



# OPERATING INSTRUCTIONS

FOR

VACUUM TUBE VOLT METER

MODEL 208



**MANUFACTURING COMPANY**

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## GENERAL DESCRIPTION

The Seco Model 208 VTVM is especially designed for the electronic technician. It has a sloping front meter which is easy to read and provides 7 a-c, 7 d-c and 7 ordinary OHMS ranges -- PLUS -- a special RETMA (Electronic Industries Association) ohms scale for extra fast checking of these coded values and their tolerance limits. The function selector switch is a specially designed "shift lever" which allows change of function without looking. The two most often used functions, PLUS D-C and OHMS are at the two extremities of the switch. The color of the test lead to be used is also indicated opposite each function.

The input resistance on all d-c ranges is 11 megohms, which is high enough to prevent loading of most circuits under test. A one-megohm isolation resistor is incorporated in the d-c test probe. An additional feature, exclusive with the Seco 208, is a separate terminal for connecting a "high voltage" probe which extends the d-c voltage range from 1500V to 50,000V, without disconnecting the regular probes and provision is made for measuring a-c line volts by turning the OFF-ON switch to LINE VOLTAGE. Facilities that increase the versatility and ease of operation include zero-center indication for measuring minus and plus d-c volts and measuring tolerance of RETMA coded resistors.

## SPECIFICATIONS

Seven ranges d-c volts: 0-1.5, 5, 15, 50, 150, 500 and 1500 full scale.

D-c input resistance is 11 megohms on all ranges.

Circuit is a balanced bridge using a twin triode.

Seven ranges a-c rms volts: 0-1.5, 5, 15, 50, 150, 500 and 1500 full scale.

Seven ranges of ordinary ohms with 10 ohms center X1, X10, X100, X1000, X10K, X100K, X1 megohms. Measures 0.1 ohm to 1000 megohms with internal battery.

Seven special ranges of RETMA (EIA) calibrated ohms. Same ranges as for ordinary ohms but calibrated in standard color-coded resistance values and their tolerance limits.

Accuracy is within three percent on all scales.

Meter is a 4-1/2-inch, 200-microamp movement with burn-out protective circuit.

Multipliers are one-percent, film-type precision resistors.

Tubes used are 12AU7 twin triode in meter bridge; 6AL5 twin diode voltage doubler a-c rectifier.

Case dimensions are 5-1/4 by 8-1/2 by 3-1/2 inches high.

Shipping weight is five pounds.

Furnished with 40-inch test leads with slim probes and a common lead with clip.

Supplied with a stand for shelf or wall mounting.

Power requirements are 105 to 125 volts, 50 to 1200 cycles a. c.

Can also be supplied for operation on 220 volts, 50-1200-cycle current.

SATISFACTORY OPERATION IS OBTAINABLE with the Seco 208 over the full range of popular commercial power frequencies. No recalibration of the VTVM is necessary at 60, 400 or 800 cycles. Slight readjustment of the "line voltage" calibrator may be required in some instances in that the indicated output will vary slightly with frequency as well as waveform of the supply.

High-voltage probes suitable to extend d-c range to 50,000 V are:

\*Eico HVP or HVP-2

\*RCA WG-289

#### FUNCTION OF CONTROLS AND RECEPTACLES

##### OFF-ON SWITCH:

Two functions: (1) turns power ON and (2) when turned to "line" voltage makes direct a-c line voltage measurements. NOTE: Effective meter damping is obtained in the OFF position. Therefore, this switch should be in this position when transported or shipped.

##### FUNCTION SELECTOR:

Selects plus or minus d-c volts, a-c volts and ohms. Also selects proper probe and disconnects the unused one.

##### RANGE SELECTOR:

Permits choice of range for desired voltage or resistance measurements.

##### ZERO ADJ KNOB:

Used to position meter pointer at left-hand "0" or when FUNCTION selector is set to VOLTS, to zero-center "- 0 +" position.

##### OHMS ADJ KNOB:

Used to position meter pointer at extreme right line INF on R (ohms) scale.

##### AC-DC-OHMS RECEPTACLE:

Connection for AC, DC and OHMS cable.

##### HIGH VOLTAGE RECEPTACLE:

Connection for HV probe. Permits high voltage measurements without removing regular cables. This same terminal also accommodates high frequency RF probes.

CABLE:

Black . . . . . Common or ground  
Red . . . . . Ohms and a-c volts  
Gray . . . . . D-c volts

OPERATING INSTRUCTIONS

PRELIMINARY ADJUSTMENTS:

1. Connect volt-ohm cable to AC-DC-OHMS terminal. Locking ring of connector must be screwed tight to assure good ground connection.
2. Plug power cord in an outlet supplying 105-125 volts a. c. , 50 cps.
  - a. Turn power switch to ON and allow ten minutes for instrument to reach stabilized operation.
  - b. Set FUNCTION selector to PLUS VOLTS.
  - c. Set meter pointer to left-hand 0 with ZERO ADJ knob.
  - d. Turn OFF-ON knob to LINE VOLTAGE. Line voltage is indicated directly on the meter. Multiply the reading on the 0-15V scale by 10. NOTE: The FUNCTION and RANGE selector may be in any position.
  - e. Turn OFF-ON-LINE VOLTAGE switch back to ON position.
  - f. Set FUNCTION selector to OHMS. The meter pointer should move to full scale.
  - g. Use OHMS ADJ knob to position meter pointer on last line INF on R scale.
  - h. Short OHMS probe to ground cable. Meter pointer should be on left-hand "0".

When instrument is thoroughly warmed up, switching function selector and range selector throughout their ranges should have little effect on the meter pointer at the left-hand zero on the scales. However, when function selector is set to AC and range selector to 1.5V, stray a-c fields may cause the meter pointer to shift from zero. Readjust zero knob, with RED probe connected to ground clip, if necessary.

## D-C VOLTAGE MEASUREMENTS:

CAUTION: Although the meter is protected against burn-out under ordinary conditions, it is good practice to start with a range higher than the voltage expected to be measured. To measure d-c voltages, proceed as follows:

1. Set FUNCTION selector to PLUS DC VOLTS or to MINUS DC VOLTS, as required.
2. Set RANGE selector to a range higher than voltage to be measured.
3. Connect ground cable to ground side of voltage source to be measured.
4. Connect DC probe to high side of voltage source.
5. Reset RANGE selector to a position which gives reading on center half of scale, whenever possible.

## ZERO-CENTER OPERATION:

Zero-center operation permits observation of either polarity positive or negative d-c volts.

1. Set FUNCTION selector to PLUS DC VOLTS.
2. Rotate ZERO ADJ knob to position meter pointer to center "- 0 +".
3. Set RANGE selector to a position which permits meter pointer to remain on scale when test voltage is applied.
4. After test reading, set RANGE selector to lowest position which permits meter pointer to remain on scale.

## RESISTANCE MEASUREMENTS.

Remove all power from equipment under test (preferably unplug from a-c receptacle) before making resistance measurements so that no voltage is present.

1. Set FUNCTION selector to OHMS.
2. Short OHMS probe to ground cable. Use ZERO ADJ knob to position meter pointer to left-hand 0, if necessary.
3. Separate OHMS probe from ground cable. The meter pointer should deflect to full scale. Use OHMS ADJ to position meter pointer on last line, INF on R scale, if necessary.

4. Connect ground cable to one terminal of the resistance to be measured.
5. Touch OHMS probe to other terminal of resistance to be measured.
6. Set RANGE selector to give a convenient deflection on the R scale.
7. Multiply reading on the R scale by factor indicated on RANGE selector.

CAUTION: Low-current, low-resistance devices such as meter movements and thermocouples may be damaged unless a range above "R  $\times$  10" is used. At "R  $\times$  1" and "R  $\times$  10" positions, the Seco 208 applies up to 1.5V to resistance under measurement.

When checking low-resistance devices, do not leave the ohmmeter leads connected for any length of time. Make check as short as possible or the device may be damaged.

Do not touch tip of OHMS probe with fingers when measuring resistance as false indications may result.

#### MEASURING RESISTANCE VALUES ON RETMA (EIA) SCALE

The RETMA scale on the Seco 208 is an added convenience used to check coded resistors with a  $\pm 10$  percent and  $\pm 20$  percent tolerance.

TO USE THE RETMA SCALE SEE THE FOLLOWING EXAMPLE:

To check a 2200-ohm resistor that has a ten-percent tolerance rating, the RANGE selector is set to "R  $\times$  100". The meter pointer should fall near the 22 mark for a 2200-ohm resistor. If the meter pointer deflects to the graduation between 22 and 27, the resistor would be considered to be ten percent high in value. If it deflects to the graduation between 18 and 22, it would be considered as ten percent low in value.

To check a 2200-ohm resistor that has 20-percent tolerance, the meter pointer must deflect to not more than 27 (for plus 20 percent) and not less than 18 (for minus 20 percent).

EXAMPLE NO. 2 SHOWING HOW TO USE THIS SCALE:

To check a 6800-ohm resistor that has a 20-percent tolerance limit, set the RANGE selector at "R  $\times$  1000". The meter pointer should deflect somewhere near 6.8, and definitely between 5.6 and 8.2 on the ten-percent scale. These, then, are the tolerance limits for 20-percent resistors.

A 6800-ohm, ten-percent resistor must fall between the two small unlabeled graduations adjacent to 6.8. These are the tolerance limits for a ten-percent resistor.

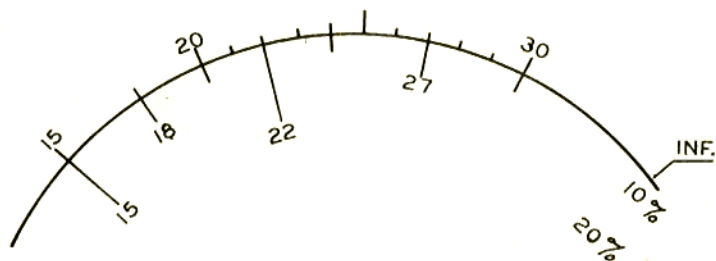


Figure 1. Section of RETMA (EIA) Ohms Scale



#### A-C VOLTAGE MEASUREMENTS:

1. Set FUNCTION selector to AC.
2. Set RANGE selector to a position somewhat higher than anticipated voltage to be measured.
3. Use ZERO ADJ knob to set meter pointer at left-hand 0, if necessary.
4. Connect ground cable to ground side of voltage source and touch AC probe to high side of voltage source.
5. Reset RANGE switch as necessary.

#### HIGH VOLTAGE MEASUREMENTS:

High voltage measurements are conveniently made with the Seco 208 without removing the AC-DC-OHM cable. Measure the high voltage as follows:

1. Connect high-voltage probe to high voltage receptacle.
2. Set FUNCTION selector to PLUS DC VOLTS.
3. Set RANGE selector to either 150V or 500V. Multiply reading on voltage range by HV probe multiplying factor. (See information on HV probes.)
4. Connect high-voltage probe ground cable to ground side of voltage source.
5. Touch tip of high-voltage probe to high side of voltage source.

#### HIGH FREQUENCY RF MEASUREMENTS:

Connect a suitable HIGH FREQUENCY RF probe to receptacle labeled HIGH VOLTAGE. Read rms voltage direct on the proper scale.

#### SUGGESTIONS AND TIPS FOR GETTING THE MOST AND BEST USE FROM YOUR SECO VTVM MODEL 208

The d-c volt range of the Seco 208 is from 0.02V to 1500V in seven overlapping ranges read on two easy-to-read scales. To extend the range beyond 1500V, using your existing high-voltage probe, examine or measure the resistance of the probe and label the barrel of the probe with its multiplier number.

**EXAMPLE:** If the probe has an 1100-megohm resistor in it, the multiplier, when used on the Seco 208 is:

1100 MEG resistance (probe) divided by 11 MEG equals 100. The multiplying factor then is 100 times the meter scale reading. It is suggested that you label the barrel of the probe "multiply by 100".

The 150V and 500V ranges are generally used in testing of TV power supplies. Multiply the reading by the multiplier as explained above. (See Specifications for suitable HV probes.)

#### USING THE A-C VOLTMETER:

The Seco 208 is designed and calibrated to read rms volts and its accuracy is as stated at 60 cps. It is essentially flat in response throughout the audio-frequency range as well as radio frequencies well above 2 mc. When an auxiliary crystal-diode probe is used, the usable frequency range can be extended to 250 mc or higher depending on probe design.

Rms voltage readings as well as peak-to-peak voltage measurements may be taken by multiplying the rms scale reading by 2.82 in most often encountered low frequency service.

#### IMPORTANT NOTES:

1. Reliable a-c voltage reading can be assured only if the frequency pass limits of the voltmeter are not exceeded.
2. The impedance of the circuit under test must be lower than the impedance of the voltmeter. For the Seco 208 this will average about 1.3 megohms up to 2 megacycles.
3. Peak-to-peak voltage measurements should always be made in conjunction with a good scope having suitable broad band amplifiers. The voltmeter readings alone do not have any significant value, because distortion of every conceivable type may actually be present and still not detectable.

When sine-wave voltages are measured with the Seco 208, rms voltages are read direct from the scale. Multiply by 2.82 to obtain the peak-to-peak value.

**EXAMPLE:** If the RANGE selector is set to 15V and a sine 10 rms V is applied to the instrument, the meter pointer will indicate 10 rms V. Therefore, 2.82 times 10 rms V equals 28.2 peak-to-peak volts.

Rms voltage readings are valid only for sine-wave sources. Peak-to-peak readings obtained by multiplying the rms voltage scale reading by 2.82 are valid whether sine wave or complex wave. However, the upper frequency pass limit of the instrument will require higher multiplying factors as the test frequencies approach the upper pass limit.

The above facts clearly reveal that peak-to-peak voltage measurements are of little practical value unless made in conjunction with scope observations.

#### MAINTENANCE

- A. Remove the six Phillips head screws holding the bottom plate for access to the tubes and adjustments.
- B. Should replacement of any components become necessary, parts equivalent in all ways to those listed on the schematic should be used.
- C. The type 12AU7 tube should be replaced when the d-c range cannot be properly set to ZERO even after reasonable warmup time. When a new tube is installed in the instrument, it is necessary to age the tube for 24 hours. This can be done as follows: age tube in a tube tester by inserting tube in socket and applying 15V to the filament circuit only, or it may be aged by leaving VTVM on continuously for 24 hours. The calibration should be checked after this period. In case ZERO center adjust cannot be reached, a new tube should be tried.
- D. If it should be necessary to replace the 6AL5 tube, the following procedure should be used.
  1. The new 6AL5 should be aged in the same manner as the 12AU7 (except at 7.5 volts).
  2. Adjust the a-c balance calibrator potentiometer as explained under heading "Recalibration".
- E. The 1.5V cell should be replaced when OHMS ADJ knob will not set meter pointer to full scale. Do not leave exhausted battery inside case or chemicals from deteriorated battery may damage components.

#### RECALIBRATION:

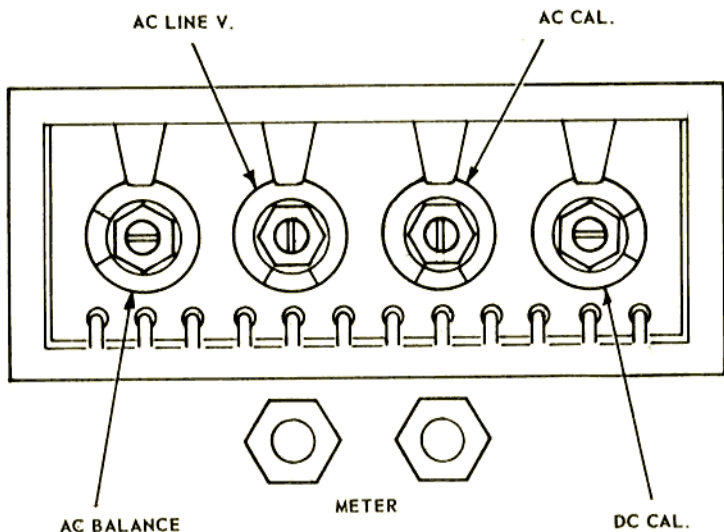
Recalibration is seldom necessary even when tubes are replaced. However, if it becomes necessary, proceed as follows: (NOTE: Location of calibrating controls can be found by referring to Figure II.)

### AC BALANCE:

1. Turn power knob to ON and allow the Seco 208 to warm up for at least 30 minutes.
2. Set FUNCTION selector to PLUS DC.
3. Set RANGE selector to 1.5V.
4. Short DC probe to ground lead.
5. Rotate ZERO ADJ knob to position meter pointer at left-hand "0".
6. Move FUNCTION selector to AC.
7. Short AC probe to ground cable.
8. Turn AC BALANCE (Figure I) to position meter pointer at left-hand "0".

### AC CALIBRATION:

1. Set FUNCTION selector to AC.
2. Set RANGE selector to 5V.
3. Touch AC probe to hot end of filament supply. Use this voltage as a reference if no other accurate known voltage is available. This 4.7 volts is within plus or minus five percent at 117V input.
4. Turn AC CALIBRATE control until meter pointer indicates 4.7V.



#### DC CALIBRATION:

1. Set FUNCTION selector to PLUS DC.
2. Set RANGE selector to 5V.
3. Turn DC CALIBRATE until meter pointer indicates 1.55V while testing a fresh standard dry cell.

#### LINE VOLTS:

1. Set FUNCTION selector to PLUS DC.
2. Use ZERO ADJ knob to position meter pointer at left-hand "0".
3. Turn OFF-ON switch to LINE VOLTS.
4. Turn LINE VOLTS CALIBRATE to read a known line voltage between 110 and 125V AC.

#### NOTES ON MOUNTING THE SHELF BRACKET

Most technicians prefer to operate their test equipment as close to their work as possible. It was with this fact in mind that the "lay down sloped meter" design was developed. However, each Seco 208 comes supplied with a metal mounting bracket for securely holding the instrument when used on a shelf or mounted on a wall.

The mounting bracket is especially designed to provide utility and also safeguard against pulling the instrument off the shelf. The instrument must be lifted up and out to remove it from the bracket.

For shelf mounting place the bracket close enough to the edge of the shelf so that the jacks will clear sufficiently. Fasten down with two wood screws.

For wall mounting fasten down with two screws using the mounting holes on the back.





SECO

## WARRANTY AND RETURN INSTRUCTIONS

SECO MFG. CO. is vitally interested in your realization of maximum performance from your instrument.

SECO MFG. CO. warrants each instrument and every other piece of equipment manufactured by it to be free from defects in material and workmanship. This warranty is limited to making good at its factory any device which shall, within 90 days after date of purchase, prove to be defective.

It is necessary that the following do's and don'ts be strictly observed so that we may assure you prompt and efficient service.

1. Register your purchase with us immediately upon purchase of instrument.
2. Do not attempt to repair it yourself as this will obviously void our agreement stated herein.
3. Write us FIRST with details of your problem. We will submit you "authorization to return".
4. Wait for the reply to your letter. It will come promptly with instructions on "How to Pack" and "How to Ship".

Evidence of misuse or rough handling will void the above warranty.



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# **K4XL's** **BAMA**

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