



CE106

BALL AND BEAM APPARATUS

Compact, self-contained, bench-mounting apparatus to study basic and advanced principles of control, including control of naturally unstable systems



- Self-contained, compact and bench-mounting unit that mimics a real control problem in unstable systems, such as missile or rocket take-off
- Highly visual apparatus, with moving ball and front panel mimic diagram of the process – students can see what they are controlling
- All inputs and outputs buffered for connection to TecQuipment's optional controllers or other suitable controllers
- For basic and advanced experiments with angle, velocity and position control

BALL AND BEAM APPARATUS

DESCRIPTION

The Ball and Beam Apparatus shows the control problems of unstable systems, for example a rocket or missile during launch, which needs active control to prevent the missile going unstable and toppling over.

The apparatus has a steel ball which is free to roll on two parallel tensioned wires. The wires are on a beam that pivots at its centre. A servo motor controls the beam angle and sensors measure the beam angle and ball position. The basic control problem is to vary the beam angle to control the ball position. The system is a double integrator, so it is naturally unstable. It needs active feedback control using phase-advance methods.

ESSENTIAL BASE UNIT

- Controller (CE120) – A controller with analogue and digital controls and instruments
or
- Digital Interface (CE122) – An interface which connects between most products in the Control Engineering range and a suitable computer (not included)
or
- Other suitable controller with +/- 10 V inputs and outputs

Both the CE120 and the CE122 include TecEquipment's CE2000 Control Software with editable, pre-made control experiments for use with the CE106.

STANDARD FEATURES

- Supplied with comprehensive user guide
- Five-year warranty
- Made in accordance with the latest European Union directives

LEARNING OUTCOMES

- Measurement of system dynamics by transient and closed-loop methods
- Design of analogue phase-advance compensators
- Design of state reconstructors to obtain estimates of ball velocity and position

The flexible design of the equipment allows the user to develop many other analysis and control exercises to suit their needs. It is good for extended or advanced control experiments, and is ideal for student project work.

ESSENTIAL SERVICES

ELECTRICAL SUPPLY:

90 VAC to 250 VAC, 0.4 A, 50/60 Hz, with earth

BENCH SPACE NEEDED:

1.5 m x 750 mm

OPERATING CONDITIONS

OPERATING ENVIRONMENT:

Laboratory

STORAGE TEMPERATURE RANGE:

-25°C to +55°C (when packed for transport)

OPERATING TEMPERATURE RANGE:

+5°C to +40°C

OPERATING RELATIVE HUMIDITY RANGE:

80% at temperatures < 31°C decreasing linearly to 50% at 40°C

SOUND LEVELS

Less than 70 dB(A)

SPECIFICATIONS

NETT DIMENSIONS AND WEIGHT:

1070 mm x 330 x 420 mm; 18 kg

PACKED DIMENSION AND WEIGHT:

0.64 m³, 52 kg (approx – packed for export)

INPUT (0 TO 10 VDC):

- Motor

OUTPUTS (0 TO +/- 10 VDC):

- Ball position
- Beam angle

OTHER PARTS INCLUDED:

- Connecting cables
- Spare balls and wire
- Accessories for cleaning the wire