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New Type of Precision Thermometer Offers Unrivalled Accuracy and Stability

Isothermal Technology Limited (Isotech) has introduced a new type of precision thermometer, which it claims will set new world standards for accuracy and stability. Designed for a wide range of highly accurate industrial and scientific calibration applications, the instrument uses a completely new measurement technique to achieve accuracies better than 0.4 parts per million (ppm) - equivalent to 0.0004°C - when used with a standards platinum resistance thermometer (SPRT).

Designed and manufactured in Britain, **MicroK** is believed to be the only instrument of its type in the world which will work to this precision with all three commonly used sensors, platinum resistance thermometers (PRTs), thermocouples and thermistors. In terms of long term stability, MicroK achieves literally zero drift for resistance ratio measurements and an annual drift of only 3 ppm for voltage measurements.

While utilising sophisticated software and specially developed circuitry, the MicroK is easy to use and has a comprehensive range of built-in features. It utilises on a 6.4-inch VGA colour touch screen as the main user interface, providing a number of graphically presented user options and controls. The underlying operating system is Microsoft Windows CE™ facilitating direct reading of temperature for all sensor types, data logging, export of data into Microsoft Excel™ applications and graphing facilities.

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Measurement 'Best Practice' guidelines recommend the use of two separate reference thermometers when carrying out temperature calibrations. For that reason the designers of the MicroK have incorporated three channels, enabling users to achieve best practice without having to invest in additional multiplexers. The instrument also includes 'keep-warm' current sources to maintain the power in a PRT when it is not being measured. This feature effectively eliminates uncertainty resulting from power coefficients.

A key to achieving such high accuracies and stability is the use of a specially designed analogue to digital converter (ADC) within the instrument's measurement circuits. In conjunction with a digital signal processor (DSP), this uses a unique adaptation of existing advanced sigma-delta ADC techniques to achieve linearity better than 0.4 ppm. A further major benefit of this ADC technique is its low noise performance, and the designers claim that electronic noise is reduced by a factor of 32 over conventional sigma-delta ADC circuits.

A further break with convention is that the instrument uses no mechanical switches, relays or potentiometers whatsoever (other than the main power on/off switch), relying on solid state switching to route voltage and current signals internally. Comparative instruments in this class have used high quality mechanical relays for this purpose, a technique which inherently introduces inaccuracies arising from thermal EMFs, and degrades reliability. By using the latest semiconductor technology, performance has been enhanced, component counts have been reduced and reliability considerably improved.

The MicroK range consists of two instruments, offering a choice of measurement accuracy:

The **MicroK 400** is accurate to 0.4 ppm over the whole temperature range of SPRTs with $R_0 \geq 2.5\Omega$, equivalent to 0.1 milliKelvins (10^{-4} K) at 0°C. With thermocouple sensors the voltage uncertainty is 0.25µV (250×10^{-9} Volts), equivalent to 0.01°C for Gold-Platinum thermocouples.

The **MicroK 800** is accurate to 0.8 ppm over the whole temperature range of SPRTs with $R_0 \geq 2.5\Omega$, equivalent to 0.2 milliKelvins (2×10^{-4} K) at 0°C. With thermocouple sensors the voltage uncertainty is the same as the MicroK 400 model.

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According to Isotech, the two instruments in the MicroK range offer performance characteristics and features which are simply not available elsewhere. Comparable instruments available internationally do not achieve the same accuracy or stability (zero drift characteristics with SPRT measurements are not obtainable in any other instrument), do not support the same variety of sensors, and offer considerably less operational features. As a result, the 'Cost of Ownership', a key feature of growing international importance, has been considerably reduced.

MicroK Specifications:

<u>Ranges</u>	Resistance Thermometers: 0Ω to 500kΩ Thermocouples: ±125mV
<u>Accuracy – PRTs</u>	μK400: 0.4ppm maximum over whole range for SPRT with $R_0 \geq 2.5\Omega$ (equivalent to 0.1mK at 0°C, or 0.4mK over full range) 1ppm maximum over whole range for SPRT with $R_0 = 0.25\Omega$ μK800: 0.8ppm maximum over whole range for SPRT with $R_0 \geq 2.5\Omega$ (equivalent to 0.2mK at 0°C, or 0.8mK over full range) 2ppm maximum over whole range for SPRT with $R_0 = 0.25\Omega$
<u>Accuracy – Thermocouples</u>	Voltage uncertainty: 0.25μV (equivalent to 0.01°C for Gold-Platinum thermocouples at 1000°C)
<u>Resolution</u>	Resistance: 0.01ppm of range Voltage: 10nV (125mV range)
<u>Stability</u>	Resistance (excluding resistance standard): 0 ppm / year Voltage: 3 ppm / year
<u>Measurement Time</u>	1s
<u>Temperature Conversions</u>	<u>PRTs:</u> ITS-90, Callendar-van Dusen <u>Thermocouples:</u> IEC584-1 1995 (B,E,J,K,N,R,S,T), L and gold-platinum <u>Thermistors:</u> Steinhart-Hart
<u>Sensor Current</u>	0-10mA in 3 ranges: 0.1mA ±0.4% of value, ±70nA, resolution 28nA 1mA ±0.4% of value, ±0.7μA, resolution 280nA 10mA ±0.4% of value, ±7μA, resolution 2.8μA
<u>Keep-Warm Current</u>	0-10mA ±0.4% of value, ±7μA, resolution 2.8μA
<u>Cable Length</u>	Limited to 10Ω per core or 10nF shunt capacitance (equivalent to 100m of RG58 coaxial cable)
<u>Internal Standard Resistors</u>	1Ω ±0.1% TCR = ±10ppm/° typical, stability = ±25ppm/year 10 Ω ±0.1% TCR = ±0.6ppm/° typical, stability = ±5ppm/year 25, 100, 400 Ω ±0.1% TCR = ±0.3ppm/° typical, stability = ±5ppm/year

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<u>Input Connectors</u>	Versatile connectors accepting 4mm plugs, spades or bare wires Contact material: gold plated tellurium copper
<u>Interfaces</u>	RS232 USB (1.1) - host
<u>Display</u>	163mm / 6.4" VGA (640 x 480) color TFT LCD
<u>Operating Conditions</u>	15-30°C / 50-85°F, 10-90% RH (for full specification) 0-40°C / 32-100°F, 0-99% RH (operational)
<u>Power</u>	88 – 264V (RMS), 47-63Hz (Universal) 20W maximum, 1.5A (RMS) maximum
<u>Size</u>	520mm x 166mm x 300mm / 20.5" x 6.6" x 11.9" (W x D x H)
<u>Weight</u>	11.3kg / 25lb

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Further information from:

Lorraine Clark
Isothermal Technology Limited
Pine Grove
Southport
Merseyside
PR9 9AG.
Tel: 01704 543830
Fax: 01704 544799
Email: info@isotech.co.uk
Web: www.isotech.co.uk