Thermocouple Referencing Techniques

Isotech has a world leading range of thermocouple referencing equipment. From laboratory models for standard thermocouples through to large scale installations used in power stations, aeronautical, industrial and research institutes.

Types of Equipment

Automatic Ice Point

The junctions are maintained at a fixed temperature of 0°C

Features

- Provides 0°C reference as adopted by thermocouple tables
- Reference from one to a 100 Junctions
- Will reference any type or combination of thermocouple types
- Can be bench or rack mounted.

Constant Temperature Ovens

The junctions are maintained at a fixed temperature typically in the range 40 to 75°C

Features

- The junctions are maintained at a fixed elevated temperature.
- Reference up to 100 Junctions
- Will reference any type or combination of thermocouple types
- Can be provided as bench, rack mounted or in a weatherproof wall mounting case to IP66

Isothermal Systems

The junctions are not maintained at a fixed temperature, but are held in a thermal reservoir with an output signal which is fed to the instrumentation system.

Features

- The junctions float at ambient temperature in an isothermal block - no loading errors
- Can be fully passive with no power requirement
- Will reference any type or combination of thermocouple types
- Can be provided as bench, rack mounted or in a weatherproof wall mounting case to IP66

Types of Housing

Bench Mounting

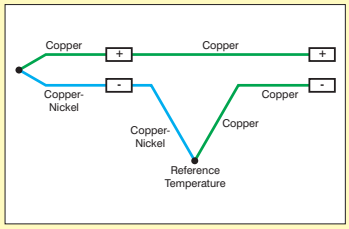
Wall Mounted

Rack Mounted

Types of Junction

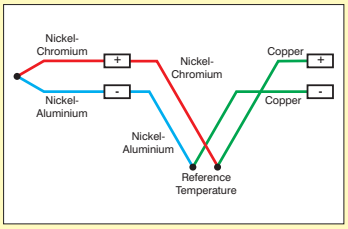
Single Junction

This is particularly useful with Type T thermocouples. With Type T one leg is copper, so only the Copper / Constantan wire needs to be processed thermally.



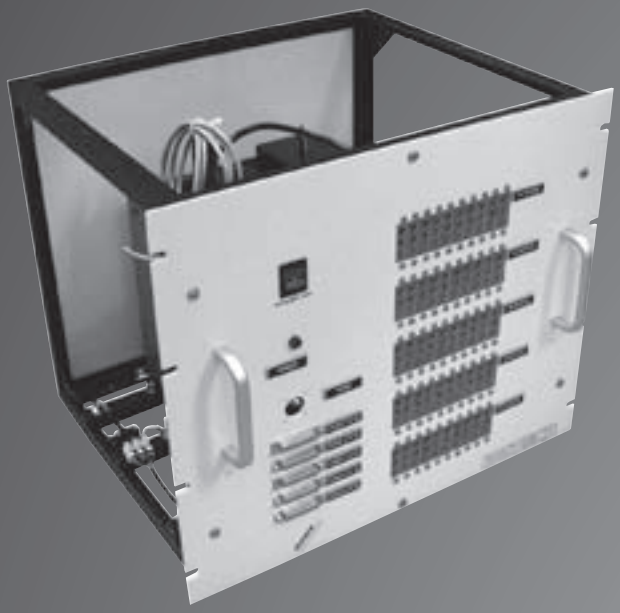
Double Junction

This is the most commonly used method. The input signal being connected to the "double junction" with the output on copper wires.

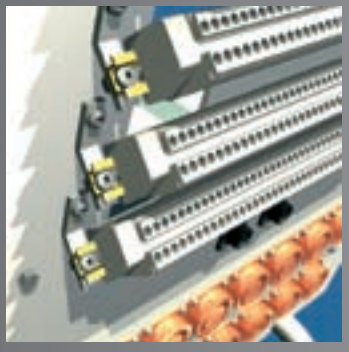


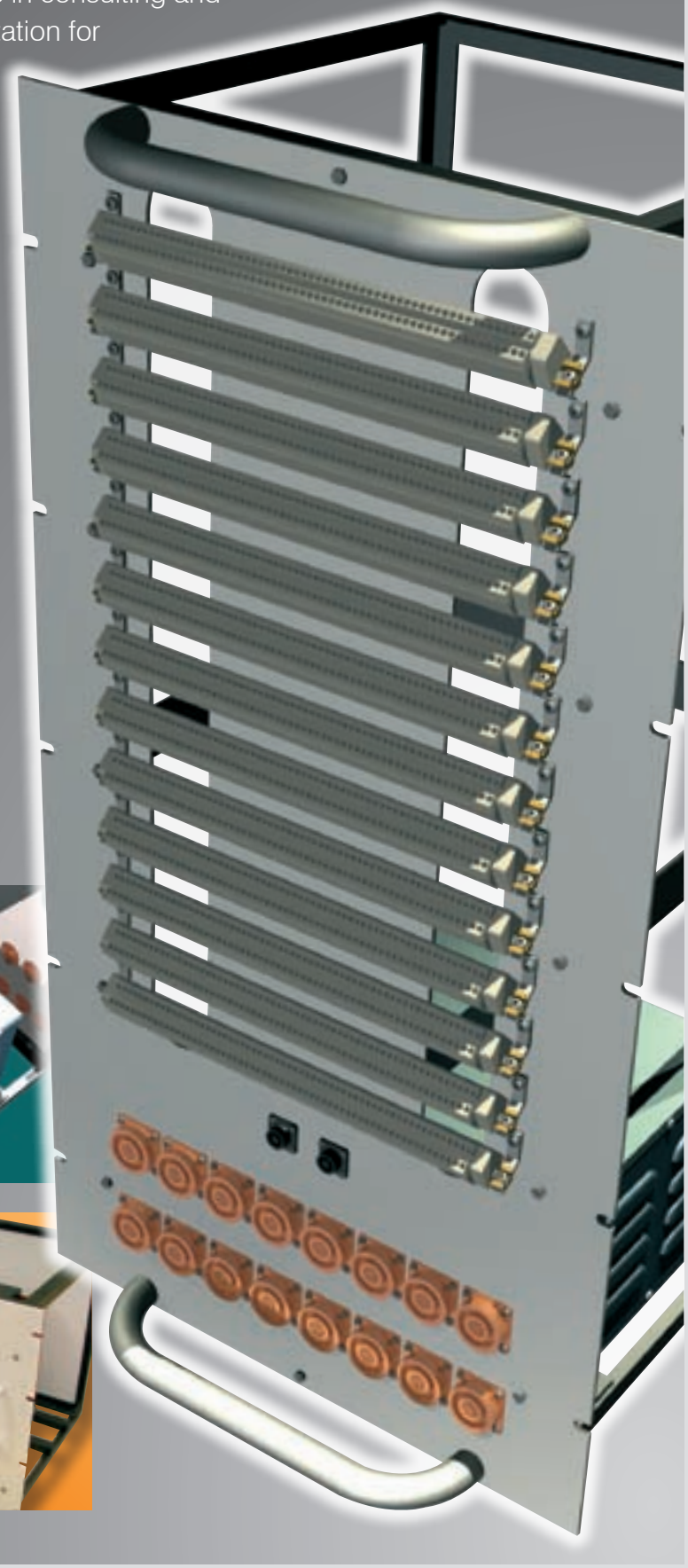
Isotech Custom Engineering

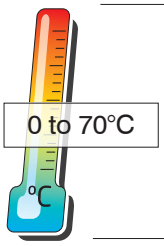
Isotech have more than 30 years experience in consulting and designing referencing systems. With a reputation for outstanding reliability, long term support and excellence Isotech can provide systems from a single, to several thousand junctions.



Solutions for Aeronautical, Power Stations, Environmental Monitoring, Space, Boiler Rooms, Maritime...







Thermocouple Probes
Cold Junction

- Looms for Compensation Units
- Saves on On Site Wiring
- Maintains Accuracy of Unit

Probes are suitable for use with all Isotech thermocouple reference units or may be used with any other equipment including ice flasks and ice point reference units.

They can be supplied to suit a single thermocouple, or up to ten double junctions in a single assembly.

These probes are normally specified to order, or are made to match the reference equipment to which they will be fitted. Normal lead length, L2, is 1M but can be specified at the time of order along with the probe length, L1.

All wire material is to the highest grade available and PTFE insulated, numbered and colour coded for the appropriate thermocouple type.

Double junctions are most commonly supplied (four wire connections per junction). Single junctions (two wire connections per junction) can also be supplied.

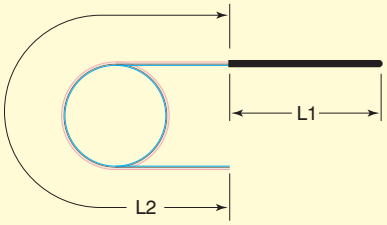
For Types R & S cold junctions are most commonly made from low cost compensating cable but can be supplied in platinum material to special order.

Standard thermocouple Types are, K, E, J, T, N, U, S and R.

Other materials available on request

For Isotech reference units simply advise which model the junctions are for, and the types and number required. For custom junctions the following information is required.

Number of Junctions Required	
Thermocouple Type	
Single or Double Junction	
Length of Probe, L1	
Length of Lead, L2	
Maximum Probe Diameter	



Standard Combinations Available

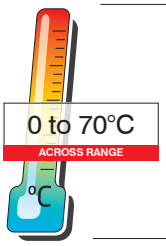
Code	Single Junction Probes
K	Nickel Chromium vs Nickel Aluminium
E	Nickel Chromium vs Copper Nickel (Constantan)
J	Iron vs Constantan
T	Copper vs Constantan
N	Nicrosil vs Nisil
U	Copper vs Cupronic
S	Platinum vs Platinum 10% Rhodium
R	Platinum vs Platinum 13% Rhodium

Code	Double Junction Combinations examples
K	Nickel Chromium vs Copper
K	Nickel Aluminum vs Copper
J	Iron vs Copper
J	Constantan vs Copper
U	Cupronic vs Copper
S/R	Platinum vs Copper
S	Platinum 10% Rhodium vs Copper
R	Platinum 13% Rhodium vs Copper

("U" is a substitute metal alloy combination for Pt/Pt Rh types in the range 0 to 50°C).

Other materials are available on request.

How to order
Model 880 Cold Junction Probes are normally specified for each order. Please discuss your exact requirements with us before ordering.



Thermocouple Reference Unit
TRU Model 938

- Suitable for Laboratory or High Capacity Applications
- Works in high ambients up to 65°C
- Reliable Solid State Design

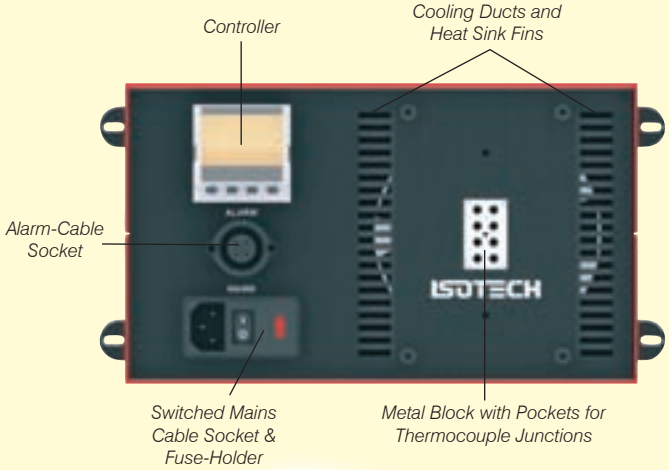
The TRU (Thermocouple Reference Unit) supplies a stable and accurate 0°C, or elevated reference temperature.

It is a self-contained all solid-state unit using Peltier technology which provides maintenance free operation.

The TRU features rapid temperature shift even from high ambient temperatures and is stable within 10 minutes from switch on.

An alarm will be activated should the reference temperature deviate by more than 0.2°C.

The 938 can be ordered with a choice of one of two block types. B1 is recommended for laboratory use and has 6 pockets 6.2mm x 130mm deep and a 4.2mm pocket and can accommodate up to 36 junctions. Block B2 is for higher capacity applications and can accommodate up to 100 junctions with 8 8.2mm pockets x 76mm deep and a 4.2 pocket for an optional monitoring PRT.



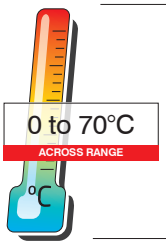
Model	938
Operating Temp.	0°C (or 45° to 70°C)
Ambient Range °C	2°C to 65°C
Stability	±0.03°C, Errors introduced by thermocouple loading can be removed by adjusting controller offset
Stabilising Time	10 minutes from 44°C
Capacity	B1 6 x 6.2mm Pockets + 4.2mm pocket 130mm deep or B2 8 x 8.2mm Pockets +4.2mm pocket 76mm deep.
Alarm Facilities	Non-latching relay rated 5 Amps 240V
Power	100 Watts typical 100-130 or 208-240 VAC 50/60Hz
Dimensions	Height 228mm Width 253mm Depth 148mm
Weight	5.5kg

Accessories

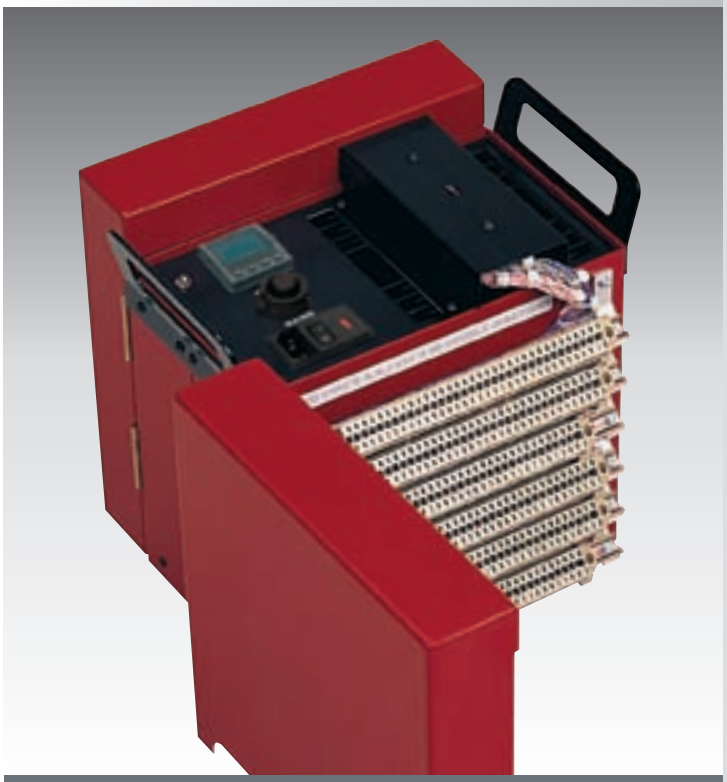
935-14-54	Platinum Resistance Thermometer suits Block B1: Includes UKAS Calibration at 0.01°C
935-14-55	Platinum Resistance Thermometer suits Block B2: Includes UKAS Calibration at 0.01°C
935-17-32	Fan Filter - recommended for high dust environments

How to order

TRU Model 938
Normally uniquely specified for each order.
Please discuss your exact requirements with us before ordering.



Thermocouple Reference Unit
TRU Model 937



- Up to 100 Channels
- Compact, Pre Wired Thermocouples
- Operates in High Ambients

The TRU 937 (Temperature Reference Unit) supplies a stable and accurate 0°C or elevated Reference Temperatures between 45°C and 70°C.

It is a self-contained all solid state unit using peltier technology which provides maintenance free operation. The TRU 937 features rapid cool down from high ambient temperatures and is stable within 10 minutes from switch on.

An alarm will be activated should the reference temperatures deviate by more than the user definable span. Thermocouple Reference Junctions are located in a reference block and connected to their marked input and output terminals in an isothermal enclosure. The uniform temperature throughout the enclosure ensures that no thermoelectric EMFs are generated at the terminals.

One advantage of the TRU 937 is that the user need not be concerned with the supply and installation of reference junctions since it is only necessary to connect the thermocouple compensation cables to the input terminals and the measuring instrument to the output terminals of the TRU 937.

There are two models, the TRU 937/50 with up to 50 junctions with a single terminal cover door, and the TRU 397/100 which has doors on the front and rear, as shown in the photograph.

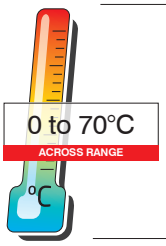
Note:
Thermocouple Referencing to ISO9000 at 0°C in Ambients up to 65°C or elevated reference temperatures between 45°C and 70°C
References up to 100 Thermocouples
Pre-wired Thermocouples, Compact Design

Model	**937**
Operating Temp.	0°C (or 45° to 70°C)
Ambient Range	2°C to 65°C
Stability	±0.03°C, Errors introduced by thermocouple loading can be removed by adjusting controller offset
Stabilising Time	10 minutes from 44°C
Capacity	Up to 100 Double Junction Channels
Input/Output Connections	Klippon Terminals, type 1.5 AKZ
Alarm facilities	Non-latching relay rated 5 Amps 240V
Power	100 Watts typical 100-130 or 208-240 VAC 50/60Hz
Dimensions	Height 265mm Width 253mm Depth TRU 937/100 312mm Depth TRU 937/50 230mm
Weight	TRU 937/100 11kg TRU 937/50 8kg

Accessories

935-14-55	Platinum Resistance Thermometer suits Block B2: Includes UKAS Calibration at 0.01°C
935-17-33	Fan Filter - recommended for high dust environments

How to order
TRU Model 937
Normally uniquely specified for each order.
Please discuss your exact requirements with us before ordering.



Thermocouple Reference Unit
TRUrac Model 847

- Rack Mounted
- Large Capacity
- Approved for Power Station Use

The TRUrac is a 0°C or elevated temperature thermocouple reference system mounted in a 19" chassis. It has been developed for situations where ambient temperature can be up to 65°C.

The reference temperature is normally set to 0°C or between 45°C and 70°C. For other temperatures please contact Isotech.

An alarm will be activated should the reference temperatures deviate by more then 0.2°C.

Inside the rack case is a high stability thermal block which has a capacity of up to 100 thermocouple channels, the probe wires being terminated at the rear of the unit on rail mounted screw terminals.

To special order a second thermal block may be fitted to allow a capacity of 200 channels in a single unit.

The customer simply connects their thermocouple wires and copper output wires to these terminals. All the thermocouple cold junctions are inserted into a metal oven block which is accurately temperature controlled.

Model	**847**
Operating Temp.	0°C (or 45° to 70°C)
Ambient Range	2°C to 65°C
Stability	±0.03°C, Errors introduced by thermocouple loading can be removed by adjusting controller offset
Stabilising Time	10 minutes from 44°C
Capacity	Up to 100 Double Junction Channels
Input/Output Connections	Klippon Terminals, type 1.5 AKZ
Alarm facilities	Non-latching relay rated 5 Amps 240V
Power	100 Watts typical 100-130 or 208-240 VAC 50/60Hz
Dimensions 50 to 100 Channels	Height 400mm Width 483mm Depth 312mm
Weight	24kg

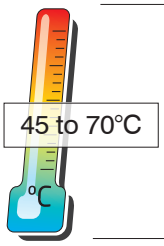
Accessories

935-14-54	Platinum Resistance Thermometer Includes UKAS Calibration at 0.01°C
935-17-32	Fan Filter - recommended for high dust environments

How to order

Should be specified uniquely on each order.
Please discuss your exact requirements with us before ordering.

Note:
Rack mounted Temperature Thermocouple Referencing System
Large Capacity. Approved for Power Station Use.
Reference temperatures set to 0°C or between 45°C and 70°C.



Thermocouple Reference Unit
Hotbox Model 830

- Water Proof Cased
- Large Capacity - up to 200 junctions
- Suitable for Power Station Use

The Hotbox is housed in a robust waterproof enclosure to IP66 incorporating bottom gland plate. Fixing lugs for wall mounting are provided. Easy access to terminal rails and oven assembly is via a hinged door.

All the thermocouple cold junctions are inserted into a metal oven block which is accurately temperature controlled.

A safety switch is fitted to cut off supplies if the temperature rises 10°C above the set point.

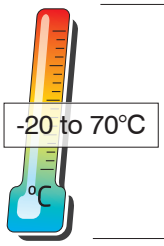
Model	**830**
Referencing Temp	45°C - 70°C
Accuracy	±0.1°C
Long Term Stability	±0.05°C per 1000 Hours
Temperature Gradient	±0.1°C between Junctions
Stabilisation Time	120 minutes
Max Ambient Temperature	50°C
Thermocouple	0 to 100 channels
Capacity	Double junction referencing
Power	250 Watts typical 100-130 or 208-240 VAC 50/60Hz
Dimensions	Height 600mm Width 600mm Depth 300mm
Weight	40kg

Note:
Numerous special versions are available and can be supplied either in their existing form or modified to customers' requirements.

Accessories

935-14-08	Platinum Resistance Thermometer. Includes UKAS calibration.

How to order
Model 830
Hotboxes are normally uniquely specified for each order.
Please discuss your exact requirements with us before ordering.



Thermocouple Reference Unit
Isobox Model 842

- Water Proof Cased
- Large Capacity
- Approved for Power Station Use

The function of this reference unit differs from other cased systems in that the temperature of the metal block in which the thermocouple and copper leads are inserted, actually varies with ambient temperature. A separate output signal is produced which is proportional to the difference between the environmental temperature and the actual reference temperature. The output signal can be fed directly into a computer/data logger to give accurate compensation over a large ambient range. A thermal reservoir, heavily insulated, contains the reference junction probes. The reservoir temperature slowly follows the ambient temperature; an electrical compensation device is thermally integrated with the reservoir and thus senses the reservoir temperature. The device produces an output proportional to the difference between the reservoir temperature and the reference temperature (usually 0°C).

This is the signal the computer/data logger uses to compensate for the temperature of the reference probes junctions.

The output signal can be in the form of a DC mV output, 4-20 mA or from a platinum resistance thermometer. Please discuss prior to order.

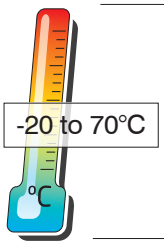
Units are housed in robust weatherproof enclosures to IP66 incorporating bottom gland plate. Fixing lugs for wall mounting are provided. Easy access to terminal rails and block assembly is via a lockable hinged front door.

Note:
Waterproof Cased Ambient Temperature Thermocouple Referencing System.
Large Capacity up to 100 Thermocouples.
Wide Ambient Range.
Approved for Power Station Use.

Model	**842**
Referencing Temp	Effectively 0°C
Accuracy	±0.1°C per 10° ambient span
Long Term Stability	±0.05°C per 1000 Hours
Temperature Gradient	±0.1°C between Junctions
Stabilisation Time	10 minutes
Ambient Temperature	-20°C to +70°C
Thermocouple	0 to 100 channels
Capacity	Double junction referencing
Power	10 Watts typical 100-130 or 208-240 VAC 50/60Hz Low level D.C. Consumption 6VA typical Passive Option Available
Dimensions	Height 600mm Width 600mm Depth 300mm
Weight	40kg

Note:
Numerous special versions are available and can be supplied either in their existing form or modified to customers' requirements.

How to order
Model 842
Isoboxes are normally uniquely specified for each order.
Please discuss your exact requirements with us before ordering.



Thermocouple Reference Unit
Isorac Model 844

- Rack Mounted Ambient Referencing System
- Large Capacity
- Approved for Power Station Use

The function of this reference unit differs from other rack mounted systems in that the temperature of the metal block in which the thermocouple and copper leads are inserted actually varies with ambient temperature. A separate output signal is produced which is proportional to the difference between the environmental temperature and the actual reference temperature. The output signal can be fed directly into a computer/data logger to give accurate compensation over a large ambient range.

A thermal reservoir, heavily insulated, contains the reference junction probes.

The reservoir temperature slowly follows the ambient temperature; an electrical compensation device is thermally integrated with the reservoir and thus senses the reservoir temperature.

The device produces an output proportional to the difference between the reservoir temperature and the reference temperature (usually 0°C). This is the signal the computer/data logger uses to compensate for the temperature of the reference probes junctions.

The output signal can be in the form of a DC mV output, 4-20 mA or from a platinum resistance thermometer. Please discuss prior to order.

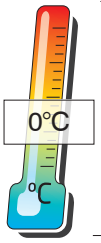
Model No.	**844**
Reference Temperature	Effectively 0°C
Temperature Gradient	±0.1°C between Junctions
Stability	±0.05°C per 1000 Hours
Ambient Range	-20°C to +70°C
Accuracy	±0.1°C per 15°C ambient span
Stabilisation Time	10 mins
Thermocouple Capacity	0 to 100 channels double junction referencing
Power	10 Watts typical 100-130 or 208-240 VAC 50/60Hz Low level D.C. Consumption 6VA typical Passive Option Available
Dimensions Up to 50 channels	Height 255mm Width 483mm Depth 312mm
Weight	17.2kg
50 to 100 channels	Height 309mm Width 483mm Depth 312mm
Weight	20.4kg

Numerous special versions are available and can be supplied either in their existing form or modified to customers requirements.

How to order
Model 844
Isoracs are normally uniquely specified for each order.

Please discuss your exact requirements with us before ordering.

Note:
Rack Mounted Ambient Temperature Referencing System.
19" Rack Mounting.
Large capacity up to 100 Thermocouples.
Approved for Power Station Use.



Thermocouple Compensation
Trio Model 885

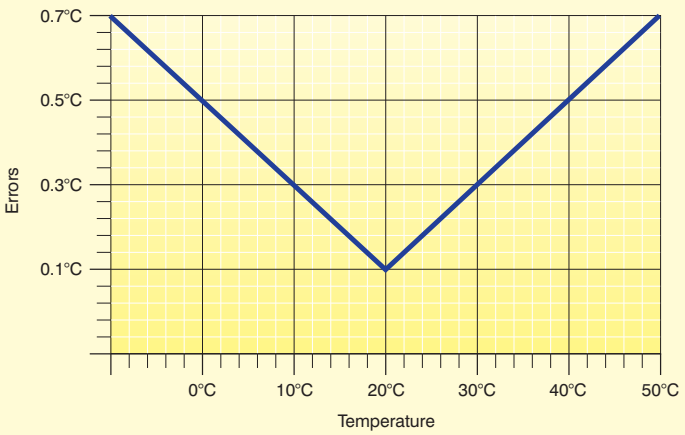
- Three Channel Referencing System
- Accurate
- Convenient

The Isotech Trio is a low-cost, accurate, portable unit designed to compensate three thermocouples for the variations in EMF caused by the cold junction not being at the standard reference temperature of 0°C.

Tables are available for each thermocouple combination which give the voltage versus temperature variation. The Trio senses the ambient temperature and generates an electrical voltage to cancel out the variation, thus providing equivalent of a 0°C cold junction reference bath. The Isotech Trio contains three electronic networks, incorporating a temperature-sensitive element which is thermally integrated with the thermocouple cold junction for maximum precision.

The unit is mains operated. The Trio is manufactured to the highest standards and after assembly each unit is calibrated to ensure conformance to the relevant thermocouple table. A wide range of thermocouple types are available. As standard, six thermocouple combinations are offered to customer requirements. The internal structure of the Trio allows either one, two or three thermocouple types to be compensated.

Accuracy of Compensation (Base Metals)



Note:
The Trio has a common power supply and in some circumstances with grounded thermocouples earth loops can form causing apparent errors in compensation.

Model	**885**
Reference Temperature	0°C (others by arrangement)
Operating Temperature	0 to 55°C
Output Impedance	Less than 200 ohms
Power	10 Watts typical 100-130 or 208-240 VAC 50/60Hz
Accuracy	See Graph
Error due to Supply Variations	Negligible
Compensation for type	K, T, J, E, U, N U Wire used for R & S types unless otherwise specified
Stability	Typically 0.02% p.a.
Dimensions	Height 38mm Width 80mm Depth 150mm
Weight	349g

How to order
Trio Model 885
Specify 3 thermocouple types and supply voltage
e.g. Trio K.K.E. 220V 50Hz.

About the Laboratory

Isotech's UKAS accredited calibration laboratory, Northern Temperature Primary Laboratory (NTPL), was established in 1980 and has grown to be a full scale laboratory providing calibration to the smallest of uncertainties. Isotech was the first UKAS laboratory to be accredited to calibrate ITS-90 Fixed Point Cells. Our accredited uncertainties are now smaller than many the scope of other accredited laboratories and smaller than most National Measurement Institutes.

NTPL comprises of three physically separate laboratories, A Primary Laboratory, A Secondary Laboratory and Calibration laboratory for Industrial Products

Summary of Accreditation

Electrical

Bridges and similar instruments, resistance
Calibrators, temperature simulation
Resistance boxes
Resistors, AC
Resistors, DC
Temperature indicators, electrical calibration
Voltmeters, DC

Temperature

Block calibrators
Fixed point cells
Resistance thermometers, calibration by comparison
Resistance thermometers, fixed point calibrations
Temperature indicators and recorders, electrical calibration without sensor
Temperature indicators and recorders, with temperature sensor(s)
Thermocouples, base metal types, e.g. K, N, T
Thermocouples, gold/platinum
Thermocouples, platinum/rhodium types, e.g. S, R

http://www.isotech.co.uk/lab

NTPL calibrate both Isotech equipment and devices from other manufacturers to the smallest of calibration uncertainties. The latest UKAS schedule can be downloaded from our website, a brief summary follows.

■ Calibration of Thermometers

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks
Calibration by comparisons	-80°C to -40°C	7.0 mk	
	-40°C to 50°C	4.0 mk	
	50°C to 156°C	5.0 mk	
	156°C to 300°C	6.5 mk	
	300°C to 420°C	20 mk	
	420°C to 660°C	35 mk	
Calibration at Fixed Points *(See Note 1)*			
BP Nitrogen	-195.798°C	5 mK	*Note 1: Suitable only for HT/SPRTs with high stability. Includes extrapolation to zero power and immersion checks.*
TP Argon	-189.3442°C	0.50 mK	
TP Mercury	-38.8344°C	0.24 mK	
TP Water *(See Note 2)*	0.01°C	0.07 mK	
MP Gallium	29.7646°C	0.15 mK	
FP Indium	156.5985°C	1.0 mK	*Note 2: Suitable for most SPRTs using nominal current.*
FP Tin	231.928°C	1.0 mK	
FP Zinc	419.527°C	1.2 mK	
FP Aluminium	660.323°C	2.0 mK	
FP Silver	961.78°C	7 mK	

■ Calibration of Thermocouples

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks
Platinum thermocouples			
Calibration by comparisons	-50°C to 0°C	0.5°C	*Thermocouples without a cold junction will have increased uncertainty*
	0°C to 50°C	0.45°C	
	50°C to 660°C	0.4°C	
	660°C to 1100°C	0.7°C	
	1100°C to 1300°C	1.7°C	
Calibrations at fixed points			
FP Tin	231.928°C	0.4°C	
FP Zinc	419.527°C	0.4°C	
FP Aluminium	660.323°C	0.4°C	
FP Silver	961.78°C	0.4°C	
Gold/Platinum thermocouples			
Calibration at fixed points			
TP Water	0.01°C	0.06°C	
FP Zinc	419.527°C	0.05°C	
FP Aluminium	660.323°C	0.05°C	
FP Silver	961.78°C	0.05°C	
	0°C to 1000°C	0.10°C	*Including uncertainty of interpolation/extrapolation*
Other thermocouples	-196°C	0.3°C	
	-80°C to 0°C	0.25°C	
	0°C to 50°C	0.1°C	
	50°C to 300°C	0.25°C	
	300°C to 420°C	0.30°C	
	420°C to 660°C	0.4°C	
	660°C to 1100°C	0.8°C	
	1100°C to 1300°C	2.2°C	

TP = Triple Point FP = Freezing Point MP = Melting Point BP = Boiling Point

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The latest schedule can be found on the Isotech website or at www.ukas.org.