

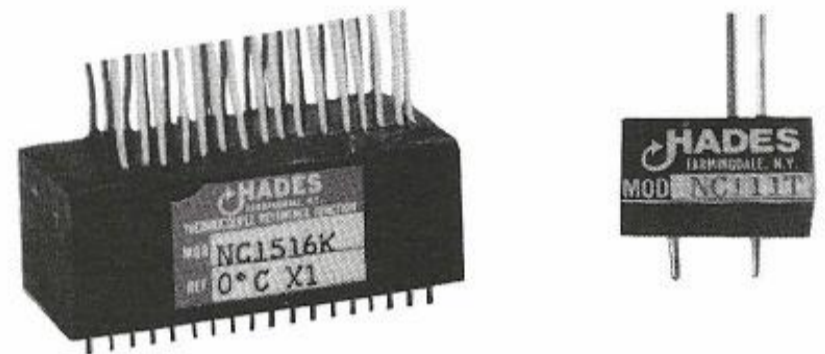
HADES

MANUFACTURING CORP.

SHORT
FORM CATALOG

Temperature
Measuring
Equipment

Equipment for Temperature Measurement and Control Systems



Half Bridge and
Full Bridge Thermocouple
Reference Junction
Compensators

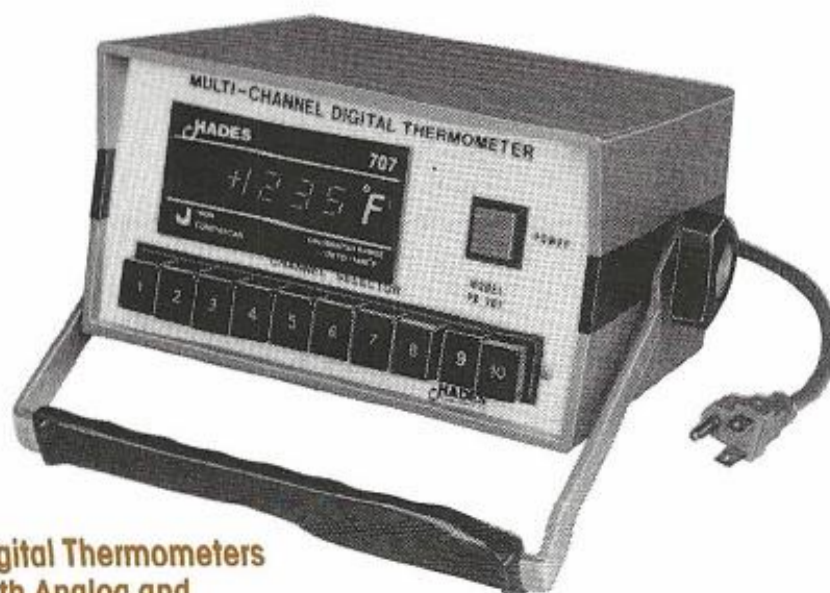
Single and Multi-Channel



Temperature Differential
Monitor/Controller



Airborne Isolated
Multi Channel
Thermocouple System



Digital Thermometers
with Analog and
BCD Outputs



μ Volt D.C. Signal
Conditioning Amplifiers



Thermocouple Reference Junctions

Hades produces an extensive line of thermocouple reference junctions including half-bridge, full bridge, self powered and multichannel units, in a variety of packages. All are available for the full list of thermocouple materials shown in Table I. Basic modules and specifications of standard Hades units are listed

in Table II. Besides its proprietary standard line, Hades can supply specials to precisely fit a customer's specification and welcomes inquiries for volume runs from OEM's manufacturing equipment involved in temperature measurement and control.

How to Select and Specify a Thermocouple Reference Junction

Tables I and II and the accompanying curves are designed as aids to anyone who uses reference junctions in temperature measurement or control systems. Table I lists the

generally used thermocouple materials and their letter designation. Table II lists Hades Standard Reference Junctions for use with these materials and gives basic specification

data. The curves show the applicable temperature range and the millivolt outputs for each material. Full details are available in the appropriate Hades Specification Publications. Any of the material listed in Table I can be obtained in the listed reference junctions.

TABLE I THERMOCOUPLE MATERIALS

BASE METAL	Letter Designation	Material		Color Code		Application Characteristics		Letter Designation	Material		Color Code		Application Characteristics	EXTENSION ALLOYS ¹	Letter Designation	Mat
		+	-	+	-				+	-	+	-				
NOBLE MATERIALS ¹	J	Iron	Constantan	White Black*	Red Yellow*	Most widely used. Low cost relatively high output/degree.		S	Platinum 10% Rhodium	Platinum	Black	Red	Suitable for high temperatures Resistant to oxidation.	SX	Extension	
	K	Chromel	Alumel	Yellow White*	Red Green*	Resists oxidation better than other base metal TC's. Adversely affected by reducing atmosphere.		R	Platinum 13% Rhodium	Platinum	Black	Red		RX	Extension	
	T	Copper	Constantan	Blue Red*	Red Yellow*	Good performance from -300 to +700°F. Suitable for mildly reducing or oxidizing atmospheres.		B	Platinum 30% Rhodium	Platinum 6% Rhodium	Black	Red		BX	Extension	
	E	Chromel	Constantan	Purple White*	Red Yellow*	Highest EMF/degree. Covers range from 0 to 1600°F. Linearity better than J, K, or T. Suitable for mildly reducing or oxidizing atmospheres.		G	Tungsten	Tungsten 26% Rhenium	Orange	Red		GX	Extension	
								C	Tungsten 5% Rhenium	Tungsten 26% Rhenium	Orange	Red				
						D	Tungsten 3% Rhenium	Tungsten 25% Rhenium	Green	Red	CX	Extension				
											DX	Extension				

TABLE I NOTES

TABLE II THERMOCOUPLE REFERENCE JUNCTION SELECTION GUIDE

Hades Series Designation	Number Channels	Ref. Temp. (Standard) °C	Compensation Accuracy at ^{2 and 8} Module Ambient Temperature				Stability °C	Power Required ⁴		Output Impedance Ohms ⁵	Environmental	Packaging	
			(α +25°C)	0°C to +50°C	-25°C to +75°C	-55°C to +100°C		Current	Volts				
Half Bridge Single Channel NC 111	1	0	±0.25°C	±0.5°C	±0.75°C	±1.0°C	±0.25°C	<1 mA	0.4 d.c. *	<125Ω	Meets MIL-E-5400 & Space	Encapsulated	
Half Bridge Multichannel NHMA NHMB NHMC	8 max 9 to 16 2	0	±0.25°C	±1.0°C ±0.5°C	±1.5°C ±0.75°C	±2.0°C ±1.0°C	±0.25°C	<1 mA	1, 1.35, 5, 10, 15 or *	<250Ω	Meets MIL-E-5400 & Space	Encapsulated	
Full Bridge Single Channel NC 140 NC 143 NC 240	1 1 1	-5 to +5 Adjustable ⁶	±0.25°C	±0.5°C	±0.75°C	±1.0°C	±0.25°C	<1 mA	1, 1.35, 5, 10, 15 or *	<250Ω	Meets MIL-E-5400 & Space	Encapsulated	
Full Bridge Single Channel Self Powered NC 420 NC 425	1 1	0	±0.25°C		(±0.5°C, +15°C to +35°C—+0.75°C, 0°C to +50°C)		Consult Factory	±0.25°C	Internal battery ⁷ 1500 hrs. Internal 7 battery 5000 hrs.	1.35	<250Ω	Consult Factory	Encapsulated
NC 340	1	0	±0.25°C		(±0.5°C, +15°C to +35°C—±0.75°C, 0°C to +50°C)		Consult Factory	±0.25°C	Internal battery 5000 hrs.	1.35	<250Ω		Metal Case
NC 830	1	0	±0.25°C		(±0.5°C, +15°C to +35°C—±0.75°C, 0°C to +50°C)		Consult Factory	±0.25°C	<0.25 mA	115 or 330V 50 or 60 Hz			Metal Case
Full Bridge Multichannel NCMC	2	0	±0.25°C	±0.5°C	±0.75°C	±1.0°C	±0.25°C	<1 mA	1, 1.35, 5, 10, 15 or *	<250Ω	Meets MIL-E-5400 & Space	Encapsulated	
NCMA NCMB	8 max. 9 to 16	0	±0.25°C	±1.0°C	±1.5°C	±2.0°C	±0.25°C	<1 mA	1, 1.35, 5, 10, 15 or *	<250Ω	Meets MIL-E-5400 & Space	Encapsulated	
Full Bridge Differential Temperature NDT 150	NA	0	±0.25°C	±0.5°C	±0.75°C	±1.0°C	±0.25°C	<1 mA	1, 1.35, 5, 10, 15 or *	<250Ω	Meets MIL-E-5400 & Space	Encapsulated	

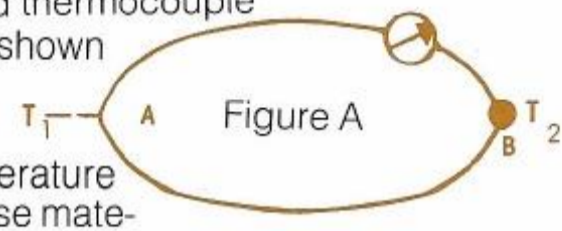
* Non Standard Voltages available upon request.

Principles of Operation

In the basic thermocouple circuit, two dissimilar metals are joined in a loop, one end of which is immersed in the medium or in contact with the material whose temperature is to be measured. The other end is at a known temperature. (See Figure A). When there is a temperature differential between these points (T_1 and T_2) current will flow in the circuit, the direction being dependent upon which point is the warmer and the magnitude being dependent upon the degree of difference.

Since the temperature at T_2 is known, this signal, suitably processed, can be used to operate a display or control device. In practice, the materials are joined only at the measuring end of the circuit; the other end of the TC wires being connected to copper wires for completion of the circuit. These TC-to-copper wire junctions are maintained at a known temperature, usually 0°C . They are referred to as the "cold junctions", regardless of whether the measured point is above or below the reference temperature. The simplest method of establishing a reference temperature is with a bath of pure water and shaved ice in a dewar flask. Obviously, this is impractical outside of a laboratory. Accurately controlled ovens also can be used to establish a reference temperature. However, their application is restricted to systems where an extended warm-up time, size, weight and power consumption are not constraints. Furthermore, they are limited to applications where the ambient temperature range is moderate. However, the method most widely used in TC systems simulates a constant reference temperature electrically. The thermocouple wire to copper wire junctions are connected in a bridge circuit (See figures on page 4) one leg of which—R1 and R2 in the schematic—is temperature responsive with a curve matching that of the emf vs temperature curve of the TC material. This constitutes the compensating portion of the

device. (Often referred to as a "half bridge"). To complete a reference junction a second leg is added. This leg includes a fixed calibration resistor which nulls the system at the desired reference temperature. Thermocouple reference junctions are small, extremely rugged and require just milliwatts of regulated DC power. Accuracy of standard production units can be as good as $\pm 1/4^\circ\text{C}$ at 25°C ambient and $\pm 1/2^\circ\text{C}$ over a broad ambient temperature range. Measured temperature ranges for the most generally used thermocouple materials are shown in the curves below



The emf/temperature curves for these materials has been accurately tabulated by the National Bureau of Standards. In designing a reference junction, Hades fabricates resistors whose resistance/temperature curve corresponds to the NBS tabulated emf of the TC materials. These are used in the compensator leg. The voltage change across R2 is equal to and opposite the emf of the thermocouple cold junctions resulting in very accurate compensation. The ratio of the resistors in the reference temperature leg is factory set to produce an offset voltage equal to the selected reference temperature. (Tables are available listing emf in mV per degree for fahrenheit and celsius scales.)

Material	Color Code		Application Characteristics
	+	-	
grade for S	Black	Red	Alloys used as extension wire in place of expensive noble metals.
grade for R	Black	Red	
grade for B	Black	White	
grade for G	Orange	Red	
grade for C	Orange	Red	
grade for D	Green	Red	

Units made with base metal or extension alloys cost substantially less than those incorporating noble metals.
*Military Coding

Size Inches (Approximate)	Weight	Connections	
		Power & Signal Out	TC Input
0.89 x 0.24 x 0.5	<5 gm	Wire P.C. Pins or Solder Lugs	TC Wire In
1.1 x 0.65 x 0.7 1.95 x 0.7 x 0.9 1.5 x 1.5 x 0.5	<25 gm <60 gm <30 gm		
1 x .59 x .23 1 x 1 x 0.31 1.5 x 1.5 x 0.4	<7 gm <10 gm <30 gm		
0.75 diam. x 1.675 0.75 diam. x 3.0	<70 gm <50 gm		
2.675 x 1.125 x 2	<170 gm	Banana Plug	TC Conn or Bdg Post
	<3 lbs.	a.c. cord bind. post	TC Conn.
1.5 x 1.5 x 0.5	<30 gm	Wire P.C. Pins or Solder Lugs	TC Wire In
1.1 x 0.65 x 0.7 1.95 x 0.7 x 0.9	<25 gm 60 gm		
1.5 x 1.5 x 0.5	<30 gm		

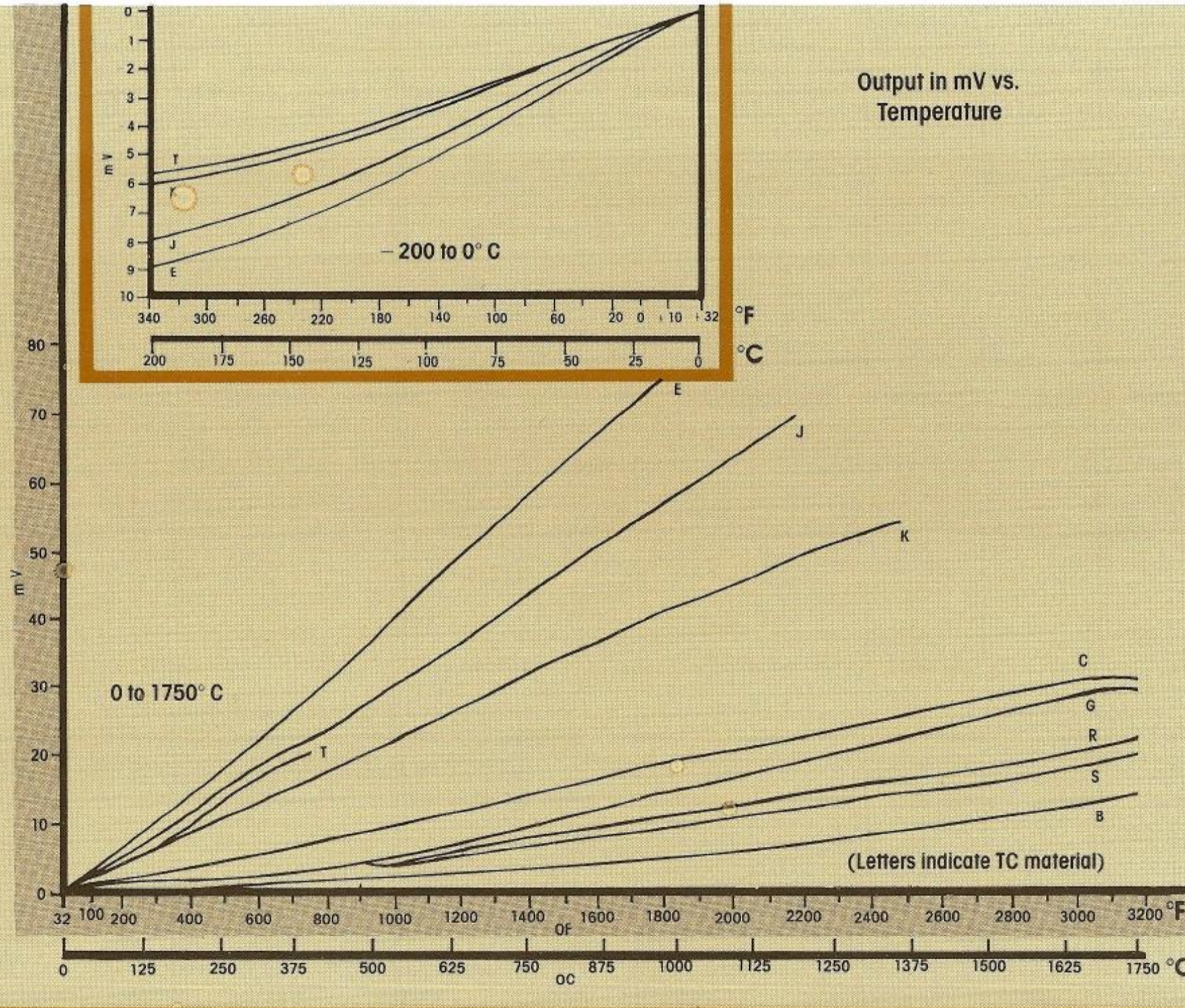
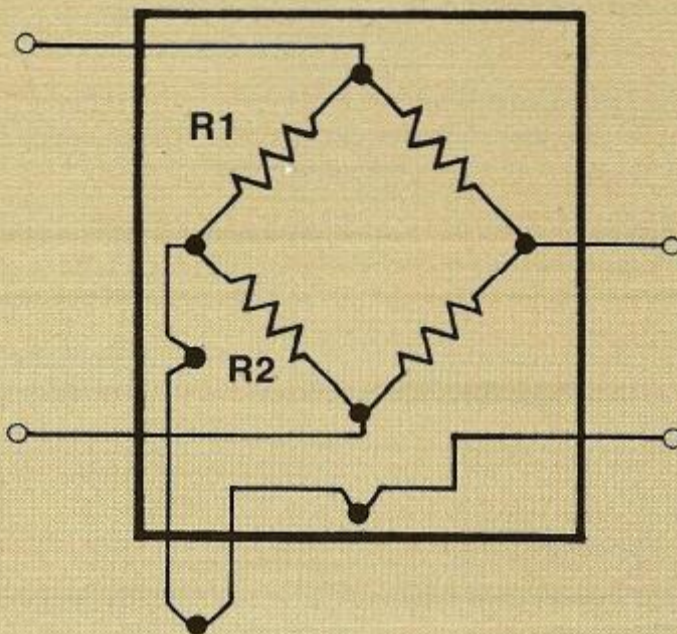


TABLE II NOTES

1. Other reference temperatures available as required. 2. At any stabilized ambient temperature within range. Wider ranges available. 3. At any stabilized ambient temperature within stated range. 4. Other voltages available to meet customer requirements. 5. Other impedances can be supplied. Gain is unity unless otherwise shown. 6. Other adjustment ranges available. 7. Continuous duty rating. For intermittent use up to 2 years for 1500 hour battery, 3 years for 5000 hour battery. 8. Compensation accuracy at 0°C Reference Temperature. All specifications subject to change without notice.

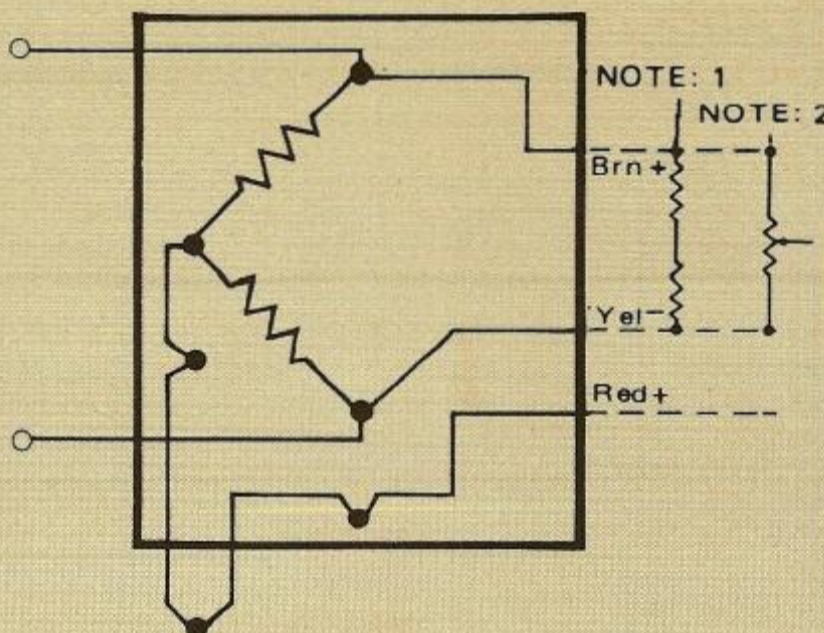
Full Bridge

Full bridge thermocouple reference junction compensators incorporate the complete network, including the thermally responsive resistors. Output is factory set for the specified reference temperature which usually is 0°C. However, adjustable models, permitting fine trimming for system offset or imbalance, are available.



Half Bridge

Half bridge units also incorporate the thermally responsive resistors. The bridge network, however is completed externally. The required resistors may be fixed (either Hades or customer supplied) or a rebalancing potentiometer such as a servo indicator.



NOTE 1: External full-bridge completion resistors.
NOTE 2: External servo rebalance potentiometer.

Internal Attenuation of TC Signal

In some applications, to make the TC signal level compatible with other equipment, it is desirable that the output signal be adjusted to a range other than that directly resulting from temperature variations in the medium being monitored. Hades can incorporate circuitry to accomplish this directly within the reference junction package. In many models this can be done without a change in package size.

The adjustment is a decrease in signal level, uniform over the output range of the TC material being used. Alteration of the output is usually a constant multiple (or division).

Units for Use with Unregulated D.C. Supply

For accuracy, reference junctions require a stable d.c. supply voltage, usually $\pm 0.1\%$. Hades offers units to special order which function with power from an unregulated d.c. source. The regulation is accomplished by circuitry incorporated within the reference junction package.

TC Reference Junction Standard Configurations (Continued)

Single Channel Encapsulated

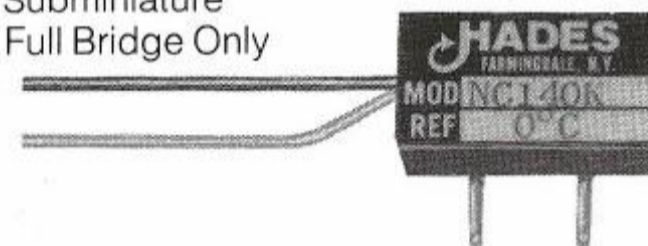
SERIES NH 111

Subminiature
Half Bridge Only



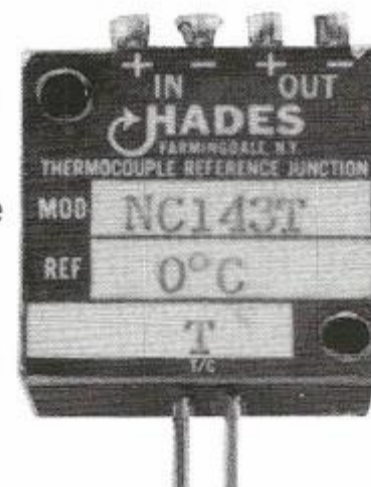
SERIES NC 140,

Subminiature
Full Bridge Only



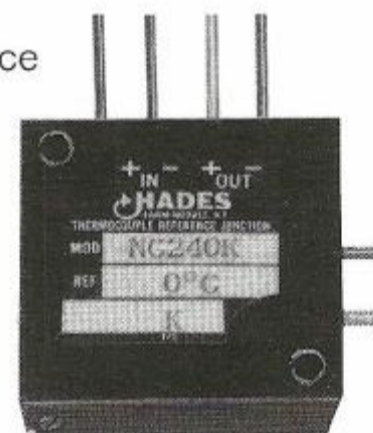
SERIES NC 143

Miniature with
Mounting Holes
Full or Half Bridge



SERIES NC 240

Adjustable, reference
with Mounting
Holes
Full Bridge Only



Models for

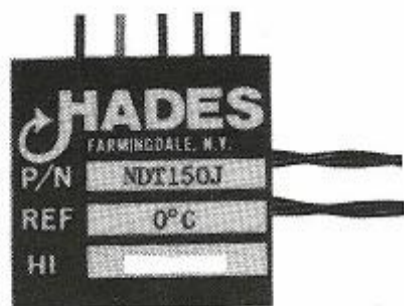
Hades manufactures a variety of TC reference junctions for special applications including units designed specifically for use in severe environments. Performance characteristics are essentially those of the encapsulated units listed in table II. Three representative models are illustrated here.

Junction Compensators

(See Table II for performance and dimensional data.)

Multi-Channel Encapsulated

SERIES NCMC and NHMC

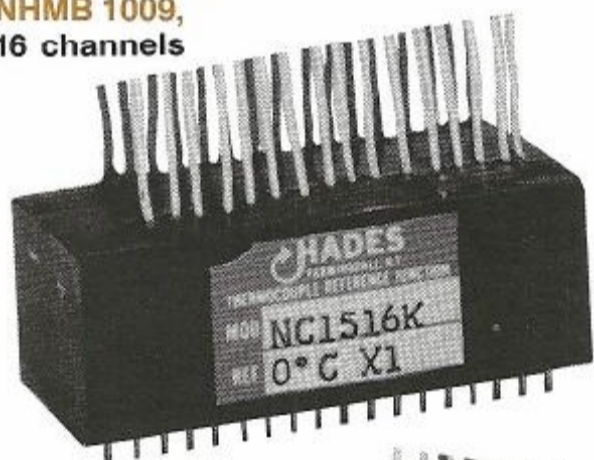


Two Channel
Full or Half Bridge

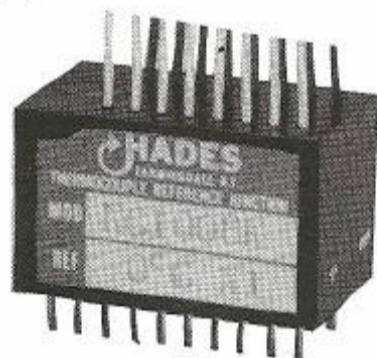
**SERIES NCMA and NHMA 1001
SERIES NCMB and NHMB 1009**

Multiple cold junctions and a full or half bridge reference junction in a network and package configuration which maintains all at an identical reference temperature. These units are particularly well suited for multiplexing.

**Series NCMB 1009 and NHMB 1009,
9 to 16 channels**



**Series NCMA 1001 and NHMA 1001,
up to 8 channels**



Self Powered Encapsulated

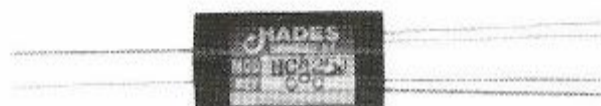
SERIES NC 420

5000 hrs. Continuous Duty
3 years Life on Intermittent Duty
Full Bridge Only



SERIES NC 425

1500 hrs. Continuous Duty
2 years Life on Intermittent Duty
Full Bridge Only



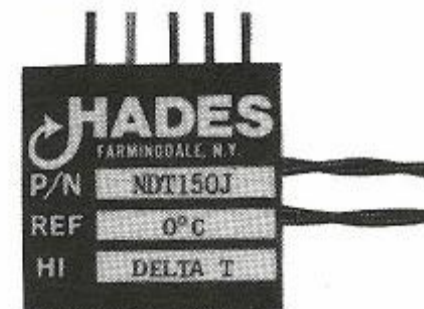
SERIES NC 340 and NC 340-2



Both units incorporate calibration adjustment for battery voltage change. The -2 units incorporate TC input connectors instead of binding posts. Each has a replaceable battery. Full bridge only.

Temperature Differential Measurement

SERIES NDT 150



Designed for instrumentation and control systems where the temperature differential between two points must be monitored or regulated. Two compensated secondary thermocouple junctions are contained in a single encapsulated package. The desired reference point is factory set. Full bridge only.

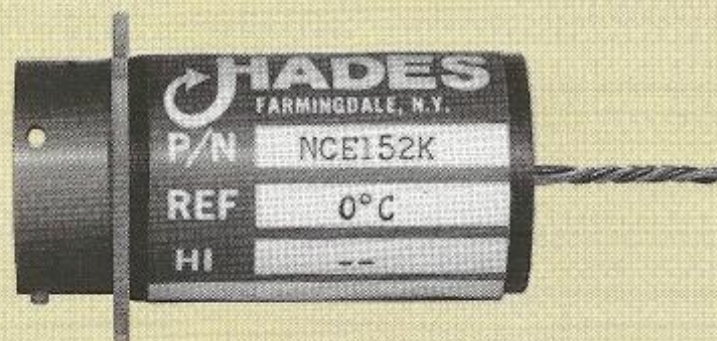
A.C. Powered, Field/Lab Portable

SERIES NC830



Contains an integral power supply for operation from an a.c. power line. Standard voltage is 115, 50/60 Hz; 230 V, 50/60 Hz is optional. Case is metal. The units are portable and, unlike ovens, operate instantly when plugged in. Output terminals are binding posts, input is a thermocouple connector. A mating TC material connector is supplied.

Severe Environments



Model NCE 1_2

Withstands missile launch environments. It is resistant to N_2O_2 , UDMH and gases of other propellants. The unit is epoxy encapsulated. TC input: -leads or MS locking connector. TC output; power input: -MS locking connector.



Model NCE 1_3

Developed to withstand ultra-high shock, this unit has been tested to 24,000 gs shock spectrum in each of 3 mutually perpendicular axes with power on and temperature measurements being monitored during tests.



Model NCE 1_4

Radiation hardened, epoxy encapsulated. TC input: -wire leads
TC output; Power input -MS locking conn.

Calibration and Testing Equipment for Laboratory and Field Use

SERIES NDP181

Series NDP181 units are versatile multi-function instruments. They can:

- Simulate the output of a thermocouple probe for system test and calibration
- Check a TC probe for open or high resistance
- Be used as a digital thermometer when connected to a thermocouple probe
- Provide linearized analog output for chart recorders and analog control systems (option)
- Serve as an accurate, linear multivolt signal source both in the lab and in the field

The unit incorporates a thermocouple reference junction. Display is 3½ digit, seven segment red LED 0.43" high. Power required is 110 VAC, 50 to 400 Hz or internal, rechargeable battery with internal charging and battery test circuits.

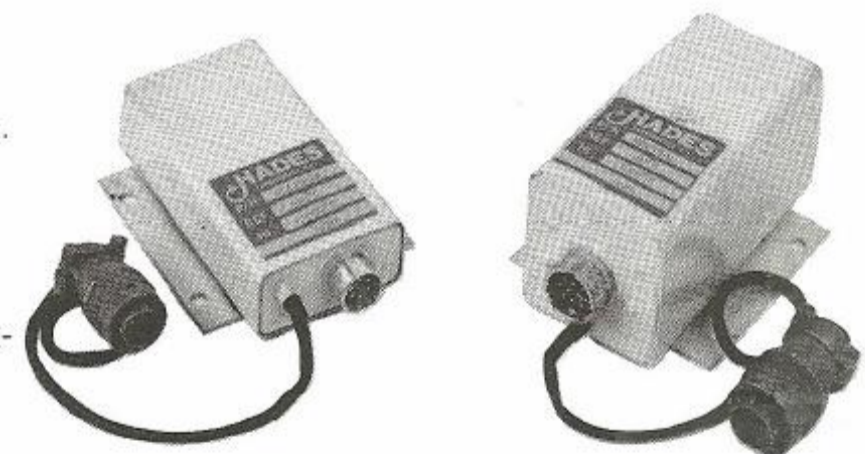


μ Volt Signal Conditioning Amplifiers

SERIES NCA 150

The Hades Model NCA 150 signal conditioning amplifier is a high gain isolation amplifier providing excellent accuracy and stability over an ambient temperature range of from -50 to +185°F. It is available with an integral thermocouple reference junction for use in TC measurement systems and without the reference junction for other applications where amplification of a low level d.c. signal is required. The unit meets or exceeds the

environmental requirements of MIL-E-5400. Input may be any span from 3.5 to 60 mVdc. Standard output is 0 to 5 Vdc. Others available. Accuracy is $\pm 1\%$ of output range + 130 μ at input over the full temperature range. Power required is 28 \pm 4Vdc. Power consumption is less than 100 mA. Input, output and power are completely isolated from each other.



SERIES NCA 191 and NCA 991

The Hades NCA 191 and NCA 991 offer selectable voltage gains of X100, X200, X300, X400 and X500. The 191 is a single channel unit, the 991 is a 10 channel version in a standard rack mount. Both models may be ordered with an integral thermocouple reference junction for use with TC temperature measurement systems. Power is supplied by a replaceable 9 volt battery. Standard output is 0 to 5Vdc. Long term gain stability is $\pm 0.1\%$ /year. Operating temperature range is 0 to 150°F. Zeroing adjustment is provided by a multi-turn potentiometer.

SERIES NCA 991



SERIES NCA 191

Hades instrument line includes models for temperature measurement, for monitoring temperature and temperature differential and for process control. They accept inputs from thermocouple, RTD and semiconductor sensors and are offered with or without probes. The 907 Series Process Controllers also accept voltage and current input from other types of transducers. Basic modules are shown below. Hades also produces special units for incorporation by OEM's supplying display and regulation equipment for instrumentation and control systems. Variations of the listed models can be built to meet a customer's specific requirements. Most items offer analog and BCD output options for interfacing with other equipment.

Digital Thermometers, Monitors and Controllers

OUTPUTS FOR CONTROL AND DATALOGGING

Hades instruments for process control offer a wide variety of output configurations. Units in the 907 series are available with outputs from

simple ON-OFF to full servo PID. The series 707 and 807 offer analog or digital outputs as a special option. Analog output is 1 mV/

degree F or C, linearized and buffered. Digital outputs are BCD encoded, latched, buffered parallel.

DIGITAL THERMOMETERS

Basic Performance
(See individual specification bulletins for details)

TC MODELS

Probes: Any standard TC material
Range: Refer to TC material table, page 2
Resolution: 1° C or F
Accuracy: ± 1.5° to ± 2.5° depending upon specified TC material
Input Power: 110 or 220 V, 60 or 50 Hz; 5, or 8 to 28 VDC
Display: 3½ digits, 0.43" high (7 segment) with automatic + and -

RTD MODELS

Probes: Platinum - 100 ohm DIN 43760 (Alpha = 0.00385 ohms)
Range: - 200 to +800° C, - 328 to +1471° F DIN 43760, - 160 to +199.9° C, - 199.9 to +199.9° F
Resolution: ± 1° C or F, DIN 43760 ± 0.1° C or F
Accuracy: ± 1.4° C, ± 1.9° F DIN 43760; ± 0.2° C or F
Input power: 110 or 220 V, 60 or 50 Hz; 5, or 8 to 28 VDC
Display: 3½ digits, 0.43" high (7 segments) with automatic + and -

TEMPERATURE DIFFERENTIAL MONITORS



DTA707 in bench case version

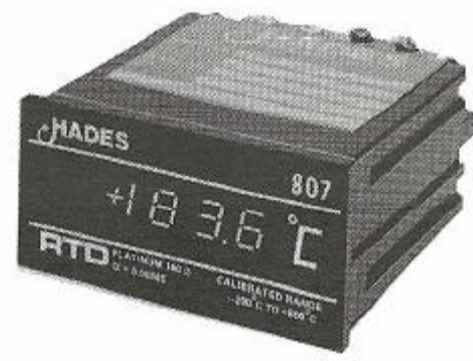


DTA100 in panel mount version

SINGLE CHANNEL



Panel Mount Series 707 for TC Input Series 807 for RTD Input



MULTICHANNEL

10 Channel Series PB707 for TC Input Series PB807 for RTD Input



Bench Case Series BC707 for TC Input Series BC807 for RTD Input



DTA Series

The Hades DTA Series constitute a unique family of instruments designed specifically for applications where the **difference** in temperature between two points must be monitored. Alike in packaging and display, they vary in output function and in the signal source, i.e. temperature measurement probe.

Display All Models

Temperature difference: 3½ digit 0.5" high LED. (Push button for reading actual temperature at one probe)

System Status Lights:

Green, temperature differential within set limits. Amber, temperature differential at warning level. Red, temperature exceeds limit value. Setting and calibration controls also are on the face of the instrument. Display may be either °C or °F.

Outputs All Models

Two form C, single pole, double throw relays for operation of remote annunciating alarms or controls. Both are normally closed so that loss of power, would actuate a remote alarm.

Series DTA707 and DTA807

(In addition to above)
Analog: 1 mV/degree, bipolar linearized and buffered
Digital: BCD parallel, latched and buffered, TTL/DTL and CMOS compatible.

Signal Source and Range

Series DTA100: semi conductor probes: - 60 to + 300° F (51 to 149° C)
Series DTA707: thermocouples, any generally used (see table on page 2 for materials and ranges)
Series DTA807: RTD; platinum - 100 ohm, - 328 to + 1471° F (- 200 to + 800° C), DIN43760 - 199.9 to + 199.9° F (- 160 to + 199.9° C)

MOUNTING BRACKET



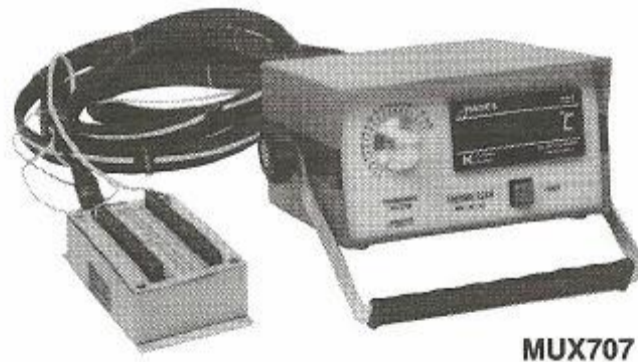
For fixed mounting of bench case units, single or multichannel; affixes to top or bottom, available for all units.

PROCESS CONTROLLER



Series 907
Hades Series 907 process controllers are designed to accept input not only from temperature transducers of all types but also voltage and current inputs. Thus they are suitable for a host of process control applications.

Remote Address Multiplexing 8, 16 or 24 channels

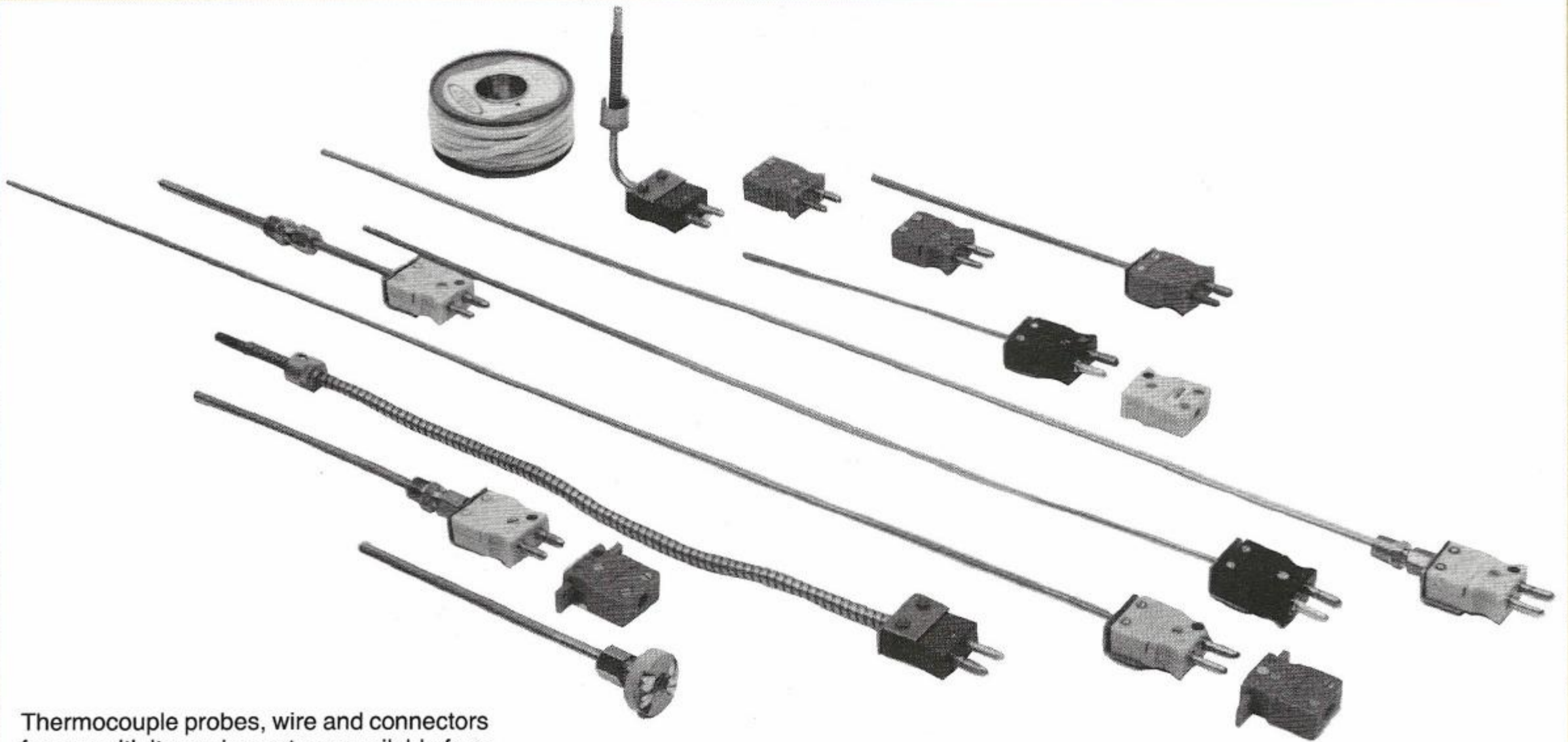


NUX711

MUX707

The complete system consists of 2 units: a package (right above), MUX707, which incorporates a basic 707 digital thermometer plus a rotary switch with a binary output and a dc/dc power supply for operation of the thermocouple multiplexer package. The NUX711 multiplexer unit is comprised of an isotherm which keeps the secondary junctions of the TC circuits at a common temperature and a solid state scanner operated by the remote binary coded switch in the MUX707 thermometer module. The harness between the two units includes the power leads, binary input leads and a single pair of TC leads connected to signal input of the digital thermometer. General specifications and output options are the same as are shown for TC models above.

Probes, Wire and Connectors



Thermocouple probes, wire and connectors for use with its equipment are available from Hades Manufacturing Corp. Hades also supplies thermocouple, resistance and solid state sensors, including versions in stainless steel sheaths.

How to Order

To order thermocouple reference junctions it is necessary to provide the following information:

- TC material being used
- Desired reference temperature (0°C or other)
- Excitation voltage
- Integral signal amplification or attenuation if desired
- Basic series number
- Number of channels if applicable

To order a Digital Thermometer or Calibration Test Set, it is necessary to provide the following:

- Temperature range to be measured
- TC material being used (if TC unit)
- Excitation voltage
- Display, °F or °C
- Basic series number
- Number of Channels if applicable
- Special options if applicable
- Set point and differential temperatures for DTA series

To order a Signal Conditioning Amplifier it is necessary to provide:

- Basic series number
- Input Range in mVdc or measured temperature range and TC material being used
- Output is 0 to 5Vdc standard, other available

To order a process controller consult specifications bulletin No. 205 "Indicator/Controllers for Temperature, Voltage and Current."

Specifications and prices subject to change without notice.



Send for FREE technical literature.

Each Hades product is covered by a technical bulletin which details performance parameters, physical dimensions, environmental data and other pertinent information. To obtain copies, call or write, stating the products in which you are interested.

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