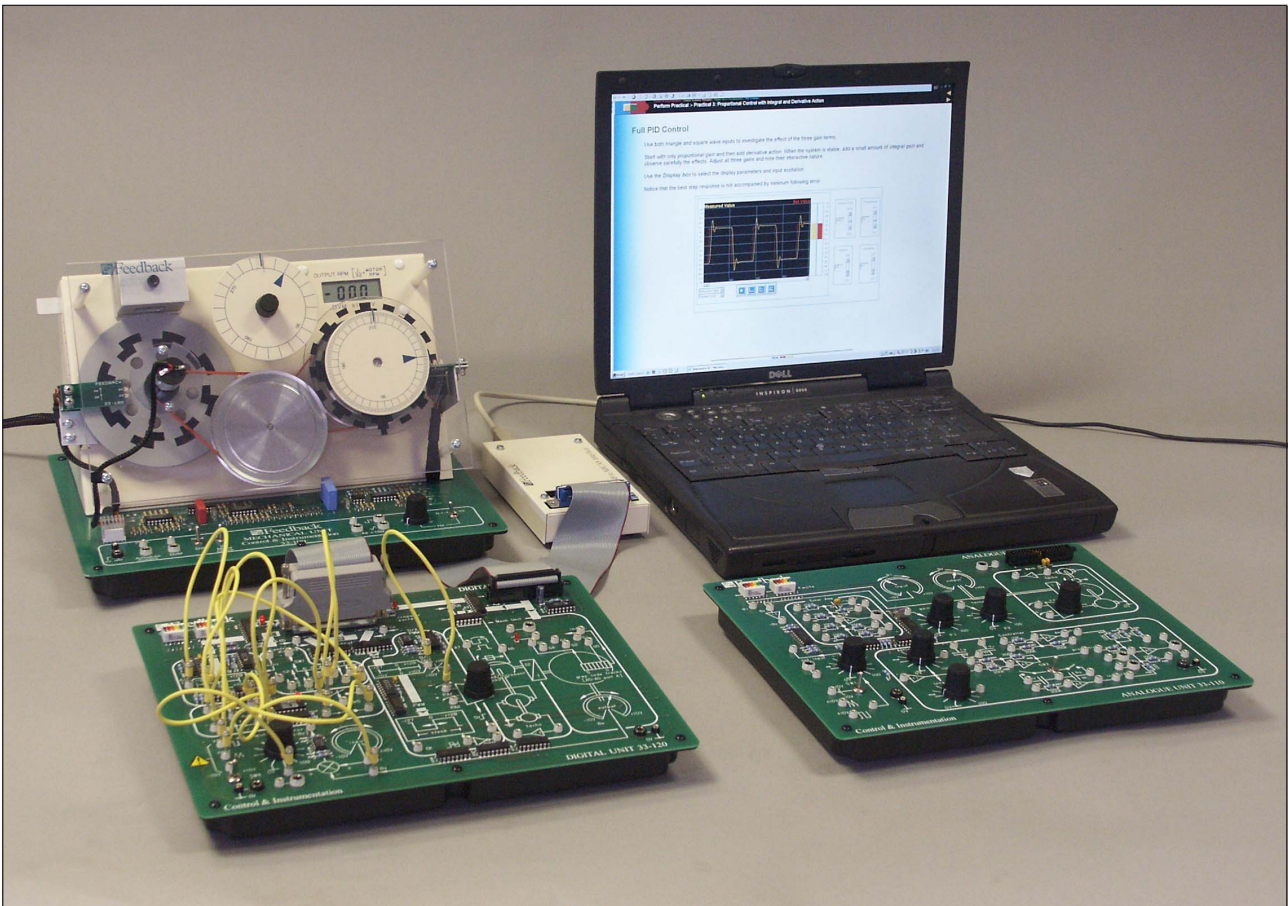


Servo Fundamentals Trainer Analogue & Digital Servo Fundamentals Trainer

Series 33



Features

- Open and closed loop speed and position control
- Both analogue and digital control techniques
- Discovery Software for computer assisted practical assignments
- Inbuilt PC based instrumentation
- On board sine, square and triangle waveform generator
- Independent single, two term, or full PID control
- Absolute position and incremental speed and position encoders
- Continuous analogue position and velocity feedback signals
- Linear or PWM motor drive
- Switched faults throughout the system
- LCD speed and digital voltmeters
- Connection to a PC via USB
- Includes power supply

Curriculum Coverage

Servo Fundamentals Trainer has been designed to be used by student to investigate the fundamental principles of servo control, both analogue and digital. The Trainer uses two methods instruction: analogue control fundamentals are provided by fifteen manual based assignments, whilst the digital fundamentals are by means of seven Discovery computer based assignments. Little prior knowledge is required of students other having had some experience of using an electric motor, the basic handling of electronic circuits and the ability to use an oscilloscope.

Analogue principles are presented in progression from operational amplifier characteristics, through position and velocity feedback, to full PID control and closed loop frequency response investigations. Digital principles include A/D and D/A conversion, absolute and incremental encoding, position and speed control and full PID control.

Wherever possible, the approach uses the minimum mathematics commensurate with the subject, making the Trainer ideal for vocational and technician courses, however the hardware is entirely suitable for more advanced studies and later assignments extend the work to cover more advanced topics suitable for higher technician and undergraduate courses.

The Servo Fundamentals Trainer covers a wide range of assignment work including:

Analogue Unit

- Familiarisation
- Operational Amplifier Characteristics
- Motor, Tachogenerator and Brake Characteristics
- Simple Control and Speed Systems
- Error Channel and Feedback Polarity
- The Influence of Gain
- Velocity Feedback
- System Following Error
- Unstable System
- Speed Control System
- Introduction to Three Term control
- Applications of Three Term Control
- Single Amplifier Control Circuits
- Transient Velocity Feedback & Derivative Feedforward
- Frequency response principles
- Applications of introductory frequency response principles to the system

Digital Unit

- Supported by Discovery software
- A/D and D/A conversion
- Motor Control
- Potentiometer Position Sensors
- Digital Encoders
- Gray Code Encoder
- Incremental Encoder
- Speed and Direction Encoding
- Position Servo using PID Control
- Position Control using Analogue Sensor
- Position Control using Digital Sensor
- Speed Control using Analogue Sensor
- Speed Control using Digital Sensor
- Position Servo using P+D Control
- Position Servo using P+I Control
- Position Servo using PID Control

Description

The system comprises three units which allow the investigation of the fundamentals of analogue and digital servo control:

- **a Mechanical Unit,**
- **an Analogue Unit and**
- **a Digital Unit**

The Mechanical unit carries a power amplifier, dc motor and tachogenerator, absolute and incremental digital encoders, input and output analogue potentiometers, a digital speed and voltage display and a sine, square and triangle waveform generator for testing purposes.

The Analogue Unit carries a four input error amplifier, a controller with independent P, I and D channels and facilities for single amplifier compensation circuits.

The Digital Unit carries ADC and DAC for signal conversion, switching and multiplexing circuits, encoder output and display and linear and PWM motor drive. Access is given to the input and output potentiometers enabling a wide range of linear and digital systems to be investigated.

Discovery software is provided for use with the Digital Unit and allows assignment work to be carried out with on screen theory, background information, patching instructions, practical screens with built in PC based instrumentation, and questions on the work done.

Interconnection between units is by ribbon cable and system interconnection is by plugged patch leads on the analogue or digital units, which carry clear graphic layouts.

Switched faults are available and are distributed through all three boards of the system.

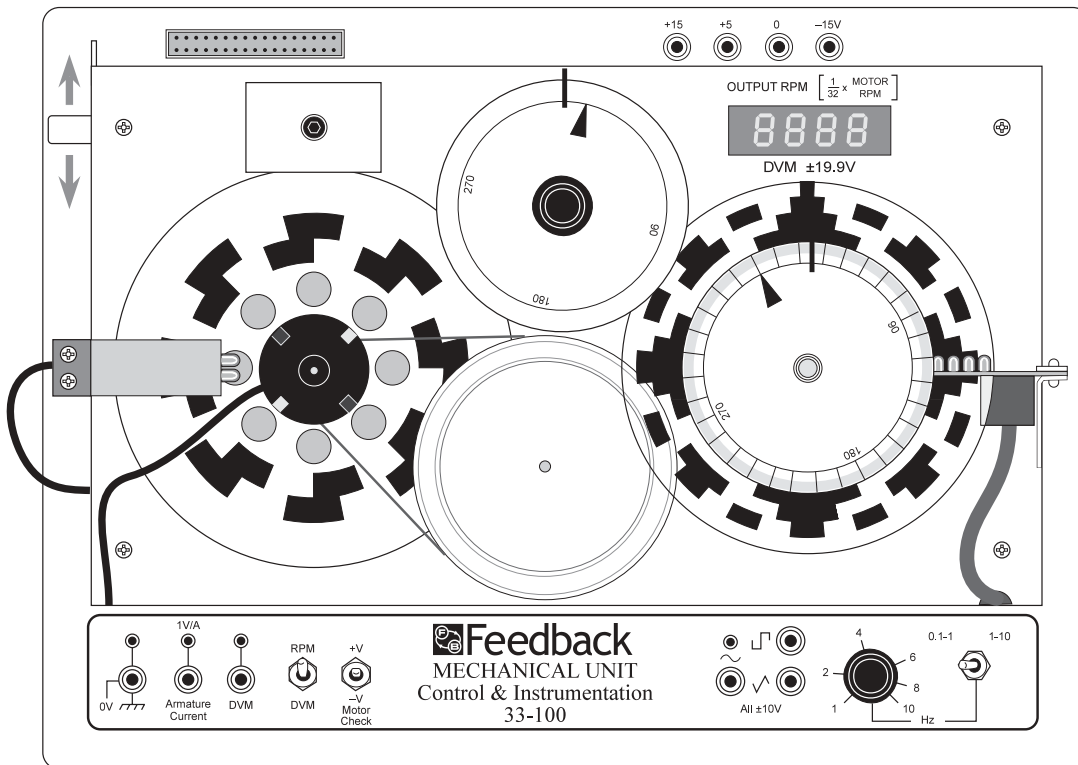
A manual is also provided with a comprehensive range of detailed experiments starting from an introductory level and progressing to frequency response principles.

A Power Supply is included which provides all of the necessary dc voltage supplies required by the system.

The system is flexible. For analogue control teaching only the Mechanical and Analogue Units are required. For digital control teaching the Mechanical and Digital Units are required. These options are available separately and the individual units are also available to upgrade to a complete system.

Mechanical Unit 33-100

The Mechanical Unit consists of an open-board format assembly carrying the mechanics of the system plus its supporting electronics. The electromechanical components comprise a dc motor, an analogue tachogenerator, analogue input and output potentiometers, absolute and incremental digital encoders and magnetic brake. The supporting electronics comprises: the power amplification; a low frequency sine, square and triangle waveform generator for testing purposes; encoder reading circuitry and LCD speed display and DVM. The power supply for the Fundamentals Trainer is connected to this unit.



Specification

Open-board format unit carrying servo, system mechanical assembly and supporting electronics.

Permanent magnet motor with armature current available.

Tachogenerator, 2.5V/1000 rpm.

Magnetic eddy current, brake for load. Input and output shaft potentiometers.

Switchable, 3-figure, 7-segment LCD display of speed or voltage.

Bi-phase incremental position or speed encoder on motor shaft.

6-bit absolute (Gray code) encoder on output shaft.

Power amplifier, continuous or PWM input.

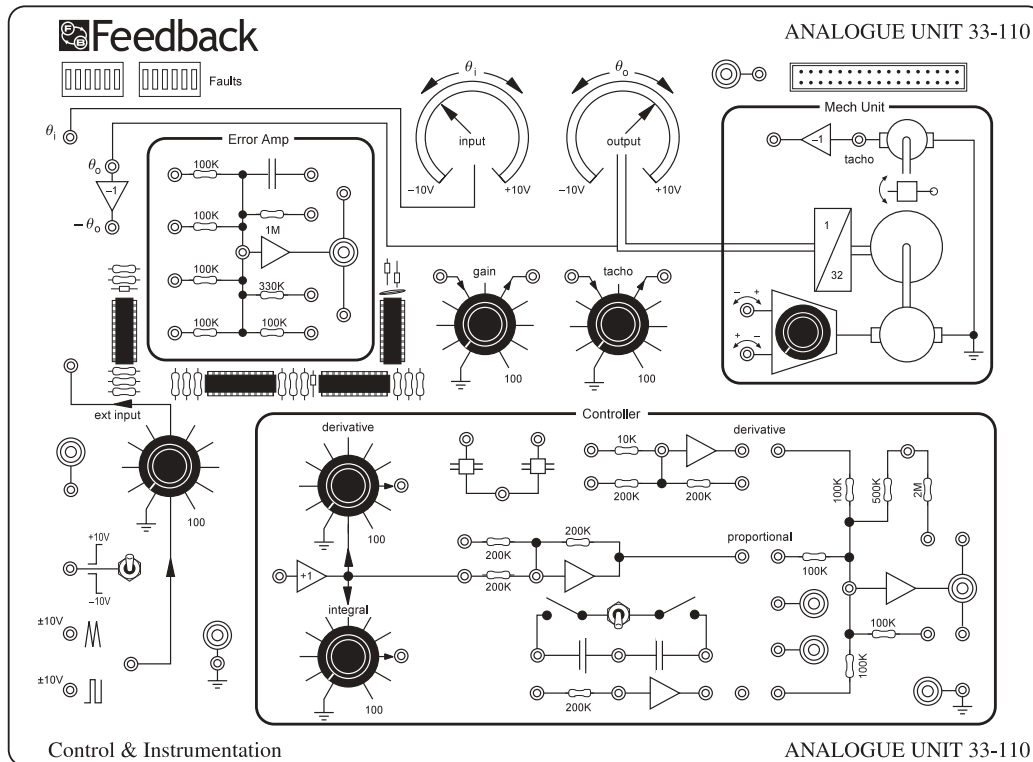
Sine, square and triangle waveform generator, 0.1 to 10Hz. Internal faults switched from other units.

Power requirements: external $\pm 15V$ at 1.5A & +5V at 0.5A. Feedback 01 - 100 is recommended.

Dimensions 150mm (H) x 295mm (W) x 220mm (D)
Weight 2.2kg.

Analogue Unit 33-110

The Analogue Unit provides all of the electronic circuitry required for performing a wide range of analogue servo control assignments, ranging from the basic introductory principles of servo control through to full PID implementation. It is of open-board construction with a clearly presented screened legend to enable the student to identify and understand the components of such control systems. Connection to the Mechanical Unit is by way of a ribbon cable which also supplies power to the unit.



Specification

An open printed circuit board unit with:

4-input error amplifier with optional additional time constant.

Gain control and velocity feedback control.

Input connections to motor drive power amplifier.

Controller with independent proportional, integral and derivative actions.

Two or three term control possible.

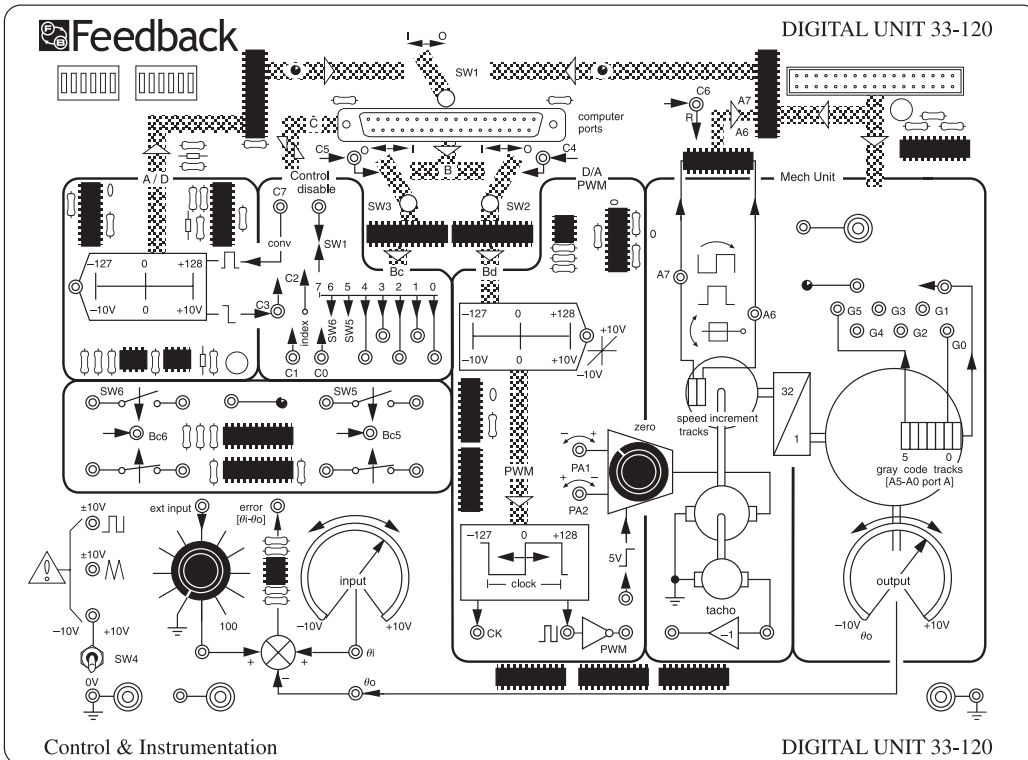
Single amplifier compensation available.

Manual or on-board test signals.

Switched faults distributed through system.

Digital Unit 33-120

The Digital Unit acts as the interface between the Mechanical Unit and a PC, or compatible microcomputer. It contains ADC and DAC circuits for signal conversion which, together with linear or digital PWM motor drive, input and output potentiometers or digital encoders enable a wide range of linear and digital systems to be realised. Computer controlled switches are provided for signal multiplexing and circuit configuration of the patching. Connection to the Mechanical Unit is by way of a ribbon cable which also supplies power to the unit and connection to the computer is via a USB cable to the PC USB port.



Specification

- Provides access to host PC, or compatible microcomputer.
- 8-way input and output busses.
- Additional control lines available.
- ADC and DAC for linear system operation.
- Linear or PWM motor drive.
- LED display of incremental and absolute encoders.
- Manual patching with computer controlled configuration and multiplexing.
- Switched faults distributed through system.

Discovery Software

The Discovery Software, in combination with the Digital and Mechanical Units, forms an innovative and motivating delivery system, which enables a wide range of assignments to be carried out. Background theory, board patching, practical control, instructions and questions, together with PC-based instrumentation, integrated into the Discovery environment, supply all the instruction and measurement requirements of the experiments. The test points used by the PC-based instrumentation in the experiments are available on the workboard, allowing other laboratory instruments to be connected if required.

Specification

An integrated instructional and hardware control delivery system.

Includes Theory, Background Information, Patching Instructions, Practical Control, Instrumentation and Questions screens.

Totally free movement between screens.

Mouse controlled, drop-down menu format, working under Microsoft Windows 98, 2000, XP, XP pro and ME operating systems.

Servo Fundamentals Trainer Additional Equipment

To operate Discovery software a modern, Windows based PC is required with the following minimum specification:

Pentium PIII 1GB processor

5Gb free hard disk space

256Mb RAM

USB Port

32Mb VGA card

Colour monitor

Microsoft Windows XP pro operating system

If required, Feedback can provide a suitable computer entirely compatible with the trainer.

Ordering Information

Servo Fundamentals Trainer 33-001-USB
(includes 33-100, 110, 120-USB, Discovery Software and Power Supply)

Analogue Servo Trainer 33-002-USB
(includes 33-100, 110, Discovery Analogue Software and Power Supply)

Digital Servo Trainer 33-003-USB
(includes 33-100, 120-USB, Discovery Software and Power Supply)

Servo Fundamentals Trainer Discovery Upgrade Pack 33-021
(For customers who wish to upgrade to USB operation for both Analogue and Digital control)

Servo Fundamentals Trainer Discovery Upgrade Pack 33-023
(For customers who wish to upgrade to USB operation for Digital control)

Individual Units may also be ordered separately.



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