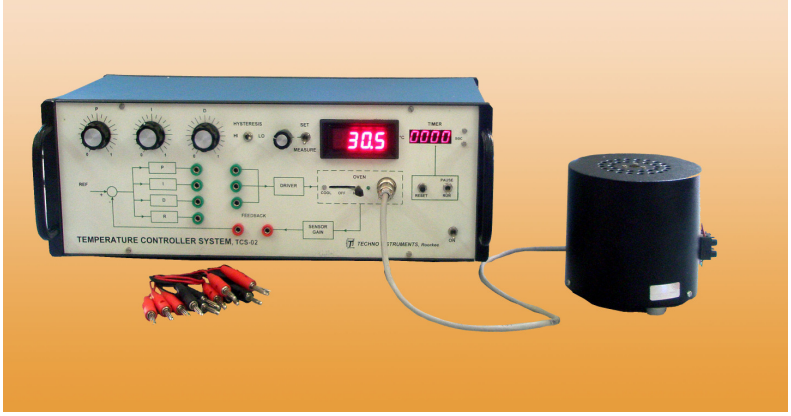
TEMPERATURE CONTROL SYSTEM TCS-02

- **Fast compact oven upto 90°C**
- **Forced cooling option**
- **Variety of control actions**
- **Digital temperature readout**
- **Built-in timer, 0-9999 sec.**
- **Solid state temperature sensor**



Introduction

Temperature control is an important application of control theory to industrial processes. This experiment has been designed to expose the students to such a practical control system, its various stages for control, and the tuning of a PID controller. The process consists of a small and fast responding oven which can be controlled in the temperature range from ambient to about 90°C. Temperature readings may be taken manually on a 3½ digit meter, mounted on the main unit, at regular intervals. A built-in digital timer having 'START', 'STOP' and 'PAUSE' switches on the panel makes the conduct of an experiment very simple. This design of the oven avoids expensive accessories like an X-Y recorder for conducting the experiment. A forced cooling arrangement has been provided to bring the oven temperature down to room temperature after every experiment. Since the oven may be cooled to the ambient relatively speedily, a number of cycles of experimentation are possible in the usual laboratory hours.

The oven is connected to the main unit through a four pin connector, two for the sensor output and the others for controller output to the heater. The main unit has provisions for configuring any type of controller such as P, PI, PD, PID or ON-OFF, and has potentiometer controls for PID coefficient settings. All supplies and metering system are built-in and no accessories are required.

Open loop response of the oven is obtained by applying a step command with feedback disconnected. Temperature readings are noted and the plot so obtained provides the characteristics of the oven, i.e., its time constant and time delay.

The simplest form of controller is a relay which switches the oven ON and OFF. Presence of hysteresis is essential for avoiding excessive relay switching, of course at the cost of accuracy. The performance is studied here for the two hysteresis settings of the built-in 'electronic relay'.

PID controllers may be set or tuned by many different methods. In this experiment the design method of Ziegler-Nichol is suggested for setting the coefficient potentiometers and the resulting response curve is studied. Other methods may also be used equally easily.

The literature accompanying the unit describes in detail the mathematical concepts, procedure for experiments and a few test results. A number of additional experiments may also be planned by the teacher using books and literature on this subject which is suggested in the references given.

Experiments

- Identification of the oven parameters
- Study of ON-OFF temperature control (with adjustable relay characteristics)
- Study of P, PI, PD and PID controls having adjustable coefficients

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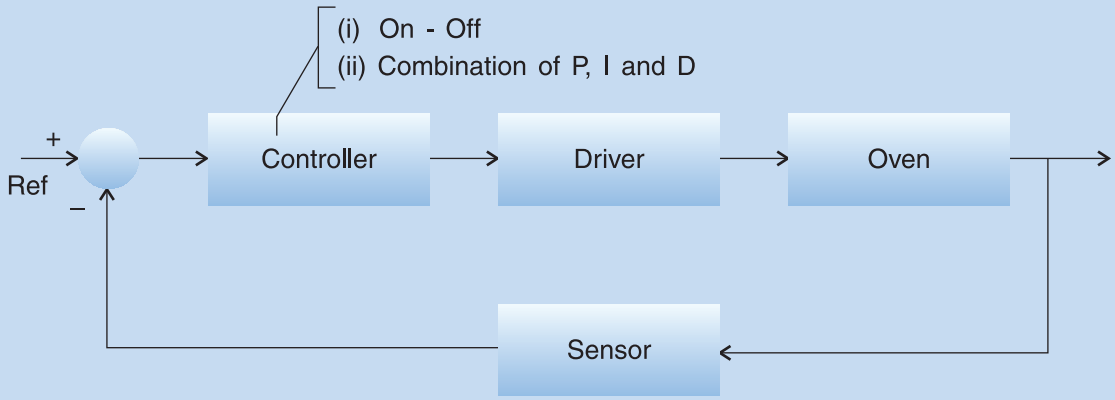
Features and Specifications

- Temperature controller with facilities for P, I, D and relay control blocks
- Operating temperature: Ambient to 90°C
- Separate controls for P, I, D channel gains
- Two settings for relay hysteresis
- Fast 25W oven fitted with IC temperature sensor
- Forced cooling option to ready oven for next experiment
- Digital display of set and measured temperature on a 3½ digit built-in DVM
- 0-9999 sec, timer on panel for a convenient temperature response experiment
- Buffered output for recorder
- IC regulation in controller circuit power supplies
- 220V±10%, 50Hz mains operation
- Supporting literature and patch cords included
- No accessories required

Schematic Diagram



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