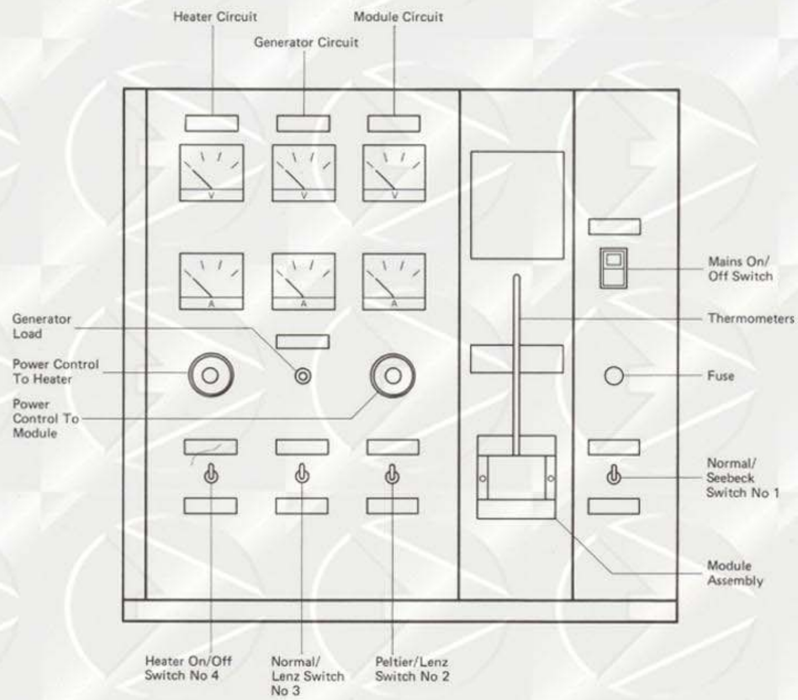
Thermo-Electric Heat Pump Unit R533

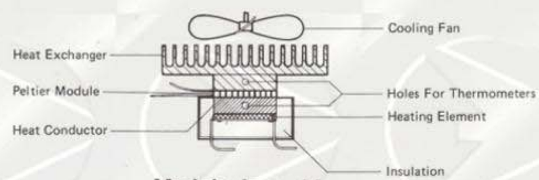
Machine Code R533 has now been superseded by R534. The unit is fitted to a new style panel and fuses are replaced by resettable miniature circuit breakers. Thermometer ranges have been rationalised to -20°C to +120°C. Operation and performance of the new unit is identical to that of the original.

Engineering Laboratory
Teaching Equipment

P. A. Hilton Ltd.

Thermo-Electric Heat Pump Unit R533





Module Assembly

Introduction

The HILTON THERMO-ELECTRIC HEAT PUMP has been designed to enable students to investigate the performance of a semi-conductor module which, on the application of an electrical power supply, will produce a refrigerating effect. Though the power required to produce this cooling effect is high, modules of this type find applications in a variety of high technology fields.

Conversely, by producing a temperature difference across the module a direct conversion of heat to electrical energy results. Again, due to inefficiency the power produced per module is small but applications do exist where alternatives are either not available or impractical.

The useful range of experiments that may be carried out with the Thermo-Electric Heat Pump make it of interest to those involved with courses in

- Power Generation
- Instrumentation
- Refrigeration
- Medicine
- Aeronautics
- Heat Transfer
- Electronics
- Thermodynamics
- Astronautics

Experimental capabilities

- Investigation of the effects upon the surface temperature of either face of the module with increasing power supply (Peltier Effect).
- Investigation of the effect upon heat transfer of reversing the polarity of the power supply (Thomson or Lenz Effect).
- Investigation of the variation in open circuit voltage across the module due to the variation in surface temperature difference (Seebeck Effect).
- Investigation of the power generating performance of the module with a steady load and increasing temperature difference.
- Estimation of the coefficient of performance of the module when acting as a refrigerator.

Background

Applications for thermo-electric devices of this type occur in fields where alternatives would be too bulky, heavy or impractical.

When used in the refrigeration mode typical applications include scientific and aerospace instrumentation for cooling and reference temperatures, in the medical field for freezing tissue samples, and more recently in the micro-electronics industry for cooling component packages and small lasers.

In the reverse mode, application of the modules to power generation is generally only possible where the load is small and alternative supplies are impractical. For this reason semi-conductor modules have found applications in remote areas for powering radios and in nuclear driven power supplies for satellites.

Description

(Please refer to the schematic diagram on the opposite page)

The semi-conductor assembly is mounted on a heat sink projecting through the front face of the glass reinforced plastic instrument panel.

The assembly consists of a module sandwiched between aluminium blocks giving both mechanical strength and thermometer wells for temperature measurement. A nickel chrome alloy element heats the outer face of the cold side aluminium block and this is thermally insulated within a stainless steel casing.

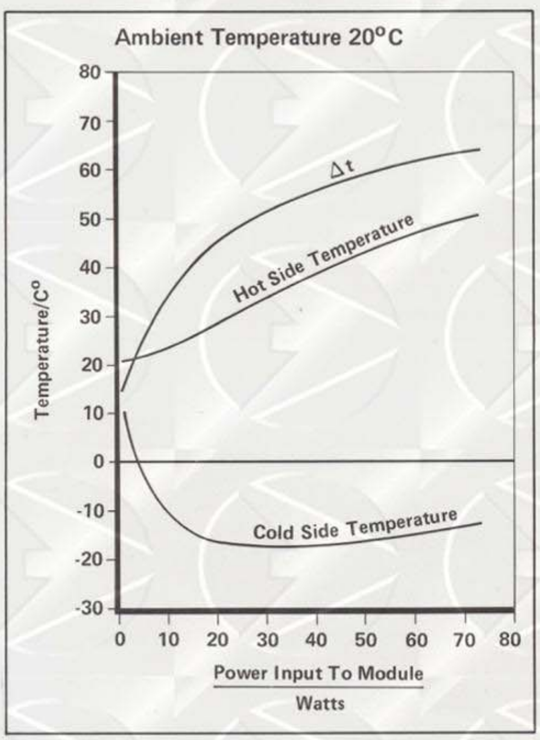
Each of the experimental configurations described may be established simply by sequenced switching of four control switches.

Variation of the power supplied to both the heater and semi-conductor module is achieved by separate long life heavy duty rheostats.

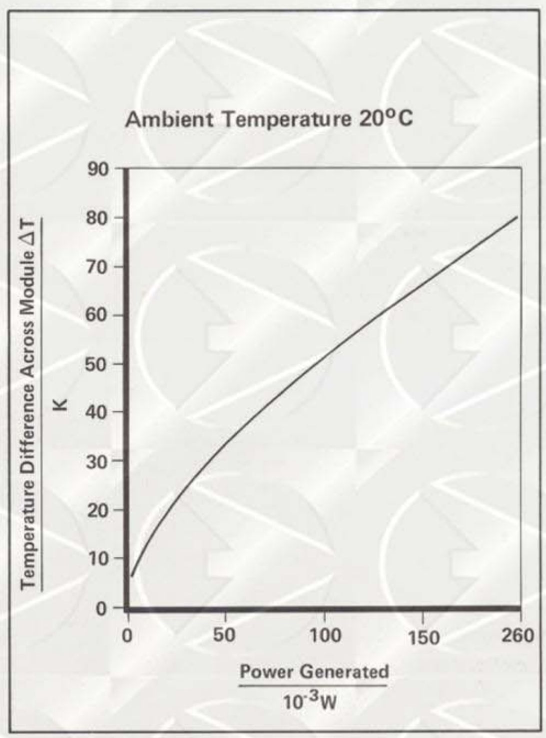
Measurement of the power supplied to the heater and module is achieved by the use of separate ammeters and voltmeters. A small lamp provides a 'load' which may be switched across the module in order to investigate the generating effect and a milli-ammeter and voltmeter allow measurement of the power generated.

Typical experimental results are shown graphically below.

Experimental Results



Peltier Effect



Generating Effect

Specification

General

A fully instrumented thermo-electric semi-conductor device demonstrating both refrigerating effects and power generating effects from the same module.

Detailed

Panel: High quality glass reinforced plastic on which the following components are mounted:

Module Assembly: Semi-conductor, thermo-electric device with hot and cold side thermometer pockets and insulated heater.

Voltmeters (3): Moving coil instruments
(2) Range 0 to 5 Volts
(1) Range 0 to 1.5 Volts

Ammeters (3): Moving coil instruments
(2) Range 0 to 15 Amps
(1) Range 0 to 250 Milli Amps

Thermometers (3): 300 mm liquid filled glass
(1) Range −100 to +110°C
(1) Range 0 to 150°C
(1) Range −50 to 30°C

Rheostats (2): Rotary triple graded with silver graphite brush

Switches (4): Multi-pole change over switches

Power Supply: Internally mounted. Single transformer, full wave rectifier and capacitor smoothing. Provides a DC supply of approximately 5 volts.

Safety Features: All electrical components earthed and mains supply fused. Both module and heater operate on a safe low voltage DC supply.

Dimensions

Height:	725 mm	Depth:	240 mm
Width	710 mm	Weight:	24 kg

Accessories and Spares

Unit supplied with:
One experimental, operating and maintenance manual.
Accessories and Spares for 2 years normal operation

Also available:
Recommended list of spares for 5 years operation (details on request).

The policy of P. A. Hilton Limited is one of continual improvement and they reserve the right to revise this specification without notice.

Services required

Electrical:

Either: **A.** 300W 220/240 Volts, Single Phase, 50 Hz. (With earth/ground)
or **B.** 300W 110/120 Volts, Single Phase, 60 Hz. (With earth/ground)

Ordering information

Order as:
R533 Thermo-Electric Heat Pump

Please specify:
Electrical supply —
Either: **A.** 220/240 Volts, Single Phase, 50 Hz. (With earth/ground)
or: **B.** 110/120 Volts, Single Phase, 60 Hz. (With earth/ground)

Language — either: English
French Spanish

Shipping specifications

Nett Weight:	24 kg
Gross Weight:	79 kg
Packing Case Size:	0.889 x 0.889 x 0.483 m
Packing Case Volume:	0.382 m^3

Please note

Units fitted with instruments calibrated in units other than SI or for use on non-standard voltages are available on special order.

P.A.Hilton Ltd.
Horsebridge Mill, King's Somborne,
Stockbridge, Hampshire, SO20 6PX, England.
Telephone: National Romsey (01794) 388382
International +44 1794 388382
Fax: (01794) 388129

Leaflet No. R533L/E/1/7758