

**A LABORATORY VOLTAGE STANDARD
FOR 1 MHz TO 1000 MHz**

A - T VOLTMETER MODEL 390

Attenuator-Thermoelement

VOLTAGE RANGE:

10 Volts to 300 Volts at 10 MHz
1 Volt to 300 Volts at 100 MHz
0.5 Volt to 30 Volts at 1000 MHz

FREQUENCY RANGE: 1 MHz to 1000 MHz

ACCURACY: Less than 1% deviation from National Bureau of Standards calibration for period of at least a year.

ACCESSORY: NBS-designed Tee adapter, Ballantine Model 2390, supplied with each Model 390.

APPLICATIONS

The Ballantine Model 390 A-T Voltmeter finds its major use as a laboratory reference standard voltmeter which may be used to calibrate ac voltmeters or signal generators operating in the range of 1 MHz to 1000 MHz. Of course it may also be used as a high level rf voltmeter or monitor with local or remote indication. It has no vacuum tubes and no solid state components, except for a UHF thermocouple. This partly accounts for its excellence as a long-term stable laboratory standard instrument.

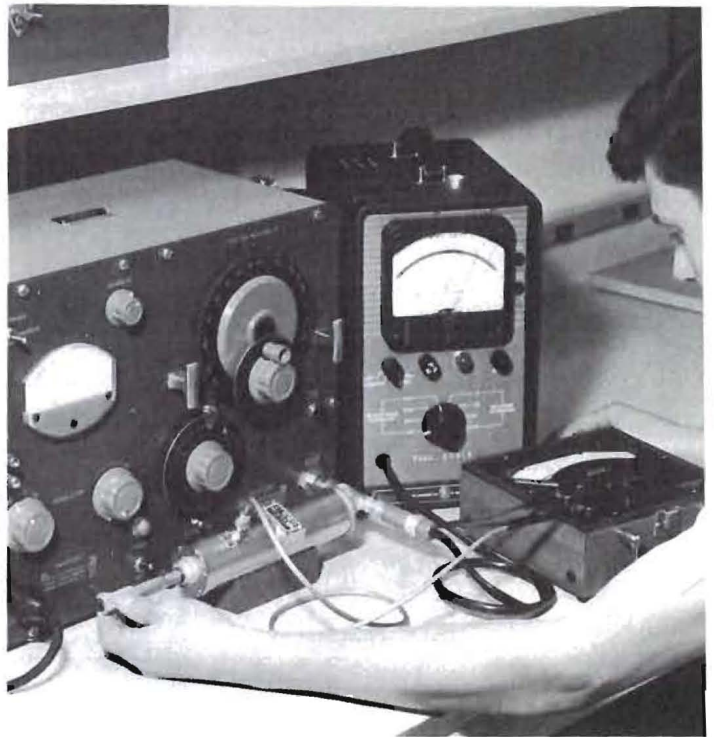
Model 390 A-T Voltmeter should be considered complementary to the Ballantine Model 440 Micropotentiometers which are used to calibrate voltmeters and ac voltage sources from 17 microvolts to 1.4 volts at frequencies up to 900 MHz.

Model 390 A-T Voltmeter should also be considered complementary to the Ballantine Model 393 HF Transfer Voltmeter which is used to calibrate voltmeters and ac voltage sources from 1 volt to 200 volts at frequencies up to 30 MHz. The accuracy of Model 393 is better than for Model 390 at corresponding voltages and frequencies but is limited to 30 MHz, or to 50 MHz with special calibration.

DESCRIPTION

Model 390 A-T Voltmeter is based on designs of Myron C. Selby and L. F. Behrent of the National Bureau of Standards. Its manufacture by Ballantine Laboratories is licensed under patents of the U. S. Government.

This instrument consists of an adjustable waveguide-below-cut-off attenuator feeding a UHF vacuum thermocouple. The dc output of the thermocouple is read on an auxiliary microammeter or microvoltmeter. The unknown signal is connected to the input electrode, and the micrometer setting of the



Model 390 A-T Voltmeter may be used to check calibration of an RF Voltmeter or of a signal generator.

attenuator is adjusted to produce a specified output from the thermocouple. The value of the unknown voltage is then obtained from the calibration chart which shows the input voltage for all settings of the micrometer at the frequency of measurement.

Model 390 A-T Voltmeter is designed to reproduce its calibration accuracy to within $\pm 1\%$ for periods of at least a year from the date of its calibration. The stability and long-term reliability of this instrument are the result of the simplicity of its design, the choice of stable, passive circuit elements, and the care taken in the fabrication of its component parts.

The barrel of the variable waveguide-below-cut-off attenuator, for example, is machined from a special casting, then plated and lapped to a final finish. The movable electrode and thermocouple are mounted on a machined carriage that slides inside the attenuator barrel on six nylon pins and two sets of plated finger stocks. The carriage assembly is driven by a two-inch micrometer, calibrated in ten-thousandths of an inch, and coupled to it by means of a spring and ball-bearing arrangement. The thermocouple itself is an insulated type made especially for ultra high-frequency use.

After assembly, each Model 390 A-T Voltmeter is carefully inspected and heat-cycled for one month to remove any mechanical stresses prior to calibration.

Ballantine Laboratories, Inc.

CALIBRATION

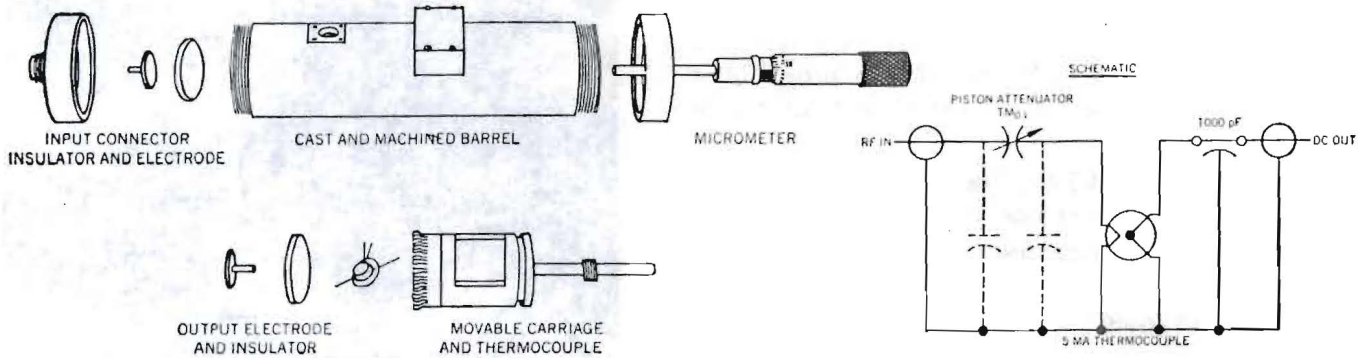
Each Model 390 instrument must be calibrated and certified by the National Bureau of Standards, Boulder, Colorado. NBS will supply a family of data showing frequency, microammeter setting and voltage. This calibration will be accurate to within $\pm 1\%$ for at least one year.

In order that there shall be minimum error, a 0-200 microampere 5 ohm dc meter, having a mirror-backed scale and as little pivot friction as possible, must be furnished the National Bureau of Standards with the A-T Voltmeter to be

calibrated. A connecting cable is supplied with each instrument which should be sent to NBS along with the instrument and microammeter.

If the required dc microammeter is to be provided by Ballantine, we will supply the Sensitive Research Model S meter with 1 millivolt full scale, an internal resistance of 5 ohms, and $\frac{1}{2}\%$ accuracy.

If a customer prefers to have the Model 390 calibrated by NBS in terms of open circuit voltage from the thermocouple, this should be so specified. In this case it will not be necessary to supply the above-mentioned microammeter.



PRICES AND ORDERING INFORMATION

Prices quoted below are net, f.o.b. Boonton, N. J. and are subject to change without notice. They do not include state or local taxes where applicable. Prices do not include charges for calibration and certification by the National Bureau of Standards. Any such calibration charges plus shipping costs will be billed to the customer at Ballantine's cost.

Model 390 A-T Voltmeter,
1 MHz to 1000 MHz complete with
Model 2390 Tee AdapterPrice \$1,925.

Model S Sensitive Research Meter 1 mV,
5 ohms, $\frac{1}{2}\%$ accuracyPrice \$275.

Ballantine cannot quote price and time for calibration by NBS, but an estimate by NBS is approximately \$1100 to 400 MHz, \$1600 to 1000 MHz, and 4 to 6 weeks for calibration.

Please indicate on purchase order if Ballantine is to arrange for the NBS calibration; otherwise the instrument will be shipped direct to the customer.



Supplied in Mahogany Storage Case as Shown approximately 1/5 Actual Size.

BALLANTINE LABORATORIES, INC.

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