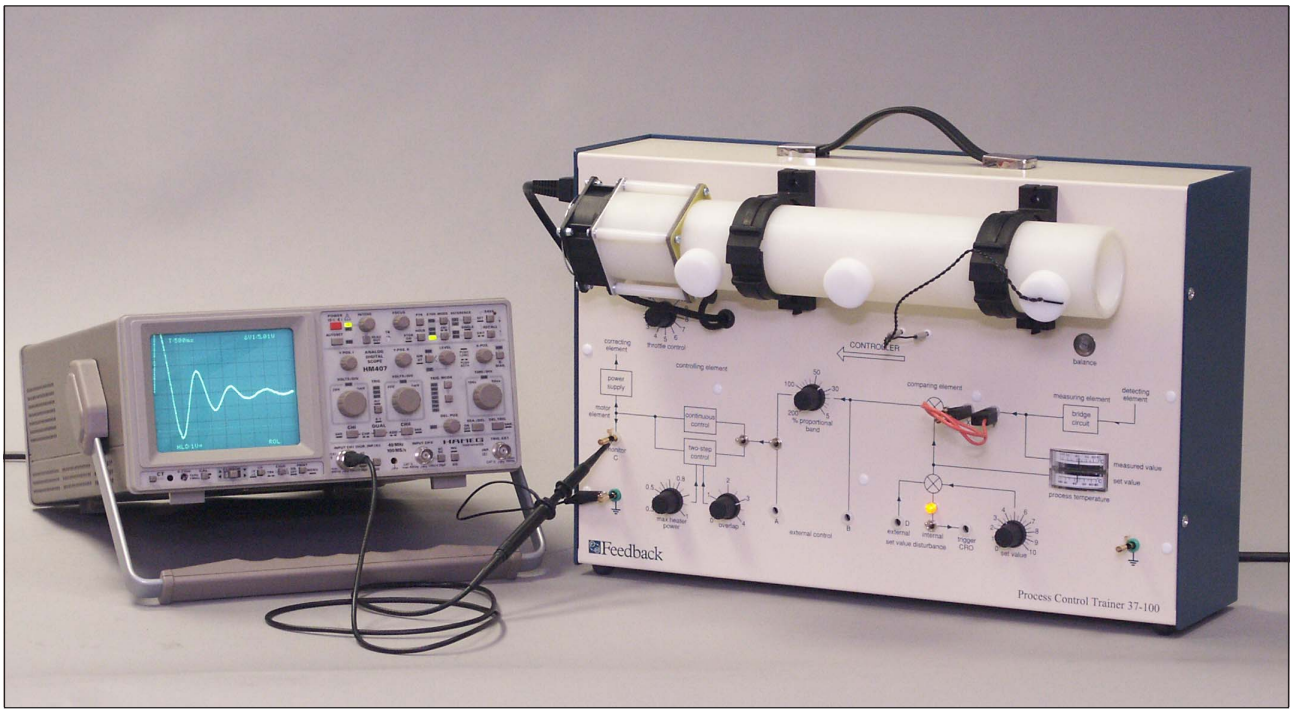
Feedback

Process Trainer 37-100



Description

A heating element controlled by a thyristor circuit feeds heat into the airstream circulated by an axial fan along a polypropylene tube. A thermistor detector, which may be placed at one of three points along the tube length, senses the temperature at that point.

The volume of air flow is controlled by varying the speed of the fan via a potentiometer. A change in setting represents a supply side disturbance and the effects are easily demonstrated.

The detector output is amplified to provide both an indication of the measured temperature and a feedback signal for comparison with a set value derived from a separate control. A comparison of these signals generates a deviation signal which is applied to the heater control circuit such that the controlled condition is maintained at the desired value.

The variation of dynamic behaviour with loop gain can be studied with the variable gain facility (proportional band). By increasing the loop gain, oscillatory responses and finally instability are caused. Provision is made for the introduction of set value disturbances in the form of electrical inputs from a suitable function generator (e.g. Feedback FG601).

Many simple temperature control systems use two step (ON/OFF) controls which operate when the temperature is outside the controlled limits. A simple switch converts the 37-100 to this mode so that control accuracy and stability can be demonstrated. The effects of adjustments of overlap and maximum heater power can be studied.

An extended range of practical experimental work can be tackled by combining the Process Trainer 37-100 with the 3-term controller Proportional, Integral and Derivative unit PID150Y. As a simple demonstration, this shows the powerful action of a 3-term controller in reducing deviation and improving response time.

Features

- **For teaching the basic ideas of process control to technicians, process operators and control engineers**
- **A practical process in miniature**
- **Designed for the instruction of students at all levels**
- **Demonstrates closed and open-loop continuous control as well as two-step control**
- **Response times enables dynamic behaviour to be seen on oscilloscope or chart recorder**
- **The system exhibits thermal time constants and time transport lag**
- **Meters with side-by-side pointers indicate set and measured values**
- **Can be used with the Feedback PID150Y module to apply three term control**

Feedback

Distance/Velocity Lag	With the loop open a signal is applied to the controller. Either a step change from a switch on the panel or a signal from an external function generator. Distance/velocity lag (or transport lag) can be measured directly on an oscilloscope triggered by the applied signal.
Transfer Lag	The open-loop response to a step change can be measured directly on an oscilloscope. The shape of the curve is principally determined by the heater/air and detector/air time constants, and an increase in air flow rate will be seen to produce a reduction in transfer lag.
Calibration	Monitoring points are available which enable the steady-state signal levels at different parts of the system to be measured.
Two-step Control	The two-step controller has overlap adjustable down to zero and means of controlling maximum heater power. The effect of overlap on the amplitude and frequency of temperature alternations can be demonstrated.
Proportional Control	With the loop closed the effect on offset of altering the proportional band width can be observed by comparing the readings on the 'set value' and 'measured value' meters or by observing deviation directly on an oscilloscope. As proportional bandwidth is decreased offset is reduced until a point is reached at which the system becomes unstable.
System Response	A supply side disturbance can be produced by changing the inlet air flow, and a change in set value introduced either internally or externally. The response to a step function disturbance can be made under-damped, critically damped or over-damped by adjustment of proportional band.
Frequency Response	With the loop open and a sine wave signal applied to the input side, measurements of gain and phase are made over the frequency range 0.1 to10Hz. The uses of Nyquist and Bode diagrams in the analysis of the results is discussed.
Compound Controller Action	By coupling to the Proportional Integral and Derivative Unit PID150Y the use of P+I, P+D, or I+D control to eliminate offset, reduce overshoot etc, can be demonstrated. The results of the frequency response experiment can be used as a basis for setting up the compound controller.

Specification

Maximum heater power	80W
Velocity flow range	1 - 10ft/sec (0.304 - 3.05m/sec)
Detector temperature range	Ambient to 80 degrees
Heater/detector time constant	400ms
Typical distance - velocIty lag	200ms
Typical natural period	1.0 seconds
Tube length	298mm (11.75 inches)
Electrical input and output range	µ10V
Manual supplied on CD ROM	Process Trainer 37-100
Power requirements	220-250V or 100-120V. 50 or 60Hz, 170VA.
Dimensions and Weight	Width: 520mm, Depth: 292mm, Height: 216mm, Weight: 5.6kg.
Tender Specification	Demonstrator to provide studies of basic control processes used in typical industrial applications. To provide the controls and metering required to demonstrate closed and open-loop continuous control and two-step control. To be compatible with comprehensive instruction manual of assignments and projects supplied on CD ROM.
Ordering Information	Process Trainer 37-100 Proportional, Integral and Derivative Unit PID150Y

Feedback
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