the technical specifications as Operating voltage : 12 Vdc, 5W.Rated shaft speed : 50 RPM (reduced by gear train, otherwise 2400 hence n= .02)Torque : 3.5 Kg / cm at load shaft. The angular displacement is sensed by a 3600 servo potentiometer. A graduated disc is mounted upon the potentiometer to indicates angular position with 10resolution. A small dc motor is driven by the servo motor to generate the speed proportional voltage which are used as tacho output for velocity feedback. A miniature toggle switch is provided at rear side of the motor unit to change the polarity of these tacho voltages.

Features:

Potentiometer	: Two 360^0 servo - potentiometers with calibrated dials with 1^0 resolution for reference and output position
DC motor	: 12V/1A geared PM motor (50 / 60 RPM)
Tacho feedback	: Positive/Negative tacho generator feedback with polarity reverse switch
Tacho constant	: Calibrated tacho constant 0.2 to 1 in steps
Signal	: Built in step signal for dynamic response
Gain	: Calibrated forward path gain 3 to 10 in steps
Motor unit	: The motor unit is housed in a separate cabinet with transparent cover for easy viewing. Interconnection with the main unit is through a standard 9-pin D-type connector.
Display	: 3½ digit LED is available on the panel for the measurement of various signals
Storage	: Digital storage of transient response (step mode) through built in waveform capture / display card for study dynamics in step mode
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

Operation of the position control system for different values of the forward gain to angular position commands(effect of forward path gain in steady state error)
Step response studies for various values of forward gain(to analyze the transient)
Study of the effect of velocity feedback on the transient and steady state performance of the system as well as its stability(Effect of velocity feedback upon transient response)

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SCL 107
DC MOTOR SPEED CONTROL SYSTEM

INTRODUCTION:

In industrial applications speed control of motors is very common require-ment. This experiment unit is designed to study of speed control process of a small dc motor. The unit has following features.

1. Motor unit, which comprises a small permanent magnet dc motor, rated voltage 12 Vdc, rated current 0.25A at normal run and 0.4A at full load, the torque 75 gm / cm and maximum speed in excess of 3200 rpm (open loop).An overcurrent protection circuit incorporated to exceed current 0.3A. An eddycurrent break system for adding disturbance, an opto interrupter based speed sense system. The unit can be connected with the control unit via 9 pin D type connector which is prewired with the motor unit.

2. The control unit has, speed measurement system, electronic tachogenerator, error detector and forward gain amplifier, motor drive circuit, signal source, break control and digital voltmeter for measurement.

Features:

Motor	: 12V, 4W permanent magnet d.c. Motor open/close loop
Speed	: 0 to 3000 rpm (typical)
Sensor	: Opto-interrupter based speed sensing
Display	: 4-digit speed display in rpm 3.5 digit voltmeter for signal measurements
Tacho generator	: Electronic for feedback & RPM
Loading	: Smooth, non-contact eddy current brake for loading
Motor unit	: The motor unit is housed in a separate cabinet with transparent cover for easy viewing. Interconnection with the main unit is through a standard 9-pin D-type connector.
Display	: 3½ digit LED is available on the panel for the measurement of various signals
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

Effect of loading on the speed of the motor in the open loop/close loop
Steady state error variation with forward gain
System time constant variation with forward gain
Effect of forward gain on disturbance rejection
Determination of the motor transfer function and
Tachometer characteristics

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INTRODUCTION:

This experimental set up is designed to study of a small step-per motor fitted with calibrated dial and servo potentiometer in see through cabinate. The main unit has a motor controller, pulse sequence generator, variable frequency square wave oscillator, single step monopulser and wobbling signal to observe dynamic response. The unit can be interface with uP kit feeding appropriate program given at end pages. Stepper Motor : - A stepping motor is an electromagnetic incremental actua-tor which converts electric pulses to mechanical movements. In rotary step motor the output (shaft) rotates in equal increments in response to a pulse train of input pulses. In general dc motors the speed is governed by applied motor voltages which runs continuously and its direction get reversed when the polarity of input voltage is reversed. Whether properly controlled output steps of a stepping motor are equal in number to the input pulses number.

Features:

Motor	: Stepper with 1.8 degree step,6V/1A/phase
Torque	: 2.8 Kgcm
Running mode	: Three Step,Free run and wooble
Motor unit	: The motor unit is housed in a separate cabinet with transparent cover for easy viewing. Interconnection with the main unit is through a standard 9-pin D-type connector.
Microprocessor kit	: One with standard features and application software
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

Study of manual stepping through push button switch
Study of speed and direction control logic by recording the pulse sequence for both clockwise and counter clockwise motions
Study of resonance effect at various speeds it provides an idea of the dynamic behavior of the motors
Display and measurement of the dynamic characteristics of the motor on the CRO
Programming the microprocessor kit to implement various features like direction, speed, etc.
Application software is included for demonstration and also for use as a set of subroutines

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INTRODUCTION:

This set up is designed to study of ac motor position control system .The set up comprises two parts the motor unit and the control unit. The description of complete system as follow. a. The motor unit : It consists a two phase ac servomotor with operating voltage 120 Vac, maximum current 0.15 A. Rated shaft speed : 2400 rpm, Inertia 4.6 x 10-4 Kg / cm2.Torque : 0.085x 10-2 Kg / m. The motor drive a small load through gear train. The gear ratio is 1 : 40 hence the load shaft rotation is 2400/40 = 60 rpm. The angular displacement is sensed by a 360^{0} servo potentiometer. A graduated disc is mounted upon the potentiometer to indicates angular position with 10 resolution. The complete unit is housed in see through cabinate. A cable is attached to the unit with 9 pin D type connector for connection with the control unit. The control unit : It consists power supply, servo amplifier, error detector and command potentiometer. There is facility given to record the transient period of position control system under step signal.

Features:

Potentiometer	: Two 360^{0} servo - potentiometers with calibrated dials with 1^{0} resolution for reference and output position
AC motor	: 110V two phase servo motor
Signal	: Built in step signal for dynamic response
Gain	: Calibrated forward path gain 3 to 10 in steps
Motor unit	: The motor unit is housed in a separate cabinet with transparent cover for easy viewing. Interconnection with the main unit is through a standard 9-pin D-type connector.
Storage	: Digital storage of transient response (step mode) through built in waveform capture / display card for study dynamics in step mode
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

Operation of the position control system for different values of the forward gain to angular position commands(effect of forward path gain in steady state error)
Step response studies for various values of forward gain(to analyze the transient)

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SCL 110A
SYNCHRO TRANSMITTER-RECEIVER

INTRODUCTION:

The synchro transmitter / receiver demonstrator unit is designed to study of remote transmission of position in AC servo mechanisms. These are also called as torque transmitter - receiver. The unit has one pair of transmitter - receiver synchro motors, powered by an isolated ac inbuilt supply. Sockets are brought upon the panel to make connections with attenuated compensated output in ratio of 1 : 10 for waveform observation. The synchro pair is well mounted inside steel cabinate and dials printed in degrees with resolution of 2^0 provided to study phase / displacement errors. The control knobs are factory adjusted for electrical zero and procedure is given in last page if re-correction required due to transportation. Complete unit is 220 volt ac main operable.

Features:

Transmitter	: Fitted with dial for input/output angular displacement with graduation with 2^0 resolution
Receiver	: Fitted with dial for input/output angular displacement with graduation with 2^0 resolution
Observation	: Sockets for Rotor (R1, R2) Stator (S1, S2, S3) on panel with attenuated output on sockets for view of signal observation on CRO
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

Basic characteristics study - stator voltages as a function of the rotor angle
This shows the space variation of the three voltages, VS1S2, VS2S3, and VS3S1,
causing rotation of the resultant magnetization in the stator which is fundamental to the error detection process.
Operation and error study of the transmitter-receiver pair as a simple open loop position control at a very low torque.
This is a rarely used application but is used to demonstrate the direction of the resultant magnetic field in the receivernt)

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INTRODUCTION:

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Features:

Transmitter	: Fitted with dial for input/output angular displacement with graduation with 2^0 resolution
Receiver	: Fitted with dial for input/output angular displacement with graduation with 2^0 resolution
Observation	: Sockets for Rotor (R1, R2) Stator (S1, S2, S3) on panel with attenuated output on sockets for view of signal observation on CRO
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One

EXPERIMENT COVERED

Basic characteristics study - stator voltages as a function of the rotor angle
This shows the space variation of the three voltages, VS1S2, VS2S3, and VS3S1,
causing rotation of the resultant magnetization in the stator which is fundamental to the error detection process.
Operation and error study of the transmitter-receiver pair as a simple open loop position control at a very low torque.
This is a rarely used application but is used to demonstrate the direction of the resultant magnetic field in the receivernt)

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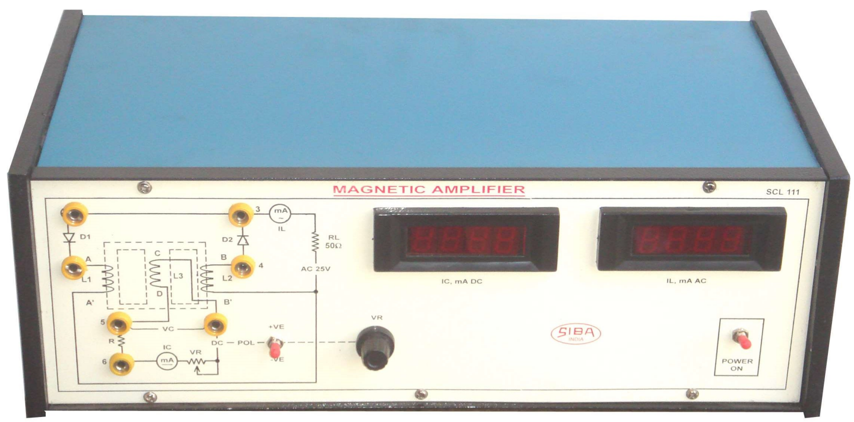
INTRODUCTION:

Amplification is the control of a larger output quantity by the variation of a smaller input quantity. Such amplification can be performed by a magnetic device called magnetic amplifier or Magamp. This set up is designed to study the basic characteristics of such amplifier. The set up consists magnetic amplifier, ac and dc power supply, two meters for load and control currents and a fixed value RL. Inductance of core : Any magnetic material particularly used in transformers is easily get magnetized when current flows through a wire surrounded it (e.g coil). Flow of an ampere in one turn of coil causes a certain amount of magnetic flux called megnatomotive force. This megnatomotive force in short mmf causes flux in the megnatic circuit is similar to action of emf in an electrical circuit. If this mmf is varied due to varying current in surrounding wire it causes to approach the megnatization to a limit called saturation as shown in B - H loop. If the current is a small alternating in nature than the change in flux moves between two finit points of B - H loop.



Features:

Diode	: Two
DC Bias	: Regulated DC bias voltage sockets to connect saturable reactor
AC supply	: Fixed AC supply voltage for load winding
Saturable reactor	: Four internally wired two ends
Bias current	: Continously variable
Switch	: One for changing bias polarity
Display	: Digital ammeter for AC load Digital milliammeter for dc bias current
Observation	: Sockets for measure control winding voltages(DC bias voltages)
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

To study input - output characteristics of a magnetic amplifier
Study of saturable reactor
To study effect of DC bias applied to control winding
To evaluate control gain(amplification factor)

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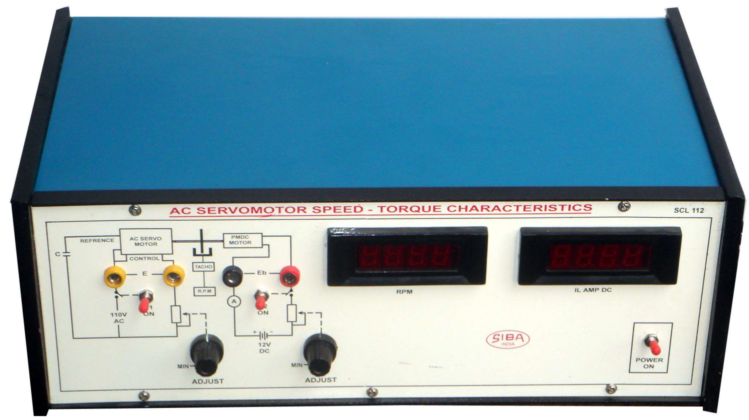
SCL 112
SPEED-TORQUE CHARACTERISTICS OF AC SERVO MOTOR

INTRODUCTION:

The devices used in electrical control system are AC and DC servomotors. AC servomotor has best suit for low power control applications. It is rugged light weighted and has no brush contacts as in case of DC servomotors. The important parameter of AC servomotor is its speed - torque characteristics. This set up is made to study of such AC servomotor speed - torque characteristics. The set up operates at 220VAC 50 Hz supply. **The AC servomotor :** An AC servomotor is basically a two phase induction motor except for certain design feature. The two phase induction motor consists of two stator windings oriented 900 electrical apart in space and excited by AC voltage which differ in time - phase by 90^0.

EXPERIMENT COVERED

To draw speed-torque characteristics of AC servomotor



Features:

Motor	: Two phase ac servo motor (1500 RPM) 110V housed in Aluminum case for cool operation
Sensor	: Electronic speed sensor with RPM display upon panel meter
Loading arrangement	: PMDC motor for loading(12V/1A)
Switch	: One for variable isolated (on/off through separate switch) supply for AC servomotor with speed control One for DC supply (on/off through switch) with potentiometer to vary PMDC motor current.
Display	: Digital ammeter for load current Digital RPM meter for speed
Observation	: Sockets for measure output voltage (fed to motor) measurement
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

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SCL 113
SERVO STABLIZER

INTRODUCTION:

The devices used in electrical control system are AC and DC servomotors. AC servomotor has best suit for low power control applications. It is rugged light weighted and has no brush contacts as in case of DC servomotors. The important parameter of AC servomotor is its speed - torque characteristics. This set up is made to study of such AC servomotor speed - torque characteristics. The set up operates at 220VAC 50 Hz supply. **The AC servomotor :** An AC servomotor is basically a two phase induction motor except for certain design feature. The two phase induction motor consists of two stator windings oriented 900 electrical apart in space and excited by AC voltage which differ in time - phase by 90^{0}.

Features:

Dimmer	: 1 KVA with servomotor output sense transformer
Loads	: Heating elements
Process	: Loop Process with variable gain
Meter	: AC Voltmeter
Observation	: Sockets for measure output voltage (fed to motor) measurement
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

To study Servo controlled AC voltage stabilizer as position control system.

Photographs are for reference only final product may vary from it

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SPEED-TORQUE CHARACTERISTICS OF DC SERVO MOTOR

INTRODUCTION:

DC servomotor has been the prime mover element most widely used in control applications. In position control the DC servomotor is of the highest choice due to simple control circuitry. These motors suffers from wear and tear because of brush and commutator. Generally the DC motor is controlled by armature control via a dc servo amplifier. In certain operations field control is used but variable flux motors suffer from costlier current source and poor control of field flux due to magnetization saturation for low speed application. In general way armature control is preffered.

The DC servomotor : A DC servomotor is basically a separately excited dc motor with only difference is made that its armature resistance is normally kept high with low mass to obtain fast response and steeper torque - speed slope. The field is energized by a constant voltage source and armature is controlled by an amplifier.

Features:

Motor	: Separately excited DC servomotor housed in separate rigid MS powder coated cabinate with moulded frame having front side see through cover
Loading arrangement	: Belt and pulley loading for torque measurement having high precision spring balance to read load separately adjustable with lead screw motion
Display	: Two digital meters (selected through switch) to take readings of volt and current for field and armature Digital RPM meter
DC supply	: Separate field and armature dc supplies (current protected)
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

To draw Torque-speed characteristics of DC servomotor keeping field current constant
To draw Torque-speed characteristics of DC servomotor keeping armature voltage constant
Transfer function evaluation (graphically)

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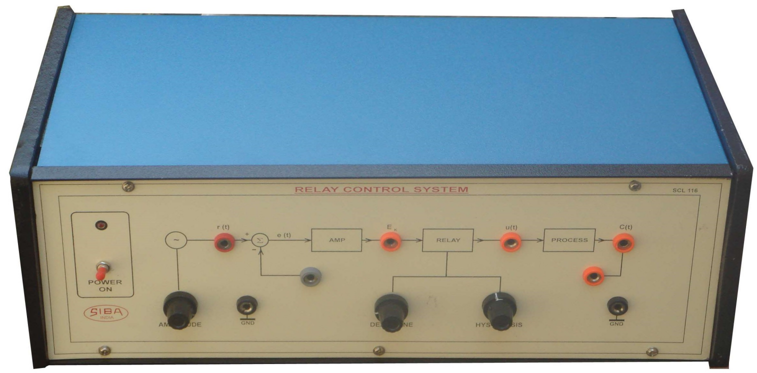
INTRODUCTION:

The relays is an important primary control element in a control system which is being controlled by an electrical signal gives advantage of cost reduction. These system deliberately introduced as on - off control.This set up is designed to study of such relay control system characteristics. The set up has simulated relay with simulated process.The relay : The relay controller system is represent in blocks upon the panel which are describe as follows. a. Error detector : At the left hand side it is first block. The error detector circuit is a summing amplifier which adds two variables, one as reference,(r) and other the feedback voltage in form of another signal taken from process output (b). The both signals are opposite in polarity hence simple op - amp summer circuit is used.



Features:

Relay	: System with electronic relay (simulated)
Dead zone	: Variable from 0-600mV (approx.)
Hysteresis	: Variable from 0-500mV (approx.)
Signal	: Sine in built
Amplitude	: 0-1V (min.) Variable
Frequency	: 100Hz
Display	: phase plane on CRO
Process	: Simulated 2nd order non-linear
C.R.O. Interface	: Facility for displaying x and y.
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

Study of the relay characteristics and display of the same on CRO for different values of hysteresis and dead zones
The transfer characteristics and output of the relay under various settings provide insight into the relay performance
Study of the effect of hysteresis on system stability.
Phase plane analysis of relay control system for various values of Hysterisis and Dead Zones.

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INTRODUCTION:

Light intensity controllers are employed in studios, in indoor sta-diums and some other applications where the lumineous intensity is required to be constant. Basically these are the close loop systems where the ambient light condition whatever it is required is sensed by the transducers and used to control the lamp intensity by suitable circuits. This set up is designed to study of such system in labs. The system has few basic blocks with a light unit having few number of small filament lamps. The brief introduction of circuit blocks and light unit is followed.1. Error detector : It is standard configurated summing amplifier which sum the reference and feedback voltages to give an output which is equal to the addition of both voltages as eo = e1 + (-e2). Note the inverted sign against e2is taken since the feedback voltage is reverse in polarity. Thus a difference voltage appear at the output.

Features:

Light source	: 3 miniature bulbs controlled by solid state regulator
Disturbance source	: 2 miniature lamps to add disturbance
Measurement	: LDR based intensity measurement.
Error detector	: Op-amp for close loop operation
Amplifier	: Gains selection from 1 to 11 in linear steps
P-I controller	: To improve the speed and to minimize control error
DC source	: Variable dc voltage source
Signal sources	: Two with constant amplitude and variable frequency 1. Square wave 2. Triangular wave
C.R.O. Interface	:Sockets for XY to connect CRO for dynamic response
Display	: 3.5. digit digital voltmeter
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One
Dimension	: 410x260x160mm (approx)

EXPERIMENT COVERED

Study of lamp dynamics (response under pulsated supply)
To study light intensity control system using an amplifier(P control)
To observe improved response usng P-I controller
To study disturbance(change in ambient light) rejection by use of controllers.
To draw loop in dynamic mode and to observe effect of gain upon loop area
To study effect of pulsation frequency

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SCL 118
STROBOSCOPE

INTRODUCTION:

A stroboscope is an instrument, which flashes the light upon rotating or vibrating object which is turning at high speeds, cause to appear it to be standstill or moving slowly. It is non - contact speed measuring instrument.In stroboscope principle, intense light flash of variant frequency is directed towards the rotating object. When the flash rate is equal to or multiple of the rotating revolution it may be standstill. The present stroboscope SCL -118, is designed to measure such rotating object revolutions from <300 ->9000 RPM, sufficient for most applications.

Features:

Speed measurement	: Non-contact through high intensity flashes no error due to friction drive, suitable for small motors and also motors in inaccessible locations
Light source	: High intensity LED flashes operation possible from a reasonable distance (0.5m) in usual ambient light in a room.
Display	: 4-digit direct speed reading in RPM operating range of 300-9900 rpm, resolution 1 rpm. High accuracy crystal controlled LED display.
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One

EXPERIMENT COVERED

Speed measurement using Stroboscope.

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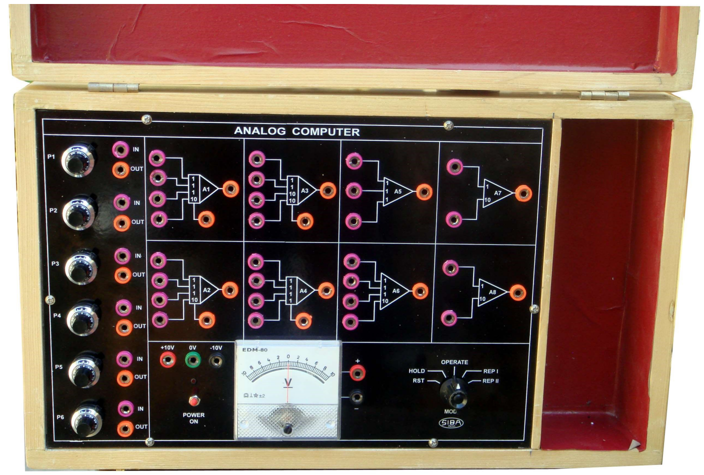

INTRODUCTION:

The analog computers are used to solve the mathematical problem with contineously variable parameters. To solve the problem there are some electrical components are used. The basic components are operational amplifiers, potentiometers, capacitors, resistors and switches. The operational amplifier is used as an inverter, summer, multiplier and integrater using the passive components abovesaid. These circuits are symbolized upon panel and electrical circuits. *The components and their symbols* : As said earlier the basic components are used to perform the operations such inverter, summer and integrters. The function of an inverter is to change the sign of input signal without altewring the magnitude of input signal.

Features:

Potentiometers	: Six multiturn precision potentiometer to set coefficients with knobs with vernier to read coefficient directly
Integrator	: Four adder integrator
Adder	: Two summers
Selector	: For Real time/Repetation/hold/reset selection
DC supply	: ± 10V DC Supply and ± 15V for circuitary
Meter	: One 80mm scaled high impedance analog center zero acrylic top voltmeter
Cabinate	: Housed in elegant teak polish cabinate with patch housing
Power supply	: Built in IC regulated power supplies
Mains	: 230V/50Hz AC
Instruction manual	: One

EXPERIMENT COVERED

Study of the relay characteristics and display of the same on CRO for different values of hysteresis and dead zones
The transfer characteristics and output of the relay under various settings provide insight into the relay performance
Study of the effect of hysteresis on system stability.
Phase plane analysis of relay control system for various values of Hysterisis and Dead Zones.

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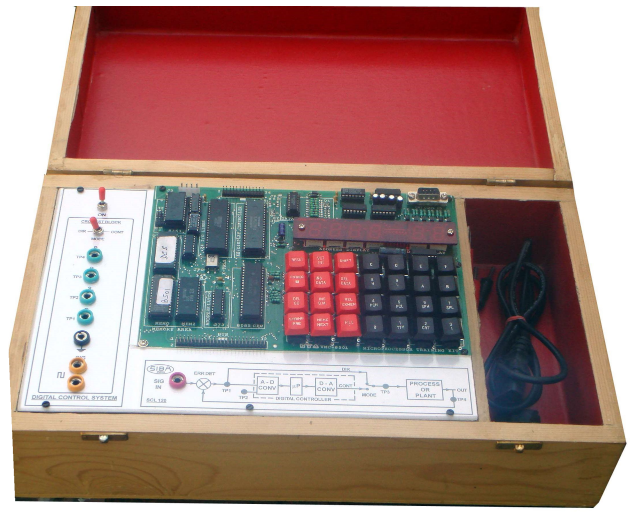
SCL 120

DIGITAL CONTROL SYSTEM(MICROPROCESSOR BASED PID)



INTRODUCTION:

The digital control systems are going popular today because of readily available inexpensive microcomputers and peripheral devices. A digital controller has versatility to change or modify its control function by changing or modifying its program instructions (in analog controllers it is modified by changing its hardware). In other words digital controller has distinct advantage over analog that it can be modified by software only where in analog world it is hardware only. Similarly it has disadvantage of computing errors due to finite word length, error in sampling and reconstruction, un-stablized sample and register overflow. In digital controller the data is taken in short duration pulses either sampled or discrete form and output the same in short pulse form of data.

Features:

Schematic	: Entire system represented in basic building blocks
Signal source	: Square wave,1Vpp at 10Hz Frequency.
Process(plant)	: 2nd order, type 0 Simulation using op-amps
Error detector	: op-amp based error detector
A to D converter	: 8 bit SAR ADC (with in built clock)
D to A converter	: 8 bit DAC, with precision References.
Microprocessor kit	: 8085 based, with hex keypad and led display
Software	: Loaded in 8 bit EPROM
Supply	: built in IC regulated supplies for circuitry and microprocessor kit
Termination	: 4 mm sockets to connect CRO
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One

EXPERIMENT COVERED

Study of variable rate sampling (observe effect of sample delay)
Study of Uncompensated system (USYS)
Study of Compensated system (CSYS) to improve steady state error and to limit overshoot.
Study of P, PI and PID controlled system (DPID)

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SCL 121

STUDY OF TIME LAG BY CHANGING THE TIME CONSTANT

INTRODUCTION:

This set up is designed to study the time response of simulated time - constants. The present set up has straightforward building blocks of simulated blocks & signal source. A cathode ray oscilloscope (dual trace is best option) is the only other apparatus required to carried out the most experiments. Basic building blocks : - There are basic building blocks are given upon the panel. All blocks has input / output sockets with arrowhead mark and common of them is connected internally with common ground. Error detector with gain :- This block has three inputs marked as Disturbance, reference and feedback. It has one output shown by arrowhead mark. The input error signals referred as e1, e2 are added and the output could be written as , {e o = K (e 1 + e 2)} No - sign indicate the output has same phase with the inputs. K is the gain factor (uncalibrated) which can be adjusted with potentiometer provided upon the panel.

Features:

:

Signal source	: Square wave,1Vpp at 20Hz Frequency.
Process(plant)	: 2nd order, type 0 Simulation using op-amps
Error detector	: op-amp based with variable gain
Time constants	: Four
Uncomitted Amplifier	: One for phase reversal
Power supply	: Built in IC regulated power supplies
Cabinate	: Housed in rigid MS powder coated with moulded frame
Mains	: 230V/50Hz AC
Instruction manual	: One

EXPERIMENT COVERED

Study of variable rate sampling (observe effect of sample delay)
Study of Uncompensated system (USYS)
Study of Compensated system (CSYS) to improve steady state error and to limit overshoot.
Study of P, PI and PID controlled system (DPID)

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SCL 100
STUDY OF SECOND ORDER CONTROL SYSTEM

INTRODUCTION:

This set up is designed to study the time response of simulated time - constants. The present set up has straightforward building blocks of simulated blocks & signal source. A cathode ray oscilloscope (dual trace is best option) is the only other apparatus required to carried out the most experiments. Basic building blocks : - There are basic building blocks are given upon the panel. All blocks has input / output sockets with arrowhead mark and common of them is connected internally with common ground. Error detector with gain :- This block has three inputs marked as Disturbance, reference and feedback. It has one output shown by arrowhead mark. The input error signals referred as e1, e2 are added and the output could be written as , {e o = K (e 1 + e 2)} No - sign indicate the output has same phase with the inputs. K is the gain factor (uncalibrated) which can be adjusted with potentiometer provided upon the panel.

Features:

Process : Second order Process block with an integrator which can be introduced by a switch

Signal source : Two

1. Sine wave : Continuously variable between two decades,10-100 and 100 to 1000 Hz, selected with coarse x10-x100 and a fine frequency dial with amplitude variable 0-10Vpp
2. Square wave : 40Hz,1Vpp fixed Square wave,1Vpp at 20Hz Frequency.

Error detector : Continuously variable between 0-10x2 readable from the gain control knob

Display : Digital

Power supply : Built in IC regulated power supplies

Cabinate : Housed in rigid MS powder coated with moulded frame

Mains : 230V/50Hz AC

Instruction manual : One

EXPERIMENT COVERED

Plot of frequency response of second order type 0 & type 1 system
Study of transient response of second order type 0 & type 1 system

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