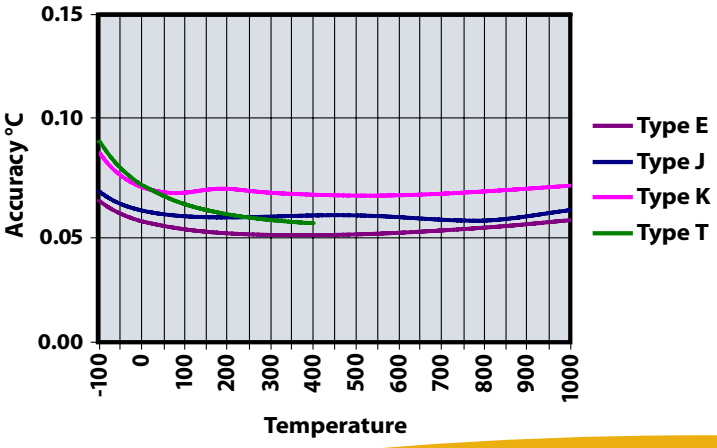
Model 1140A Thermocouple Simulator-Calibrator

The Model 1140A represents the latest innovation in thermocouple simulator-calibrators from Ectron, the originator of the Thermocouple Simulator (introduced in 1973).

Features

0.06°C Accuracy for Common Thermocouple Types
Simulate and Measure Thermocouples
Source and Measure Dc Microvolts to Volts
Dc Accuracy of 0.0025% + 2.0 µV for Six Months
Output Impedance of 0.05 Ω, All Ranges
GPIB; Ethernet, and USB Optional Interfaces

Model 1140A 6-Month Accuracy in Deg. C
Types E, J, K, T



A New Laboratory or Shop Standard...

- Highest accuracy including cold-junction compensation
- Virtually all thermocouple types
- Multiple instruments can be paralleled without loading error
- Up to 31 memories for storing preset conditions including T/C type, cold-junction temperature, zero offset
- Ramp for linearity testing
- Programmable via GPIB, Ethernet, and USB
- Supports SCPI commands
- Quoted accuracy is minimum performance — not typical
- Simple alignment
- 6-digit thermocouple resolution to 0.01°
- 7-digit dc resolution to 0.1 µV

Model 1140A Thermocouple Simulator-Calibrator

The Ectron Model 1140A incorporates unique features not found in any thermocouple simulator currently on the market. The combination of highest accuracy for thermocouple and dc signals, back-lit graphic LCD display, and many unique functions make the Ectron Model 1140A a very versatile instrument. This, along with Ectron's reputation for quality and performance in thermocouple simulators, will enable the Model 1140A to achieve wide user acceptance.

The signal output (or input) is available through binding posts or a mini-thermocouple connector. Cold-junction compensation is controlled with precision temperature sensors within the terminals. This virtually eliminates errors seen in other thermocouple simulators when using heavy thermocouple wire or temperature variations caused by ambient conditions.

Separate offsets for each thermocouple type may be specified from the front panel. These offsets allow customers to compensate for variations in the thermocouple or extension wire being used. While these offsets are often greater than the allowable measurement uncertainty, the Ectron Model 1140A enables users to compensate for these errors in a known and predictable way that will further enhance the instrument's outstanding accuracy.

The accuracy of the Model 1140A is established through the use of ultra-precision film resistor networks and a precision, monolithic voltage reference. The output is produced with a 24-bit DAC, comprised of discrete and monolithic stages. The output from each bit of the DAC does not follow a binary sequence. Rather, it is always less than the sum of outputs of follower bits. In this way, the DAC output is guaranteed to have no missing output voltages (the inverse of "no missing codes" in an ADC).

The Model 1140A uses a unique algorithm for its own alignment. The output of its DAC is measured and the outputs produced from combinations of bits are compared to the outputs from other combinations to build a matrix of measured errors. Using this matrix and an overall measurement against an external standard, the accuracy of each bit is determined and correction factors stored. In use, these correction factors help determine which bits are needed to generate the desired output voltage. In this way, the absolute accuracy of individual components used in the DACs is not nearly as important as in other instruments, and alignment is virtually a "hands off" operation.

Command Features

In addition to the superb accuracy for measure and source modes, this instrument incorporates many functions under user control. Although most users will operate the Model 1140A using computer control through one of the available interfaces, there are several internal functions that allow many testing and simulation functions to be preset and recalled when needed.

Programmed Functions

The 31 memory locations (files) retain all settable functions of the instrument: temperature, thermocouple type, reference-junction temperature, offset, autozero, and lead material (alloy or copper). In addition, a sequence function is available that allows the user to sequence through several preset settings (files) with user-specified time and repeat capabilities. Thus, a ramp can be programmed either upscale or downscale or both with preset step size and time.

Autozero Command

One of the Model 1140A's features is the autozero command. This powerful feature allows a user to follow the variation of a signal (either temperature or voltage) from the point of autozero.

This command, a step in the Output Measure menu, zeroes the readout. Following this command the readout indicates the difference between the reading at the time of re-zero and the current input signal permitting a high degree of resolution.

One of the many applications for the autozero command is to monitor the operation of thermostatically controlled temperature chambers. Setting the zero point of the Model 1140A to the thermostat's setting, the Model 1140A will then read the temperature variation allowed by the thermostat to a high degree of resolution and accuracy.

Offset

The Model 1140A has the capability for two offset values: one for copper connections and one for alloy connections.

The copper offset voltage is added to the voltage at the Model 1140A's output terminals. This can be used to measure voltages where a known offset is present or to source voltages relative to a fixed offset.

The offset for alloy material is entered in terms of temperature, and a different offset may be stored for each thermocouple type. This offset can be used to correct for known offset errors in thermocouples that the Model 1140A is to simulate or measure.

This little-understood but common error is the unavoidable result of using non-ideal thermocouple wire for connections and does not result from the use of copper terminals on the Model 1140A. It is solely due to the characteristics of the thermocouple material being used to make the connections. Typically, the magnitude of this error is determined by measuring the output from a sample of the thermocouple wire in use at the expected temperature of the connections at the Model 1140A's front panel.

Guard-band Considerations

Guard bands enable test limits to be set to allow for the worst-case measurement error. Guard banding maximizes the probability that the instrument under test is within specifications even if the measurement equipment is operating at its lowest level of accuracy.

Calibrating instruments that use low-output thermocouples (T/Cs)* or those that provide only a small change in emf per degree (Seebeck effect), are the most difficult since testing these instruments requires a highly accurate and stable T/C simulator.

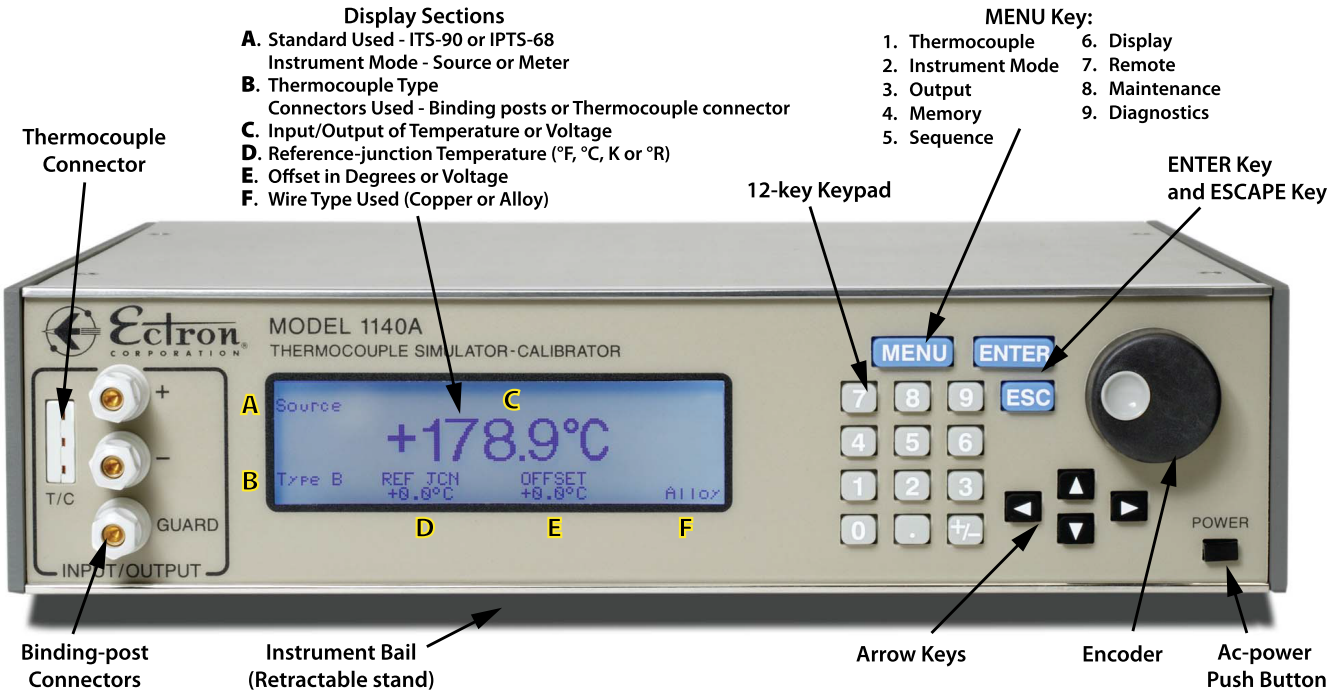
Because the Model 1140A offers a new level of T/C simulation accuracy, guard bands can be reduced while maintaining the assurance that the device under test meets its specification. For example, when a data system is using Type S T/C material, and a test point is required at 1500°C, the T/C output is 15,581.67 µV, and the Seebeck coefficient (emf change per degree) is only 12.0369 µV. A lesser calibrator can provide only a calibration to 0.46°C, whereas the Model 1140A has an accuracy of 0.26°C. With accuracy demands increasing, 0.46°C may not be tolerable.

Even for T/Cs in their normally used ranges, the Model 1140A's contribution to error budget allows users to virtually ignore the calibrator's error margin.

*Types B, D, G, N, R, S

Ectron CORPORATION
8159 Engineer Road San Diego, CA 92111 (858) 278-0600 sales@ectron.com
www.ectron.com

Model 1140A Thermocouple Simulator-Calibrator



Thermocouple Accuracy – Source and Measure

Includes accuracy, conformity, cold-junction compensation, noise, stability, and temperature (±3° of T_{cal})
Does not include errors in external thermocouple wire

T/C Type	Range °C From	Range °C To	Accuracy °C 24-hour	Accuracy °C 6-month	Accuracy °C 1-year
B	250	<350	0.58	0.85	0.95
	350	<445	0.41	0.60	0.74
	445	<580	0.33	0.49	0.58
	580	<750	0.26	0.38	0.45
	750	<1000	0.21	0.31	0.37
	1000	1820	0.17	0.24	0.29
C	0	<250	0.12	0.16	0.20
	250	<1000	0.10	0.13	0.16
	1000	<1500	0.11	0.15	0.18
	1500	<1800	0.13	0.18	0.21
	1800	<2000	0.14	0.20	0.23
	2000	<2250	0.17	0.24	0.29
	2250	2315.56	0.19	0.26	0.32
D	0	<100	0.16	0.23	0.27
	100	<300	0.12	0.17	0.20
	300	<1400	0.10	0.13	0.15
	1400	<1650	0.10	0.15	0.17
	1650	<1930	0.12	0.16	0.20
	1930	<2100	0.14	0.19	0.23
	2100	<2200	0.15	0.21	0.25
	2200	2320	0.18	0.25	0.30
E	–270	<–245	0.95	1.10	1.20
	–245	<–195	0.13	0.16	0.18
	–195	<–155	0.07	0.09	0.10
	–155	<–90	0.06	0.07	0.08
	–90	<15	0.05	0.06	0.07
	15	<890	0.05	0.06	0.06
	890	1000	0.05	0.06	0.07

T/C Type	Range °C From	Range °C To	Accuracy °C 24-hour	Accuracy °C 6-month	Accuracy °C 1-year
G	0	<100	1.10	1.30	1.50
	100	<300	0.28	0.35	0.43
	300	<600	0.14	0.19	0.24
	600	<1760	0.10	0.13	0.15
	1760	<2030	0.11	0.15	0.18
	2030	<2200	0.13	0.17	0.21
	2200	2315.56	0.14	0.20	0.24
J	–210	<–180	0.07	0.10	0.12
	–180	<–120	0.06	0.09	0.10
	–120	<–50	0.06	0.07	0.08
	–50	<990	0.05	0.06	0.07
	990	1200	0.05	0.07	0.07
K	–270	<–255	1.50	1.90	2.20
	–255	<–195	0.30	0.40	0.70
	–195	<–115	0.10	0.11	0.12
	–115	<–55	0.07	0.08	0.09
	–55	<1000	0.06	0.07	0.07
	1000	1372	0.06	0.08	0.08
N	–270	<–260	3.50	4.00	5.00
	–260	<–200	0.75	0.93	1.00
	–200	<–140	0.15	0.19	0.23
	–140	<–70	0.10	0.12	0.15
	–70	<25	0.08	0.10	0.12
	25	<160	0.07	0.09	0.10
	160	1300	0.07	0.08	0.09

T/C Type	Range °C From	Range °C To	Accuracy °C 24-hour	Accuracy °C 6-month	Accuracy °C 1-year
PLII	0	<100	0.07	0.08	0.10
	100	<925	0.06	0.07	0.08
	925	<1200	0.07	0.08	0.10
	1200	1395	0.08	0.09	0.11
R	–50	<–30	0.40	0.58	0.65
	–30	<45	0.34	0.48	0.55
	45	<160	0.24	0.32	0.40
	160	<380	0.18	0.26	0.30
	380	<775	0.15	0.21	0.26
	775	1768.1	0.13	0.18	0.22
S	–50	<–30	0.38	0.53	0.62
	–30	<45	0.32	0.47	0.56
	45	<105	0.23	0.34	0.40
	105	<310	0.20	0.30	0.33
	310	<615	0.17	0.25	0.29
	615	1768.1	0.15	0.22	0.26
T	–270	<–255	1.40	1.60	1.80
	–255	<–240	0.27	0.35	0.49
	–240	<–210	0.17	0.24	0.30
	–210	<–150	0.11	0.15	0.18
	–150	<–40	0.08	0.10	0.12
	–40	<100	0.06	0.07	0.08
	100	400	0.05	0.06	0.07

8159 Engineer Road San Diego, CA 92111 (858) 278-0600 sales@ectron.com
www.ectron.com

Applications for the Model 1140A

1. Calibration of Temperature-measuring Instruments that Use Thermocouples:
   - Digital thermometers
   - Temperature recorders
   - Production-line thermocouple instruments
2. Calibration of Thermocouples
   Using measurement mode, because of the high measurement accuracy of the Model 1140A, virtually any type thermocouple can be easily calibrated. A stable temperature bath with known temperature is required.
3. Dc Calibration
   Since the Model 1140A is a high-accuracy, programmable dc standard, it serves as a general purpose dc calibrator and meter. Features of the instrument that make it valuable as a dc source include:
   - High accuracy: to 20 ppm, resolution to 7 digits, 0.1 µV
   - Low output impedance even at microvolt levels where other precision calibrators typically exhibit from 50 Ω to 200 Ω output resistance
   - Programmable via GPIB, Ethernet, RS-232, and USB
   - Sufficient accuracy to calibrate most digital and all analog meters
4. Industrial Control Systems
   Speed of response, output isolation, and accuracy, both thermocouple and dc, all contribute to make this instrument ideal for use in industrial-control applications.

Specifications for the Model 1140A*

General Source and Measure Specifications

Accuracy (24 hours):
±20 ppm + 1 µV

Stability with Time:
Six months: ±5 ppm + 1 µV
One year: ±10 ppm + 1.5 µV

Input Impedance:
10 MΩ ±5%, all ranges

Output Impedance:
0.05 Ω max. all ranges

Output Current:
50 mA min. limited to <100 mA

Output Slew Rate:
100 V/s

Common-mode Rejection:
160 dB at dc, 140 dB at 60 Hz

Noise:
1.0 µV peak, 0.1 Hz to 10 Hz, 95% confidence

Temperature Coefficient:
5 ppm/°C + 0.2 µV/°C

Terminals:
Binding posts and mini-thermocouple connector

Interfaces:
GPIB; Ethernet, and USB available

Terminal Protection:
Indefinite short-circuit protection. No damage will occur if ±120 V dc or ac rms is applied to the output or input terminals.

Thermocouple Mode

Temperature Scales:
Celsius Fahrenheit
Rankine Kelvin

Types:
B, C, D, E, G, J, K, N, PLII, R, S, T

Settling Time:
<200 ms to rated accuracy

Accuracy:
See Thermocouple Charts

Ranges:
See Thermocouple Charts

Output Impedance:
0.05 Ω

Resolution:
6 digits, 0.01° max. (Can be limited to 0.1° and 1°)

Conformity vs. NIST T/C Curve:
< 0.4 µV

Temperature Standards:
ITS-90
IPTS-68

Reference-junction Error:
< 0.004°C/°C

Voltage Mode

Millivolt Ranges (Auto):
0 to 999.9999 mV
0 to 9999.999 mV
0 to 11000.00 mV

Volt Ranges (Auto):
0 to 9.999999 V
0 to 11.00000 V dc

Resolution:
7 digits, 0.1 µV max. (Can be limited to 1 µV, 10 µV, 100 µV, and 1 mV)

Settling Time:
<1 s to rated accuracy

Physical Properties

Size
Height: 88.9 mm (3.5 in)
Width: 366 mm (14.4 in)
Depth: 356 mm (14.0 in)

Weight:
5 kg (11 lb) net
7 kg (15.4 lb) shipping

Power:
85 V ac to 250 V ac,
50 Hz to 60 Hz, 20 VA

Operating Temperature:
0°C to 50°C

Humidity:
10% to 90% noncondensing

*(Specifications apply at 23°C ± 3°C and after a 30-minute warmup.)

8159 Engineer Road
San Diego, CA 92111
(858) 278-0600
sales@ectron.com

Ectron CORPORATION

Printed in U.S.A.

10/14

MODEL 1140A OPTIONS & ENHANCEMENTS

With these latest innovations, Ectron has enhanced the value point of the Model 1140A Thermocouple Simulator-Calibrators for all its customers. Drawing upon many years of design expertise as well as awareness of developing market trends, Ectron once again demonstrates its industry-leading core competency in this class of test & measurement instrumentation. By delivering decisive technical advantages over the competition, Ectron advances the state of the art in temperature measurement and simulation objectives.

Additional features in the Ectron Model 1140A:

Data Logging — In meter mode, the Model 1140A can record up to 10,000 data points, display them, and transfer the data to a computer through a remote interface.

Standardized Product — The Model 1140A with GPIB has a National Stock Number 7Z 6685-01-573-6135. Naval Inventory Control Point (N35) is the source of supply for this product.

Options:

Remote Interfaces
`Part No: 1140A - GPIB, ETH, RS232`
Optional interfaces are GPIB, Ethernet, and RS-232. Up to two can be installed at a time. (USB interface is built in.)

Battery Operation
`1140A - BATTERY`
Rechargeable Nickel-Metal Hydride (NiMH) battery, which provides up to 10 hours of continuous usage.

1120 Emulation Mode
`1140A - 1120 EMU`
With the Ectron 1120 emulation mode installed, the Model 1140A can be used with software designed for the Model 1120.

Rack Mount
`1140A - RACKMT`
Allows the Model 1140A to be mounted in a standard 19 rack.

Accessories:

Carrying Case
`1140A - CASE`
A padded ballistic nylon carrying case for improved portability when taking the unit from the lab to the field test environment.

Calibration Test Kit
`1140A - CALKIT`
Includes two calibrated thermocouples (accuracy to <1 µV), high-grade copper cable, a shorting bar, and a terminal cover for realignment of the unit at semi-annual or full-year intervals.

Ectron CORPORATION
8159 Engineer Road
San Diego, CA 92111
(858) 278-0600
sales@ectron.com

www.ectron.com