# ESI - 250D Impedance Bridge




**ESI, Electro Scientific Industries, was founded in Oregon as Brown Engineering Company and renamed ESI in 1953. Production was focused on scientific instrumentation, precision resistors, and impedance bridges. As had happened with Collins for the R-390 receiver, ESI proposed a highly innovative solution for the time: the transition from an analog scale, on which the value was read with the aid of gear ratios, vernier ratios, and interpolations, to a numerical readout using ten-position coaxial switches and knobs calibrated directly in hundreds or thousands of ohms, with the central knob connected to a precision variable resistor and displaying exactly 100 divisions. The Decapot was ESI's first breakthrough coaxial component, precision decade voltage divider. It stacked a series of switched, high-precision discrete resistors underneath a continuous, highly linear wire-wound potentiometer on the central shaft.**

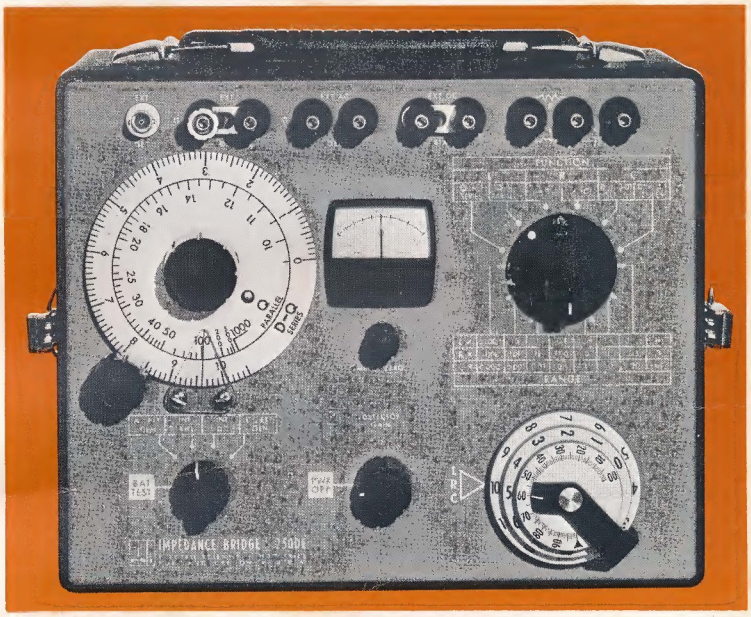
**As a variant of the Decapot, the Dekastat was developed specifically as a coaxial decade rheostat/resistor network, becoming an industry standard precision potentiometer also for other companies (The solutions available at the time, the bulky GR or TIC potentiometers or the compact 10-turn Helipot Beckman type ones, offered 100 dial divisions against the 10,000 or 100,000 divisions of an ESI Dekastat potentiometer.). In the years ESI also introduced its Dekacap step-variable capacitor and Dekatran, a precision step-variable inductance, used among the others in the Gertsch CBR-4 Complex Ratio Bridge.**

**The 250DE is a precision portable bridge capable of both DC and AC operation to measure resistance, capacitance and inductance with accuracy in the order of 0.1-0.2 percent.**

esi

# 250DE portable impedance bridge

- high-accuracy resistance, capacitance, inductance measurements
- solid-state ac-dc detector and generator
- battery-operated from four 1.5-volt D cells
- provisions for bias, external generator-detector, range extension
- portable, rugged, lightweight




The Model 250DE Impedance Bridge is a completely self-contained, portable instrument for precision measurements of resistance, capacitance, and inductance. It can also be used to measure dissipation factor and storage factor for capacitors and inductors. Its accuracy is conservatively rated at 0.1% for resistance, 0.2% for capacitance, and 0.3% for inductance. Even greater precision is possible for comparative measurements because of the 12,005 divisions of dial resolution.

This instrument is extremely versatile for ac measurements involving dc bias and is recommended where battery portability is desirable. Other applications include non-destructive life prediction testing, production limits testing, and temperature measurement using copper resistance. Operation instructions are permanently affixed to the inside cover of the carrying case.

An ac-dc null detector is combined with an ac generator with transformer output and diode rectifiers for direct current. Both are solid-state throughout. Precision mica card resistors ensure accuracy and stability, and the patented DEKADIAL® coaxial main dial provides maximum ease of adjustment and convenience in reading.

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## 250DE portable impedance bridge

The various functions of the Model 250DE Impedance Bridge are shown in the accompanying table, along with instrument range and specified accuracy. Accuracy is also shown in graphic form for measurements of resistors, low-loss inductors, and capacitors.

DETECTOR

**AC Characteristics**

**Input Impedance:** 1 MΩ.

**Sensitivity:** Continuously variable, 10 μV minimum detectable signal.

**Frequency:** 1 kHz.

**DC Characteristics**

**Input Resistance:** 1 MΩ.

**Sensitivity:** Continuously variable, 20 μV minimum detectable signal.

GENERATOR

**AC Characteristics**

**Open-Circuit Voltage:** 2.7 V rms.

**Short-Circuit Current:** 70 mA.

**DC Characteristics**

**Open-Circuit Voltage:** 2.1 VDC.

**Short-Circuit Current:** 40 mA.

**Supply Power:** Four 1.5 V size D batteries (supplied).

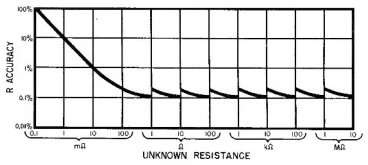
**Battery Life:** Approx 500 hr (6 mo normal service).

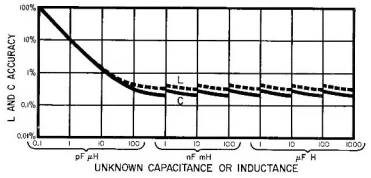
**Dimensions:** Width 10.6 in. (26.9 cm), height 8.4 in. (21.3 cm), depth 6.9 in. (17.5 cm).

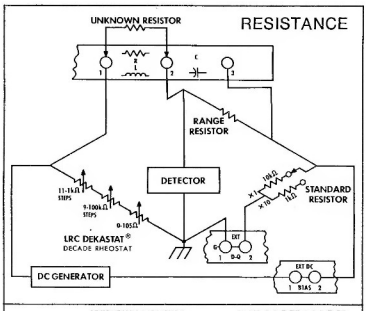
**Weight:** 12 lb (5.4 kg).

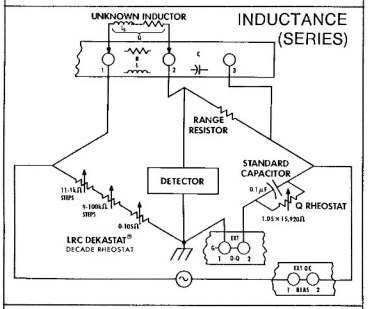
**Price:** $470.00 f.o.b. Portland, Oregon.

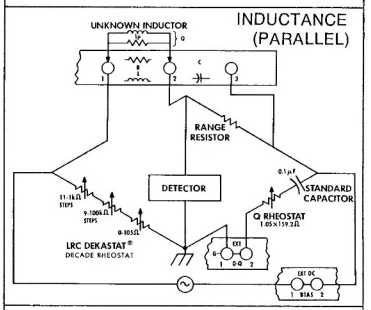
U.S. Patents 2,786,122, D-198,163, 3,150,634 and patents pending.

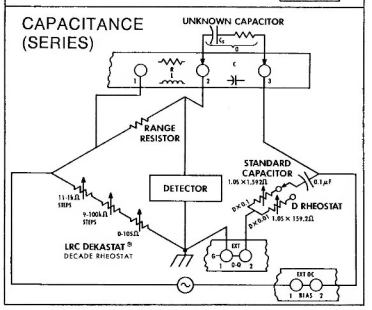



| FUNCTION | RANGES | | ACCURACY | | |
|---|---|---|---|---|---|
| | MAGNITUDE | D OR Q | RANGES | MAGNITUDE | D OR Q |
| Resistance | 0-12 MΩ in eight ranges; 0.1 mΩ per dial division on lowest R range. | | All eight ranges | 0.1% + 1 dial division | |
| Inductance (Series) | 0-1200 H in seven ranges: 0.1 μH per dial division on lowest L range. | Q = 0 to 10.5, 0.1 per dial division. | Highest | 0.3% + 1 dial division + 4.0% × 1/Q | 0.040 (1 + Q²) + 0.02Q |
| | | | Other five | 0.3% + 1 dial division + 0.5% × 1/Q | 0.005 (1 + Q²) + 0.02Q |
| | | | Lowest | 0.3% + 1 dial division + 4.0% × 1/Q | 0.040 (1 + Q²) + 0.02Q |
| Inductance (Parallel) | 0-1200 H in seven ranges: 0.1 μH per dial division on lowest L range. | Q = 10 to 1000, scale reads Q; dial is linear in 1/Q. | Highest | 0.3% + 1 dial division + 4.0% × 1/Q | 0.040 (1 + D²) + 0.02Q |
| | | | Other five | 0.3% + 1 dial division + 0.5% × 1/Q | 0.005 (1 + D²) + 0.02Q |
| | | | Lowest | 0.3% + 1 dial division + 4.0% × 1/Q | 0.040 (1 + D²) + 0.02Q |
| Capacitance (Series) | 0-1200 μF in seven ranges; 0.1 pF per dial division on lowest C range. | D = 0 to 1.05 in two ranges, 0.001 per dial division on lowest D range. | Highest | 0.2% + 1 dial division + 4.0% × D | 0.040 (1 + D²) + 0.02D |
| | | | Other five | 0.2% + 1 dial division + 0.5% × D | 0.005 (1 + D²) + 0.02D |
| | | | Lowest | 0.2% + 1 dial division + 4.0% × D | 0.040 (1 + D²) + 0.02D |

e|s|i®

**Electro Scientific Industries**

13900 N.W. SCIENCE PARK DRIVE • PORTLAND, OREGON 97229

**BRIDGES AND ACCESSORIES**

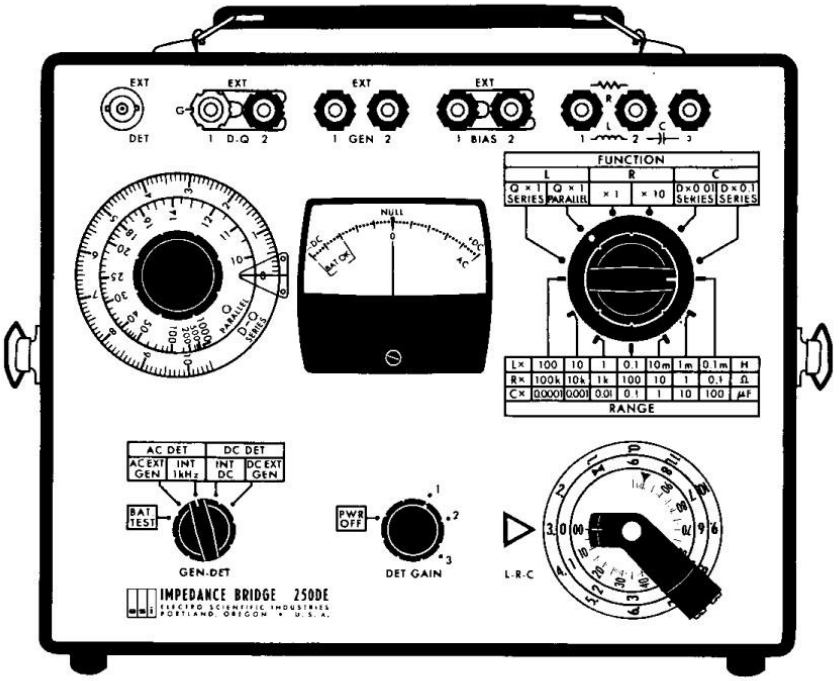
APRIL 1967
REPLACES JUNE 1966

MODEL

# 250DE

*Instruction Manual*

# UNIVERSAL IMPEDANCE BRIDGE




SERIAL NUMBER: _____

PART NUMBER: 13202

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# SECTION I

# INTRODUCTION

## 1.1 DESCRIPTION

The esi® Model 250DE Impedance Bridge is an instrument that measures resistance, inductance, capacitance, and the dissipation factor (D) and the storage factor (Q) of inductors and capacitors.

The instrument is battery operated and completely portable. An internal generator supplies ac and dc, and an internal solid-state ac-dc detector indicates bridge balance.

Figure 1-1 is a simplified schematic diagram of the instrument in each of the four modes of operation: resistance, capacitance, and series and parallel inductance.

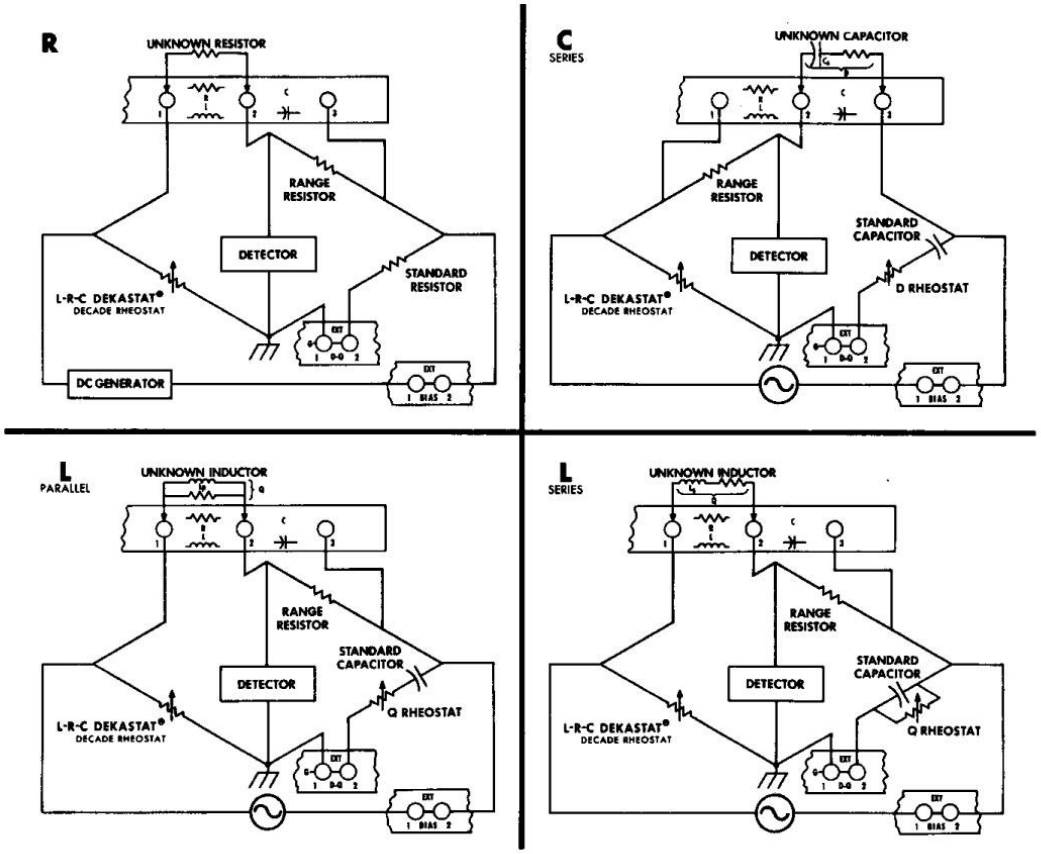
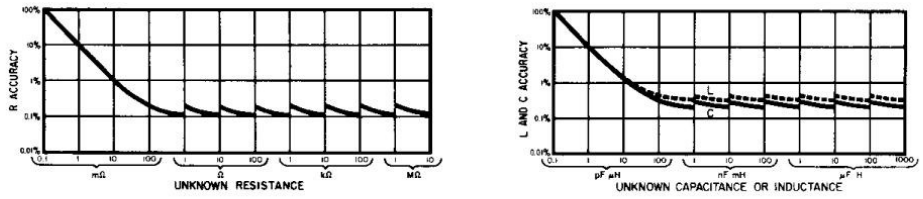
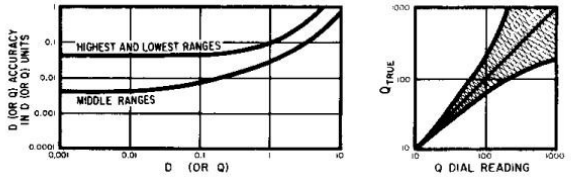



Figure 1-1. Simplified Schematic Diagrams




The specified accuracy for measurements of resistors, Low-loss inductors and capacitors.

The specified accuracy for measurements of D and Q.




The accuracy of inductance and capacitance measurements is influenced by the D and Q value. This curve shows the accuracy to be expected at various D and Q values.

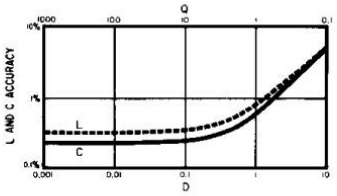



Figure 1-2.