



**MODEL TS-113
VOLT-OHM-MILLIAMMETER**

Operator's Manual



WARNING

**READ AND UNDERSTAND THIS MANUAL
BEFORE USING THE INSTRUMENT**

Failure to understand and comply with the WARNINGS and operating instructions can result in serious or fatal injuries and/or property damage

SAFETY SYMBOLS

This Operator's Manual contains special caution and warning headings which alert the user to check hazardous operating and servicing conditions. These headings appear throughout this manual where applicable, and are defined below. To ensure the safety of operating performance of this instrument, these instructions must be adhered to.

WARNING

This **WARNING** sign denotes a hazard. It calls attention to a procedure, practice or the like, which if not correctly performed or adhered to, could result in personal injury.



This **WARNING** sign denotes a hazard. It calls attention to a procedure, practice or the like, which if not correctly performed or adhered to, could result in personal injury.

WARNING

This instrument is designed to prevent accidental shock to operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely before making any measurements. Failure to follow directions can result in serious or fatal accident.

SHOCK HAZARD: As defined in IEC-1010-1 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, a shock hazard shall be considered to exist at any part involving a potential in excess of 30 volts rms (sine wave) or 42.4 volts DC or peak where a leakage current from that part to ground exceeds 0.5 MIU (Measurement Indication Units) when measured with an appropriate instrument as defined in Section 6.3.1.2 Annex A of IEC-1010-1.

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1. INTRODUCTION

The Simpson TS-113 Volt-Ohm-Milliammeter (hereafter referred to as the TS-113 or the Instrument), is a rugged, reliable instrument which has been designed specifically for the widest possible range of electrical measurements associated with the RAILROAD SIGNALING and COMMUNICATIONS field. In construction and general principle it follows closely the proven Simpson pattern which is based on the experience of many years of successful multimeter manufacture.

Among its special features are provisions for:

Low insertion loss AC current measurements using an internal current transformer.

“ON” time measurement at any rate in excess of 30 pulses per minute.

An adjustable “Pointer Stop” which facilitates observation of “peak” readings of pulsating voltage or current on coded track.

A current-limiting diode preventing meter movement overload beyond acceptable limits.

SUPPLIES AND ACCESSORIES

All supplies and accessories required to operate the TS-113 are supplied with the Instrument and are listed in Table 1.

Table 1
Items & Accessories Furnished with Instrument

| Qty. | Description | Part No. |
|-------------|---|-----------------|
| 1 | Carrying Case Black | 00834 |
| 1 | Carrying Case Yellow (Optional) | 00832 |
| 1 | Test Lead Set, Pair of 4' Flexible Color-Coded Ends with Banana Plug & Insulated Clip | 6-117744 |
| 1 | Operator's Manual | 6-117753 |
| 1 | * 1.5 Volt D Cell, NEDA 13A, Alkaline | |
| 2 | * 9V NEDA 1604A, Alkaline | |
| 1 | * 2A Fuse, Littelfuse 3AG 2A, or equal | |
| 1 | * 2A Cartridge fuse (Littelfuse BLS 2 600V or Bussman BBS 2A) | |

*** Batteries and Fuses are standard items from retail store**

TECHNICAL DATA

Table 2 lists the technical data for the TS-113.

DC RANGES

| VOLTAGE | CURRENT |
|------------|------------|
| 0 - 0.25 V | 0 - 15 mA |
| 0 - 0.6 V | 0 - 60 mA |
| 0 - 3 V | 0 - 300 mA |
| 0 - 15 V | 0 - 1.5 A |
| 0 - 60 V | 0 - 6 A |
| 0 - 150 V | 0 - 30 A |
| 0 - 300V | |
| 0 - 600V | |

SENSITIVITY
1,000 ohms/volt

INSERTION LOSS (mV drop)
250 mV all ranges

ACCURACY: $\pm 2\%$ of full scale (10-100% of range) all ranges except 250mV DC which is $\pm 1\%$ of full scale

AC RANGES

| VOLTAGE | CURRENT |
|-----------|----------|
| 0 - 3 V | |
| 0 - 15 V | |
| 0 - 60 V | 0 - 6 A |
| 0 - 150 V | 0 - 30 A |
| 0 - 300 V | |
| 0 - 600 V | |

SENSITIVITY
300 ohms/volt

INSERTION LOSS (60 Hz)
250 mV

ACCURACY: $\pm 3\%$ of full scale (20-100% of range) all ranges, pure sine wave

RESISTANCE RANGES:

- R X 1 = 0 - 100 Ω (6 Ω center)
- R X 100 = 0 - 10,000 Ω (600 Ω center)
- R X 1K = 0 - 100,000 Ω (6,000 Ω center)

ACCURACY: Better than $\pm 5^\circ$ of arc on Rx1, and $\pm 2.5^\circ$ of arc for Rx100 and Rx1K range. Some improvement possible by careful zero setting.

PERCENT “ON” TIME RANGE:

0-100%. Effective for 30 pulses per minute or higher. “FAST” and “SLOW” ranges are identical except for meter ballistics.

ACCURACY: $\pm 2\%$ of full scale (10-60% “ON” time range for 30 pulse rate (0.5 Hz) and approaching 10-100% for 180 pulse rate. (3 Hz))

SIZE:

| Width | Length | Depth |
|-------------------|-----------------|--------------|
| 5-1/4” (133.4 mm) | 7-1/8” (181 mm) | 3” (76.2 mm) |

WEIGHT:

2-1/2 lbs. (1.14 kg)

2. INSTALLATION

The following instructions explain the installation and shipping of the TS-113. Included are unpacking and inspection procedures, warranty, shipping, power source requirements and operating position.

UNPACKING AND INSPECTION

Examine the shipping carton for obvious signs of damage. If damage is noted, notify the carrier and supplier and do not attempt further use of the instrument. If Instrument appears to be in good condition, read Operator’s Manual in its entirety. Become familiar with the Instrument as instructed in the manual, then proceed to check the electrical performance as soon as possible. Also, check that all items are included with the instrument (Table 1). After unpacking the Instrument, a 1.5 V battery and the 9V batteries (Qty. 2) may be found in the box with the Instrument and test leads.

WARRANTY

The Simpson Electric Company warranty card is included with each instrument. Read it carefully prior to requesting any warranty repairs.

NOTE: For assistance of any kind, contact your nearest Authorized Service Center, or visit www.simpsonelectric.com for a list of Service Centers.

SHIPPING

Pack the Instrument carefully and ship it prepaid and insured to the proper destination.

CONTROLS, JACKS AND INDICATORS

All operating and adjustment controls, jacks and indicator for the TS-113 are described in the following pages. Become familiar with each item prior to operating the Instrument.

Notes:

FRONT PANEL DESCRIPTION

The Instrument's highly legible markings are designed for easy, accurate readings. The 4" red knife-edge pointer and scale mirror, permit improved resolution of readings and elimination of parallax errors.

The dial itself is color coded to match the range and function switch for ease of interpretation.

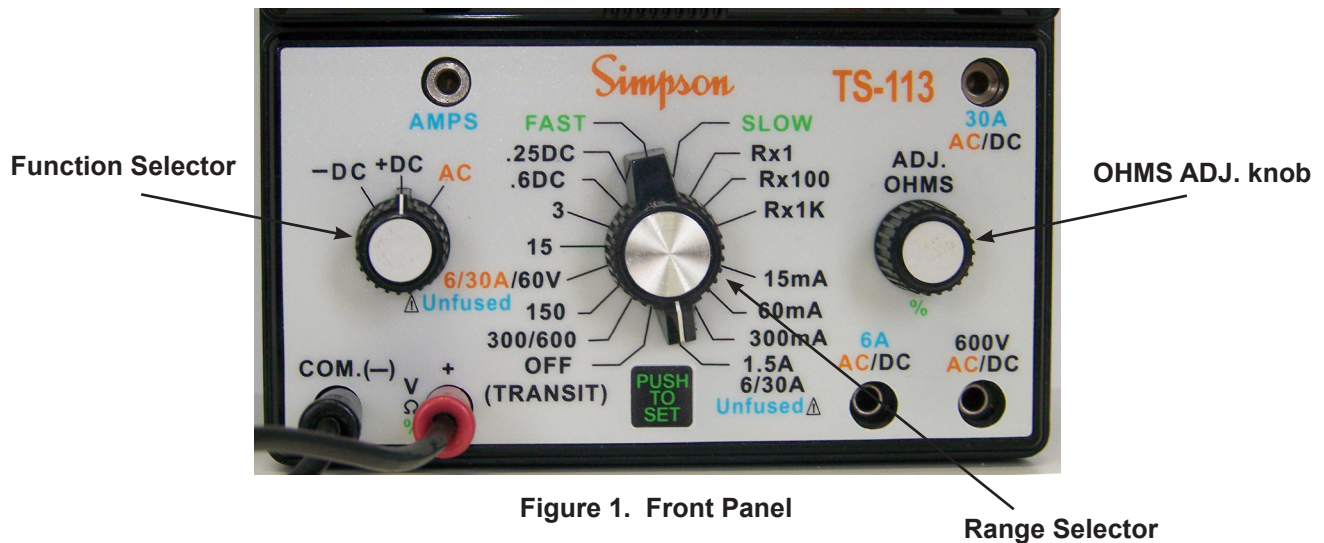


Figure 1. Front Panel

Range Selector

In the lower center of the meter cover is the adjustable pointer stop. The knob is used in peak reading determination. Travel is limited in both directions. The zero adjuster below it, rotates freely through 360°.

Six jacks provide connections for all the twenty seven direct reading ranges. Twenty one of these ranges are served by the "+" and "-" connections in the lower left corner of the panel, the remainder by the "AMP" connection and one of the two jacks (6A or 30A) on the right hand side, and the 600V jack.

The center knob rotates the range switch smoothly through a full 360°.

The panel is marked and color coded to permit easy and accurate selection of any of its positions. There is a “Transit” position for vibration protection during travel, and a blank position between ohms and mA to protect against accidentally switching between ranges.

The left knob rotates between 3 positions -DC, DC and AC.

Precise, gradual adjustment of zero ohms is made possible by the right hand knob . This control is also used to set the 100% reading for “ON” time measurements, when used together with the “Push to Set” switch. With the button depressed the right hand knob now adjusts the “ON” time full scale.

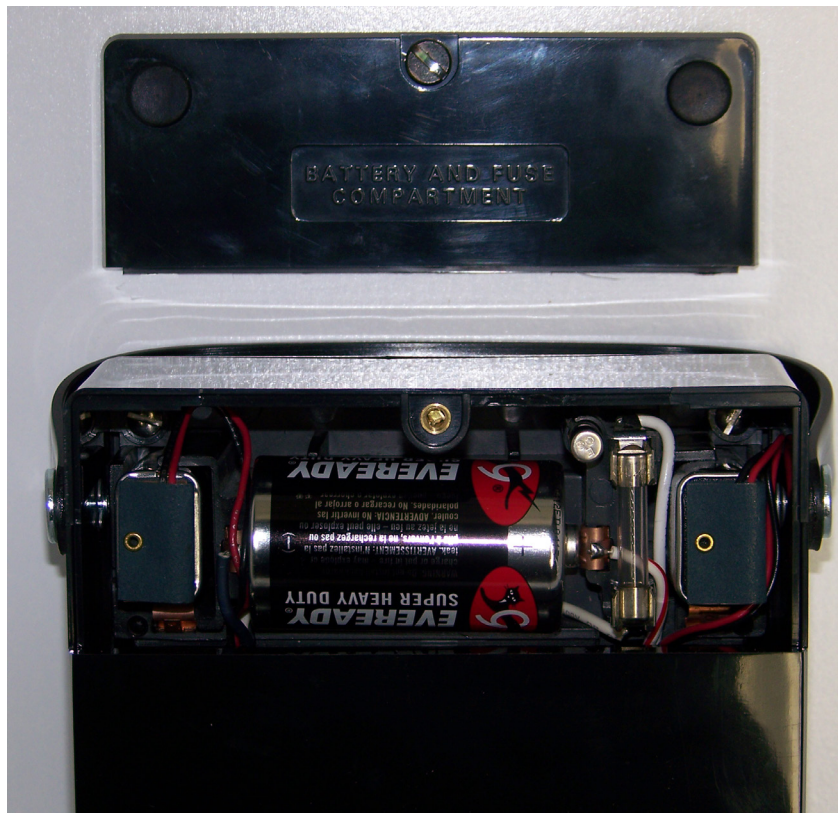


Figure 2. Rear View (Battery Cover Removed)

REPLACEABLE COMPONENTS

A 1.5 V size D battery powers all resistance-measuring ranges. The low battery voltage is aimed at preventing the accidental tripping of relays during the measurement of relay circuit resistance.

One 9.0 volt Alkaline battery powers the “ON” time measuring circuit. Other 9.0 volt alkaline powers the Rx 1K circuit.

The glass fuse unclips for fuse replacement.

Note: The rear case must be removed to replace the cartridge fuse. No other components are replaceable or serviceable by the user.

3. SAFETY PRECAUTIONS

This section of the manual contains information required to use and operate the TS-113 in a safe and proper manner.

WARNING

The TS-113 has been designed specifically for use by trained and qualified personnel working on railway signaling and communications systems. It is not intended to make measurements in heavy-duty railway equipment such as diesel-electric locomotives, railway cranes or the like. Its ranges, however, are capable of making measurements in circuits in which the available energy levels can produce dangerous arcing and explosive forces if accidentally short-circuited.

Whenever working on such circuits, the operator must take care to assure that the meter and its test leads are in good working condition, that the circuit cannot become unexpectedly shorted, that the meter controls are properly set and test leads correctly connected, and that all safety precautions are observed at all times.

The following precautions are suggestions and reminders of commonly recognized safe practices and specific hazards to be avoided and are not implied to be sufficient to ensure the safety of untrained personnel in all circumstances. Neither is the manual a substitute for technical manuals covering the equipment in which measurements are to be made. Always refer to the equipment service manual and its specific warnings and instructions and observe them as well as those contained herein. Unusual measurements under unusual conditions may require additional precautions and safety measures.

The TS-113 should only be used by personnel qualified to recognize shock hazards and trained in the safety precautions required to avoid possible injury.

- Always wear safety glasses when working in electrical circuitry.
- Do not work alone on high voltage circuits. Make certain that someone capable of rendering aid is nearby and watchful.
- Do not handle the Instrument, its test leads, or the circuitry while high voltage is being applied.
- Do not connect any terminal of this Instrument to a circuit point at which a voltage exceeding 600 volts AC or 600 volts DC may exist with respect to earth ground.
- Turn off power and discharge any capacitors in the circuit to be measured before connecting to or disconnecting leads from that circuit.
- Prior to use, check the Instrument, the accessories (if any), and the test leads for missing, damaged, deteriorated or otherwise faulty insulating parts. Do not use, or permit the use of, equipment with faulty insulation until it has been properly repaired.
- Avoid making measurements under humid, damp or other environmental conditions that could reduce the dielectric strength of the test leads or Instrument and increase the possibility of electrical shock.
- Do not change Instrument switch settings or test lead connections while the circuit is energized. A mistake could result in damage to the Instrument and possible personal injury.
- Locate all voltage sources and accessible current paths before making connections to circuitry. High voltage may appear unexpectedly or in unexpected locations in faulty equipment. An open bleeder resistor, for example, may result in a capacitor retaining a dangerous charge.
- Make certain that the equipment being worked upon is properly grounded and fuses are of a proper type and rating.
- Check and double check switch positions and jack connections before applying power to the Instrument.
- Always remain alert for low voltage circuits which may be floating at high voltage with respect to earth ground and for composite voltage (AC + DC). Such composite voltage must not exceed the Instrument's rated maximum circuit-to-ground voltage.
- Do not make electrical measurements where the air may contain explosive concentrations of gas or dust.
- When in doubt as to the range to be used, first select the highest range available. After an initial reading, the range can be changed to one that is more appropriate to the value indicated.
- This General Purpose VOM is NOT to be used to make electrical measurements on blasting circuits or blasting caps.

NOTE: The TS-113 is not waterproof and must be sheltered from rain or snow.

4. OPERATION

DC CURRENT MEASUREMENTS



Figure 3. Measuring DC Current



Note: The range selector switch position for DC serves the 1.5A, 6 A and 30 A ranges, and the correct jack must be selected. The 6A and 30A connections are unfused. Use caution when testing these high currents. Do not leave the unit measuring 30 Amps unattended, or for a long period of time as contact points can overheat rapidly.

- Set the range selector switch to one of the 4 positions shown in Fig. 3. If in doubt as to range to be used, first select the highest available range.
- Set the function switch to "DC".
- For current **less than 1.5Amps**, connect red marked lead into the "+" jack. Connect the black marked lead to the "COM (-)".
- For current **greater than 1.5 Amps**, connect the red marked lead into either the 30A or 6A jack. Connect the black marked lead into the "AMPS" jack.
- Turn off power in the circuit to be measured.
- Connect test leads in series with the circuit to be measured, with the red marked(+) lead to the positive side of the opened circuit.
- Turn on power. If necessary to change jack connections for a more suitable range, first turn off the power and discharge circuit capacitors, if any.
- Use 0-15 DCA (Blue) or 0-15 DCMA (Black) scale for the DC current readings.
- Turn off circuit power and discharge capacitors, if any, before disconnecting test leads.

AC CURRENT MEASUREMENTS



Figure 4. Measuring AC Current



Note: The 6A and 30A connections are unfused. Use caution when testing these high currents. Do not leave the unit measuring 30 Amps unattended, or for a long period of time as contact points can overheat rapidly.

- Set range switch to the orange colored "6/30A".
- Set the function switch to "AC".
- Connect black marked lead into "AMPS" jack, and the red marked lead into "6A" or "30A" jack as shown in Fig. 4. (When in doubt, first select the "30A" jack).
- Turn off power in the circuit to be measured.
- Connect the test leads in series with the circuit to be measured (either polarity).
- If necessary, to change the range you need to change the jack from blue colored "30A" to the blue colored "6A", then turn the power "ON" in circuit to be measured.
- Read current value using the 0-15 ACA orange scale.
- Turn off circuit power and discharge circuit capacitors, if any, before disconnecting test leads.

WARNING

Be extremely careful when working with high voltage circuits. Do not touch the Instrument or test leads while power is on in the circuit being measured. Do not exceed 600 volts.

PEAK READINGS OF ANY FUNCTION

To determine the peak value of a visibly fluctuating reading, slowly rotate the pointer stop knob clockwise against the pointer until pointer motion can no longer be detected. The pointer is then indicating the peak value of the energy being applied.



Figure 5. Measuring AC or DC Volts

WARNING

Be extremely careful when working with high voltage circuits. Do not touch the Instrument or test leads while power is on in the circuit being measured. Do not exceed 600 volts.

DC OR AC VOLTAGE MEASUREMENTS

- a. Set the range selector switch between 0.25DC (or 3 VAC) and 300/600 range as shown in Fig. 5. When in doubt, first select the highest available range.
- b. Set the function switch to “DC” or “AC” as desired.
- c. Turn off power in the circuit to be measured.
- d. **For voltages less than 300V,** (Fig. 5) connect the black marked lead into the “ COM (-)” jack and the red marked lead into the “+” (V Ω %) jack.
- a. **For voltages greater than 300V,** (Fig. 5a) connect the black marked lead into the “ COM (-)” jack and the red marked lead into the “600V AC/DC” jack.
- b. Set the function switch to “DC” or “AC” as desired.
- c. Connect the test leads to the circuit to be measured. Observe polarity for DC measurements (red lead to circuit positive).
- d. Apply power. Select a lower range if appropriate.
- e. Read volts on either black scale for DC measurements or the orange scale for AC measurements.

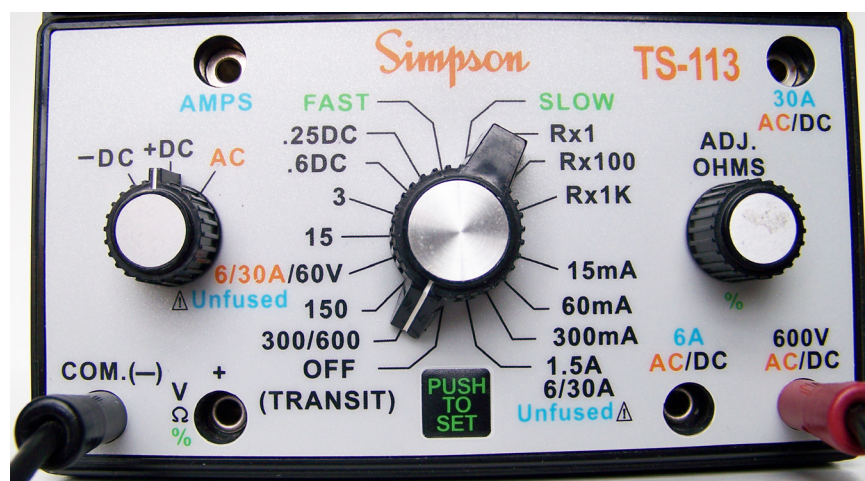


Figure 5a. Measuring High AC or DC Volts

RESISTANCE MEASUREMENTS

WARNING

Voltage applied to resistance range will cause reading errors if low and damage the Instrument if high. When making in-circuit measurements, make certain that the circuit is completely de-energized before making connections to it.

When making in-circuit measurements, circuit paths in parallel with the resistance being measured may cause reading errors. Check circuit diagrams for the presence of such components before assuming that the reading obtained is correct.

Branch and distribution circuits (120/240/480V etc.) can deliver dangerous explosive power momentarily into a short circuit before the fuse/breaker opens the circuit. Make absolutely certain that the Instrument switches are set properly, jacks are connected properly, and that the circuit power is turned off before making connections to such circuits.



Figure 6. Resistance Measurements

- Test first for the presence of an AC or DC voltage. (Refer to **Warning**).
If no voltage is present, proceed with the set up below.
- Set the range selector to “Rx1” for resistance less than 100 Ω , “Rx100” for resistance less than 10,000, or “Rx1K” for higher values. Observe correct polarity when checking DC circuit components.
- Connect leads to “COM(-)” and “+” (V%) jacks as shown in Fig. 6
- Short the lead clips.
- Adjust the “ADJ.OHMS” knob for full scale (0 ohms). Separate leads and connect to resistance to be measured.
- Read resistance on the black “OHMS” scale, above the mirror, multiplying the reading by the factor indicated by the switch setting.

PERCENT “ON” TIME MEASUREMENTS



Figure 7. Measuring Percent “ON” Time

- Set range selector to “FAST” position, and function switch to “DC”.
- Connect black lead to the (COM) jack and the red lead to the “+” (Ω V%) jack.
See Figure 7.
- Press the “Push to Set” button and adjust pointer to 100% on the green scale using the “ADJ OHMS” knob.
- Release button.
- Set range switch to “FAST” or “SLOW” position (see suggestions below) and connect leads to coded circuit. Observe correct polarity.
- Read percent “ON” time on the green (0-100%) scale. The following suggestions will be helpful:

“ON” time readings in general are taken by reading the values at the upper and lower extremes of the pointer swing as the coding contact is repeatedly made and broken, and determining the average or center reading.

“FAST” and “SLOW” positions provide a choice of meter ballistics, and the one to be selected will be determined by the pulse rate and personal preference.

In the “FAST” position, the center value stabilized quickly, but the spread between upper and lower readings will be wider, particularly with the low pulse rates.

In the “SLOW” position, time must be allowed for the reading to “settle,” but, except for the lowest pulse rate, there will be virtually no pointer oscillation, and percent “ON” time can be read directly from the scale.

5. OPERATOR SERVICING

For safety of the operator, servicing of the TS-113, other than replacement of batteries or fuses, should be referred to one of the Simpson Authorized Service Centers.

CHART FOR ALL RANGES

| Range | AC Meter Dial Cardinal Point 0-15 AC | | | | | | | |
|------------|--------------------------------------|-----|------|-------|-----|-----|-----|-----|
| | AC Volts | | | | | | | |
| | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 15 |
| 3 | DIRECT | 3V | ONLY | SCALE | | | | |
| 15 | DIRECT | | | | | | | |
| 60 | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 60 |
| 150 | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 150 |
| 300 | 40 | 80 | 120 | 160 | 200 | 240 | 280 | 300 |
| 600 | 80 | 160 | 240 | 320 | 400 | 480 | 560 | 600 |
| AC Amperes | | | | | | | | |
| 6 | 0.8 | 1.6 | 2.4 | 3.2 | 4 | 4.8 | 5.6 | 6 |
| 30 | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 30 |

| Range | DC Meter Dial Cardinal Points 0-15 DC | | | | | | | |
|-------------------------|---------------------------------------|------|------|------|-----|------|------|-----|
| | DC Volts | | | | | | | |
| | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 15 |
| 0.6 | 0.08 | 0.16 | 0.24 | 0.32 | 0.4 | 0.48 | 0.56 | 0.6 |
| 3 | 0.4 | 0.8 | 1.2 | 1.6 | 2 | 2.4 | 2.8 | 3 |
| 15 | DIRECT | | | | | | | |
| 60 | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 60 |
| 150 | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 150 |
| 300 | 40 | 80 | 120 | 160 | 200 | 240 | 280 | 300 |
| 600 | 780 | 160 | 240 | 320 | 400 | 480 | 560 | 600 |
| DC Current in Milliamps | | | | | | | | |
| 15 | DIRECT | | | | | | | |
| 60 | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 60 |
| 300 | 40 | 80 | 120 | 160 | 200 | 240 | 280 | 300 |
| DC Amperes | | | | | | | | |
| 1.5A | 0.2 | 0.4 | 0.6 | 0.8 | 1 | 1.2 | 1.4 | 1.5 |
| 6A | 0.8 | 1.6 | 2.4 | 3.2 | 4 | 4.8 | 5.6 | 6 |
| 30A | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 30 |
| 250mV | DIRECT | | | | | | | |

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Part No. 06-117753 Edition 6, 10-14