



# Instrumentation for Data Acquisition and Calibration

For environments from laboratory to deep space, airborne to industrial



Precision  
Tachometers



Thermocouple  
Simulator-calibrators



Rugged Transducer  
Conditioner-amplifiers



# ▼ Thermocouple Simulator-calibrators

The first precision thermocouple simulator-calibrator was introduced by Ectron in 1973. For the first time cal-lab personnel could perform highly accurate thermocouple-instrument calibration without requiring several instruments and a lookup table.

Ectron simulators produce an emf on their output terminals exactly duplicating the output of an ideal thermocouple heated

to the selected temperature. Used to calibrate thermocouple instrumentation, it is only necessary to interconnect the simulator to the device under test.

Ectron's latest thermocouple simulator-calibrator is the high-accuracy **Model 1140A** with auto-measure for both temperatures and dc voltages.

## Model 1140A – Ectron's Third-generation Thermocouple Simulator-calibrator

### APPLICATIONS

#### *A must-have in the calibration laboratory*

The **Model 1140A** offers the best available thermocouple simulation accuracy both with and without cold-junction compensation.

#### *Perfect for ATE systems*

As a thermocouple simulator and a precision dc source the **Model 1140A** fills a vital need in many ATE systems.

#### *Use for thermocouple calibration*

Operating as a precision digital thermometer the **Model 1140A** along with a stable bath can provide precise calibration of thermocouples, even to less than 0.01°C!

#### *Necessary in the instrument repair shop*

Easily calibrate thermocouple instruments as well as most dc products from meters to scopes to recorders to data systems

#### *Needed for production-line testing*

The **Model 1140A** is ideal for production-line test and calibration of any thermocouple or dc instrumentation.

### FEATURES

- **0.06°C accuracy for common thermocouple types, including cold-junction compensation** (not including temperature extremes)
- **Simulate and measure thermocouples**
- **Source and measure dc microvolts to volts, nV resolution**
- **Dc accuracy of 0.0025% + 2  $\mu$ V for six months, for both source and measure modes**
- **Output impedance of 0.05  $\Omega$ , all ranges**
- **GPIB, Ethernet, and USB interfaces available**
- **Options include rechargeable battery, carrying case, 1120 emulation, calibration kit, and rack mounting**



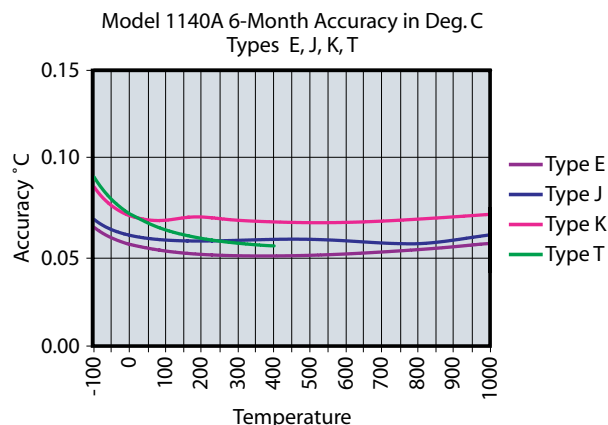
The **Model 1140A** provides four calibration functions: precise simulation of thermocouple signals, precise measurement of thermocouple signals, generation of accurate dc voltages from microvolt level to  $\pm 11$  V dc, and measurement of dc voltages over the same range. The thermocouple simulation and measurement accuracies are the highest in the industry, affording a margin of calibration accuracy heretofore unavailable.

Using a high-speed microcontroller, the **Model 1140A** offers such unique features as an autozero function to correct the zero reading of a non-ideal thermocouple. For repetitive operations, 31 sets of operating conditions can be committed to memory for future retrieval, including automatic sequencing from one condition to the next. Using one of the several interfaces, all functions can be programmed and executed under computer control.

With an output impedance of less than 0.05  $\Omega$  on all ranges, high accuracy is maintained with an absolute minimum of loading error.

Alignment of the **Model 1140A** is a simple procedure that can be completed with a minimum of test equipment. In fact the majority of the instrument's alignment can be accomplished with only a short across the front-panel terminals.

The data logging function allows up to 10,000 data points to be captured in time intervals from 1 second (2.8 hours of data) to 1 day (27.4 years of data).



The **Model 1140A** has exceptional accuracy and stability over very long time periods

## Thermocouple Cold-junction Compensators

Eliminate long-distance thermocouple wire and special-purpose amplifiers! The Ectron **Model 200 T/CMate™** thermocouple cold-junction compensator allows any following instrumentation amplifier to be used as a thermocouple amplifier with thermocouple input.

A unique optical isolator provides power for the compensation circuitry from any 5 V dc to 15 V dc power source, eliminating the need for batteries. The strain-gage excitation supply available from Ectron conditioner-amplifiers provides ideal power.

The **Model 201** additionally includes a PT-series connector for easy connection to many Ectron enclosures.



Model 201 T/CMate™ Thermocouple Cold-junction Compensator with PT06A-10-6P(SR) Connector

### T/CMate™

- Precise compensation for Type E, J, K, and T thermocouples
- Use any instrumentation amplifier
- No batteries required
- Signal isolated from power source

## Severe Environment Miniature Amplifiers with Integral Excitation Supplies

Designed for extreme environment applications, Ectron **Models 314B, 351, and 352** provide highly accurate analog data under the most severe conditions. These instruments have been used in many missile, rocket, and aircraft applications as well as rocket test sleds and other difficult ground applications.

The **Model 314B** is especially adapted to airborne applications involving shock, vibration, and temperature extremes. Able to condition and amplify signals from a variety of transducers, it is also used in missile, rocket, and test-sled applications. It is even being used in projectile testing where it is able to return accurate data while experiencing tremendous acceleration and shock forces.

Variable excitation, switch-selectable gains, and bridge conditioning make the **350 Series** amplifiers useful for all types of data acquisition. Wide bandwidth and high input impedance allow their use in many unusual applications. These rugged models are the same except for size and mounting: the **Model 351** includes four mounting studs while the **Model 352** is compatible with enclosures for the **400 Series** (see Page 5). For wider bandwidth, see the Model 416 on Page 4.



Model 351

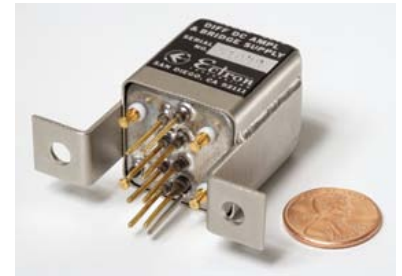


Model 352  
Transducer  
Conditioner-amplifier

## APPLICATIONS

### Model 314B

*Shot from cannons,  
literally in projectile  
Wind-turbine blade  
analysis, amplifier on  
blade  
Shock, vibration machine  
testing  
Torpedo testing*



Model 314B

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## APPLICATIONS

### Model 351

*Marine data systems  
Crane-load monitoring  
Piezoresistive transducer channels  
Wider bandwidth (to 20 kHz) transducers*

### Model 352

*Vehicle crash testing  
NASCAR & IRL on-board monitoring  
Helicopters  
Flight testing  
Shipboard  
Rocketry*



# ▼400 Series Transducer Conditioner-amplifier Systems

## Severe Environment Miniature Amplifiers with Integral Excitation Supplies

### Miniature Transducer Conditioner-amplifiers

### Precision Frequency-to-voltage Converters/Tachometers



**Model 416**  
Transducer  
Conditioner-amplifier



**Model 4280**  
Transducer  
Conditioner-amplifier



**Model 441A/AL**  
Precision Frequency-to-  
voltage Converter

- 100 g shock, 20 g vibration
- Excellent stability under large, fast temperature changes
- Excitation supply, bridge-balance options
- Ohmically isolated input, output (Models 416, 428)
- True differential input
- Operation from vehicle battery supply

An industry standard for on-board vehicle test, the Ectron **400 Series** instruments are small and rugged but able to condition and amplify the signals from almost any transducer including strain gages, LVDT/RVDTs, RTDs, mag pickups, thermocouples, and other low- and high-level signal sources. On the test track or in the air, these instruments can produce high-accuracy data despite temperature extremes and high shock and vibration conditions. EMI protection is standard to minimize the effects of spurious signals from other devices.

The **Model 428** is a true differential amplifier featuring complete isolation between the input, power supply, output, excitation, and case. Transformer coupling contributes to high common-mode rejection, and the input chopper

design results in superior zero stability, both short term and long term. The high input impedance permits operation with a large variety of signal sources; and the low output impedance permits operation into highly reactive loads, telemetry equipment, and most recording devices. The **Model 416** is the ruggedized version, designed for extreme environments of mechanical stress and temperature. The front-panel switches are eliminated, gain is adjusted with a screwdriver instead of a knob, and the unit is mountable using four 4-40 studs on the housing. For wider bandwidth, see the Model 351 on Page 3.

### Precision Frequency-to-voltage Converters/Tachometers – Models 441A and 441AL

The **Models 441A** and **441AL** produce an analog voltage output that precisely represents the input frequency. Easily adjusted set points allow the user to closely bracket the frequency of interest as well as set the output voltage scale. Signal conditioning automatically provides correct operation for a wide variety of input signal waveshapes and amplitudes, even those without zero crossing. The output responds very rapidly to changes in input frequency. The **Model 441AL**, designed for logic-level signals, offers almost instantaneous response for fast acceleration and deceleration systems.

## APPLICATIONS

### Model 416

*On-board rocket boost stage  
Helicopter rotor, engine monitoring  
Vehicle crash testing  
Vehicle engine monitoring  
Flight test  
Shipboard monitoring  
Missile test*

### Model 428

*Vehicle crash testing  
NASCAR & IRL on-board monitoring  
Helicopters  
Flight testing  
Shipboard  
Rocketry*

### Models 441A & 441AL

*Turbomachine analysis & control  
Vehicle drive-line analysis  
Fast response governor studies  
Engine overspeed monitor/controller  
Accurate flow-meter monitoring  
Precise tachometer  
ABS (antilock brake system) evaluation  
Analysis of synchro gear-box problems  
Compressor clutch response evaluation*

### Model 416/428 Options

- Option B** Output limited to the range 0 V to 5 V.  
**Option G** Binary gain steps (16, 32, 64, 128, 256, 512, 1024 and 0.1, 0.2, 0.4, 0.8, 1.6, 3.2, 6.4).

### Model 428 Options

- Option L** Front-panel overload indicator with reset switch.  
**Option O** Autozero with front-panel and remote control.

## T/CMate™

The compact, easy-to-use T/CMate converts any Ectron conditioner amplifier into a precise temperature measurement instrument. See page 3.



# ▼400 Series Transducer Conditioner-amplifier Systems

## Precision LVDT/RVDT Signal Conditioner

### APPLICATIONS

#### Model 451

*Vehicle suspension analysis*

*Valve-train analysis*

*Production monitoring of part dimensions*

#### Precision LVDT/RVDT Conditioner – Model 451

The Ectron **Model 451** is a unique advance in conditioners for LVDT\* and RVDT\* transducers. For the first time, the conditioner can be calibrated to the transducer without using a costly and time-consuming laboratory procedure, autozero can be commanded at any time, and the **Model 451**'s display indicates the analog output voltage and actual transducer displacement in real time!



**Model 451**  
Precision LVDT/RVDT  
Conditioner

\*LVDT: Linear Variable Differential Transformer

\*RVDT: Rotary Variable Differential Transformer

## Overspeed Monitor

### APPLICATIONS

#### Model 491

*Gas turbines*

*Reciprocating engines*

#### Precision Overspeed Monitor – Model 491

The Ectron **Model 491** overspeed monitor (OSM) is a precision frequency monitor that provides high-speed control and protection for a variety of mechanical devices. Designed specifically for gas turbine engines, the OSM can be applied to reciprocating engines and other mechanical systems as well.

The design of the OSM incorporates a number of features to enhance its reliability and assure safe operation. All internal systems incorporate high-reliability components. For instance, internal semiconductor devices are rated from  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ . In addition, fail-safe circuitry is incorporated such that if there is a component failure, that failure must almost always result in a fail-safe condition. The mean time before an unsafe failure exceeds 5,500,000 hours.



**Model 491**  
Precision Overspeed Monitor

## Rack-mount and Portable Enclosures

Ectron **400 Series** enclosures provide connector interface for power and signal input and output connections for **400 Series** products. Portable, bench-mount, rack-mount, and signal-conditioning systems are available with capacities from 1 to 14 units. The following Ectron products are interchangeable in these enclosures: the **Models 352** and **428** conditioner-amplifiers, the **Model 441A/AL** frequency-to-voltage converters, and the **Model 451** LVDT/RVDT signal conditioner. Thermocouple conditioning can be added using the **200 Series T/CMate™**.



**Model R408-14 Enclosure** (rear view below)



**Model E408-6 Enclosure**  
(rear view below)



**Model E408-1 Single-channel Enclosure**,  
shown with optional DIN-rail mount



# ▼Industrial Instrumentation

## Transducer Conditioner-amplifiers and Enclosures

- True differential input
- Dc to 200 kHz bandwidth
- Ac line powered (in an enclosure), 12 V dc optional

### Model 563H:

- 0.1 V to 15 V excitation
- Conditioning for  $\frac{1}{4}$ ,  $\frac{1}{2}$ , or full bridges

## APPLICATIONS

### Models 560H and 563H

*Wind-tunnel data acquisition*

*Vibration analysis*

*Precision preamplifier for data systems*

*Railroad track analysis*

*General laboratory conditioner-amplifier*

The **Model 563H** transducer conditioner-amplifier provides excitation, balance, calibration, and precise amplification for one-, two-, or four-arm bridges and other transducer types. Excellent low-level operation allows its use with very low output sources. A wide gain range from 0.01 to 2500 allows operation with a variety of sources. Versatility is further enhanced by the three-step output zero control with ranges of  $\pm 0.1$  V,  $\pm 1$  V, and  $\pm 10$  V.

Bandwidth is dc to 200 kHz. An optional five-step, two-pole Bessel filter has positions of 10 Hz, 100 Hz, 1 kHz, 10 kHz, and Wideband. Another option provides 100 mA output capability. Both provide dual output signals.

The **Model 560H** is an amplifier-only version. This low-noise, low-drift amplifier was designed to accurately process low-level signals in electrically noisy environments by providing excellent common- and normal-mode noise rejection and EMI immunity.

### Filter and Output Options (One Required)

Option	Wideband Output	Filtered Output
J	10 mA	None
K	100 mA	None
L	10 mA	10 mA
M	100 mA	10 mA
N	10 mA	100 mA



Model E513-6A with Model 563HLs



Model E513-2A Enclosure with 563HNs



Model R513-16 Enclosure with 563HNs



Model 563HL



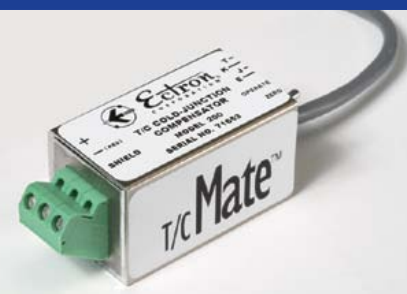
Model 560HN



Model E513-6A Enclosure (rear view)

## T/C Mate™

The compact, easy-to-use T/C Mate converts any Ectron conditioner amplifier into a precise temperature measurement instrument. See page 3.





# ▼Laboratory Instrumentation

## Precision Differential Dc Amplifiers

## Transducer Conditioner-amplifiers

## Wideband Transducer Conditioner-amplifiers

- Bandwidths from dc to 3 MHz
- Exceptional stability, accuracy, and linearity
- Plug-in conditioning assemblies (on some models)
- High common-mode and normal-mode noise rejection
- Over 1000 configurations to meet exact requirements

Ectron laboratory amplifiers and transducer conditioners offer the ultimate in precision transducer conditioning and signal amplification. They typically provide full manual and/or remote control of every parameter of the conditioning process. Because of the less dense packaging, they are more suitable for custom modifications to customer specifications.

The Ectron **Models 753A** and **778** differ in major emphasis: the **753A** has plug-in conditioner modules, while the **778** offers wideband response (3 MHz). The **Model 751ELN** is a precision differential direct-coupled amplifier without transducer excitation.

### Laboratory Instrumentation Characteristics

Model	Bandwidth	Special Feature
751ELN	100 kHz	0.01% Gain accuracy
753A	140 kHz	Isolated CV/CC Excit.
778	3 MHz	Rise time of 0.1 $\mu$ s

The common features of Ectron laboratory amplifiers and conditioners are a very stable zero ( $0.4 \mu\text{V}/^\circ\text{C}$  for **Models 751ELN** and **753A**), precise and accurate gain control, superior gain stability, high common-mode rejection, and normal-mode noise filtering.

All have integral line power supplies for independent operation. Rack-mounting enclosures are available for all models.

Many options are available to suit exact requirements including a variety of plug-in conditioning modules, Bessel filters, output zero, and current options.

## APPLICATIONS

### Model 751ELN

*Laboratory precision general-purpose amplifier  
Blockhouse amplifier for missile launch sites  
For data-system channels requiring high accuracy*

### Model 753A

*For transducer conditioning needing 10-wire functions  
Popular for wind tunnel applications  
General-purpose conditioner amplifier*

### Model 778 Conditioner-amplifier:

*Universal transducer conditioner-amplifier  
Hopkinson Bar test amplifier  
New weapon barrel trials  
Rail gun test analysis  
EMALS aircraft carrier launch analysis  
High strain-rate amplification  
Flash memory current testing*



Model 751ELN



Model 753A



Model E712-3-12 Enclosure with 751ELN



Model R718 Enclosure with 778  
(rear view below)



Model 778

## Modification of Standard Products

Ectron will modify its standard products to satisfy special applications. These modifications can involve simple changes such as special filters for an amplifier. More extensive modifications can also be made, but it usually requires a quantity order to amortize the engineering charges.

If the requirement is to tighten one parameter on an instrument, this can frequently be arranged by adding test time with little modification to the hardware. An example is a manufacturer of injectable drugs who must have a **Model 1140A** thermocouple simulator with very high accuracy over the range from 75°F to 125°F. By using special test procedures over the range of interest, the instrument's normal accuracy was improved by a factor of 2:1. Added cost after the initial order is minimal.

A company in the business of building jet engine test cells approached Ectron to make a special **Model 441A** frequency-to-voltage converter for their particular needs. They only needed two frequency ranges: 0 Hz to 22,000 Hz and 0 Hz to 120 Hz. These ranges represent the rpm of the jet engine under test and the rpm of a flow meter which indicates fuel flow, respectively. The output voltage ranges were both 0 V to +10 V. Selection of these two parameters is to be controlled by a contact closure. Normal user control of these settings is inhibited.

Because of on-going demand, Ectron has designed a version of the **Model 441A** frequency-to-voltage converter for use as an overspeed monitor. This new product is programmable over the RS-232 (or USB) bus, includes three settable monitor points actuating hermetically sealed output relays, and has an analog output (0 V to 10 V or 4 mA to 20 mA). A digitized output indicates current input frequency and all set points. Design reliability is 500,000 hours to first failure when operating at 60°C. This product, the **Model 491**, is designed to comply with CE, CSA Class 1, Div 2 Groups A, B, C, D, as well as the ATEX directive.

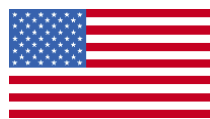
Over the years, thousands of special amplifiers, conditioner amplifiers, and thermocouple simulator-calibrators have been built. As a result, it is likely that we have already designed a special product that meets your requirements.



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Made in the U.S.A.

## Ectron Company History

Established in 1964, the company developed and produced a line of miniature, rugged conditioner amplifiers in which the founder Earl Cunningham had prior experience and knew of a general need. These miniature instruments provided highly accurate data despite harsh environmental conditions.

Originally sold to government test facilities in New Mexico, these products were used on board rocket test sleds where shock and vibration conditions were severe. Named the **400 Series** conditioner amplifiers, these instruments were then introduced to the test tracks of the auto industry in Michigan. Since then, thousands of the **400 Series** products have been sold all over the world. These products are used in all areas of vehicle test from grueling cold or sizzling hot weather to endurance or crash testing. Versions of the standard **400 Series** amplifiers are used on several rocket launch vehicles such as the Delta vehicle, the Cruise Missile, and even aboard the Space Shuttle. Now a family of conditioner products, the **400 Series** instruments find applications wherever accurate data are required under environmentally harsh operating conditions.

Again in 1973, because of a known need, the company developed the first precision thermocouple simulator and calibrator in a single instrument, the **Model 1100**. For the first time, calibration-laboratory personnel could perform highly accurate thermocouple-equipment calibration without requiring several instruments and a lookup table. This proved to be a popular instrument not only with cal labs, but in production test of recording and measuring equipment that involve thermocouple signals. A second-generation instrument, the **Model 1120**, was added in the early 1980's; and in 2007 production began for the third-generation **Model 1140A**. These instruments have made Ectron the leader in the high-accuracy thermocouple simulator-calibrator market.

Ectron developed other instrumentation amplifiers for general industrial or laboratory environments. These are the **500** and **700 Series** amplifiers. These highly accurate and versatile instruments fulfill the needs of many industrial, aerospace, and military facilities requiring superior amplifier and conditioner products.

Quality and customer satisfaction are uppermost in the efforts of all Ectron employees. Product specifications are stated as the maximum deviation from the ideal rather than only typical performance. All products receive rigorous testing, including testing at temperature extremes to insure full conformance to specifications. Under our quality-assurance group, all test equipment is referenced to in-house standards that are traceable to the National Institute of Standards and Technology.

The company is located in modern facilities in the Kearny Mesa area of San Diego, California. All Ectron products are made in the U.S.A.

Represented by: