MAINTENANCE

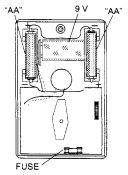
WARNING

To avoid personal harm and/or damage to the equipment, remove test leads before changing batteries, or fuse, or servicing meter.

BATTERY REPLACEMENT

This meter uses three batteries: two 1.5V "AA" batteries for the X1/X10/X1K ranges and one 9 V battery for the X10K range. The illustration below shows the location of the batteries and a protective fuse.

Test batteries when you are near the full adjustment limit of **0Ω ADJ** in any of the resistance ranges. Be sure to replace low or discharged batteries promptly. Low batteries leak corrosive acid.



1. Remove rear case, held by a single Phillips screw.
2. Note polarity and arrangement of batteries, then remove batteries and replace cover.
3. Plug black test lead into − **COM** jack, red test lead into **BATT. +** jack.
4. Set **Function/Range** to **DCV, BATT. 1.5 V** to test "AA" batteries. Discard and replace if pointer rests in **BAD** or **?** area of scale. When replacing, be sure to replace both batteries of set.
5. Set **Function/Range** to **DCV, 12 V** to test 9 V battery. Discard and replace if pointer reads less than 9 V.
6. After servicing, replace cover and securing screw.

FUSE REPLACEMENT

This meter is protected by a 250 V, 500 mA, 5 x 20 mm ceramic fuse. If the meter is inoperative, the fuse is probably blown. To replace the fuse, remove rear cover which is held by a single Phillips screw. Only replace fuse with the original type.

TEST LEADS

Periodically examine the test leads to ensure they are not intermittent or broken. Also, make sure that good contact pressure exists between the jack and receptacles. Keep contact areas clean and free from dirt.

LIMITED ONE YEAR WARRANTY

MAXTEC INTERNATIONAL CORPORATION warrants to the original purchaser that its ***BK Precision*** product, and the component parts thereof, will be free from defects in workmanship and materials for a period of one year from the date of purchase.

MAXTEC will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized ***BK Precision*** service contractor or to the factory service department, accompanied by proof of the purchase date in the form of a sales receipt.

To obtain warranty coverage in the U.S.A., this product must be registered by completing and mailing the enclosed warranty registration card to MAXTEC ***BK Precision***, 6470 West Cortland Street, Chicago, Illinois 60635 within (15) days from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

MAXTEC shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may have other rights which vary from state-to-state.

For your convenience, we suggest you contact your ***BK Precision*** distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to ***BK Precision*** Service Department, 6470 West Cortland Street, Chicago, Illinois 60635, properly packaged to avoid damage in shipment.

BK Precision Test Instruments only warrants products sold in the U.S.A and its overseas territories. In other countries, each distributor warrants the ***BK Precision*** products which it sells.

WARRANTY SERVICE

(For U.S.A. and its Overseas Territories)

1. Refer to the MAINTENANCE section of this manual for any applicable instructions.
2. If the above-indicated does not correct the problem, pack this unit securely (preferably in its original carton) or double-pack it.
3. Enclose a letter describing the problem and include your name and address. Deliver or ship prepaid (U.P.S. preferred in U.S.A.) to the nearest ***BK Precision*** authorized service agency.

For all inquiries, or if your list of authorized ***BK Precision*** service agencies has been misplaced, contact your distributor for the name of your nearest service agency, or write or phone to:

BK Precision Factory Service Operations
Precision Corporation
Segovia Circle
Placentia Ca 92870
Telephone 714-237-9220

BK PRECISION ®

1031 Segovia Circle · Placentia CA 92870

480-727-9-001D

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INSTRUCTION MANUAL

BK PRECISION ®

ANALOG MULTIMETER
MODEL 114A

SAFETY

WARNING

An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher currents are even more dangerous. Observe the following safety precautions:

1. Never apply input voltages greater than those listed in the "SPECIFICATIONS" section. Personal injury or damage to the instrument may occur.
2. This meter is not recommended for high voltage industrial use; for example, not for measurements of 440 V AC or 600 V AC industrial power mains. The unit is intended for use with low energy circuits to 750 V AC or 1000 V DC or high energy circuits to 250 V DC or AC. Accidental misuse by connection across a high voltage, high energy power source when the meter is set up for mA measurement may be very hazardous.
3. Turn equipment off before making test connections in high voltage circuits. Discharge high voltage capacitors after removing power.
4. When making voltage or current measurements in high voltage equipment, never touch equipment, meter, or test leads while power is applied.
5. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
6. Be careful to avoid touching a high voltage point. Remember that ac line voltage may be present in equipment under test (for example, at on-off switch, fuses, transformer, etc.), any time the equipment is connected to an ac outlet, even if it is turned off.
7. When removing the cover for servicing or battery replacement, remove test leads and make sure that the input is disconnected from any high voltage.
8. Use the time proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
9. When using a probe, only touch the insulated portion. Never touch the exposed tip portion.
10. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; make certain such surfaces are not damp or wet.
11. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as on-off switches, fuses, power transformers, etc., any time the equipment is connected to an ac outlet. This is true even if the equipment is turned off.
12. Some equipment with a two-wire ac power cord, including some with a polarized power plug, is the "hot chassis" type. This includes most recent television receivers and audio equipment. A plastic or wooden cabinet insulates the chassis to protect the customer. When the cabinet is removed for servicing, a serious shock hazard exists if the chassis is touched. To make measurements in "hot chassis" equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The ***B&K Precision*** Model TR-110 or 1604 Isolation Transformer, or Model 1653 or 1655 AC Power Supply is suitable for most applications. To be on the safe side, treat all two-wire ac powered equipment as "hot chassis" unless you are sure it has an isolated or earth ground chassis.
13. On instruments or any equipment with a three-wire ac power plug, only use a 3-wire outlet. This is a safety feature to keep the housing or other exposed elements at earth ground.
14. Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

SPECIFICATIONS

Accuracy specifications apply from +18 °C to +28 °C

DC VOLTS

Ranges:	0-300 mV, 3 V, 12 V, 30 V, 120 V, 300 V, 1200 V
Sensitivity:	20,000 ohms per volt
Accuracy:	± 3% of full scale

AC VOLTS

Ranges:	0-6 V, 30 V, 120 V, 300 V, 1200 V
Sensitivity:	8,000 ohms per volt
Accuracy @ 50/60 Hz:	± 4% of full scale
Frequency Response: (±1 dB)	6 V range: 40 Hz to 100 kHz 30 V range: 40 Hz to 50 kHz 120 V range: 40 Hz to 10 kHz 300 V range: 40 Hz to 5 kHz 1200 V range: 40 Hz to 1 kHz

DC CURRENT

Ranges:	0-60 µA, 3 mA, 30 mA, 300 mA, 12 A
Accuracy:	± 3% of full scale
Burden Voltage:	Less than 500 mV

RESISTANCE

Ranges:	R X 1, 0 to 2 kohms, mid scale 20 ohms R X 10, 0 to 20 kohms, mid scale 200 ohms R X 1k, 0 to 2 Mohms, midscale 20 kohms R X 10k, 0 to 20 Mohms, midscale 200 kohms
Accuracy:	± 3% of full scale
Maximum Open Circuit Voltage:	R X 1, X 10, X 1k ranges: 3V R X 10k range: 12 V
Maximum Short Circuit Current:	R X 1 range: 150 mA R X 10 range: 15 mA R X 1k range: 200 µA R X 10K range: 100 µA

dB MEASUREMENT (dB scale)

Ranges:	-10 dB to +17 dB on 6 V AC range +4 dB to +31 dB on 30 V AC range +16 dB to 43 dB on 120 V AC range +24 dB to 51 dB on 300 V AC range +36 dB on +63 dB on 1200 V AC range
0 dB Reference:	1 mW across 600 ohms

BATTERY TEST (good - bad scale)

Range:	1.5 V range for battery test only
Load:	7.5 ohms
Battery Drain:	200 mA

TRANSISTOR LEAKAGE TEST (I_{CEO} scale)

Ranges:	0 to 150 µA on R X 1k range 0 to 15 mA on R X 10 range 0 to 150 mA on R X 1 range
Accuracy:	± 5% of scale arc
Maximum Applied Voltage:	3 V, voltage measured on LV scale

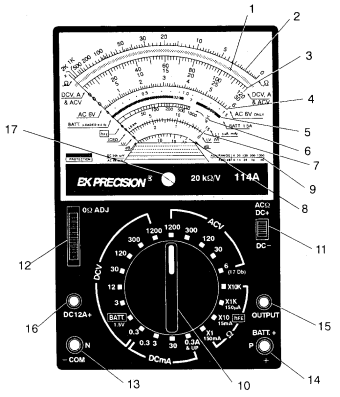
TRANSISTOR GAIN MEASUREMENT

Range:	0 to 1,000 measured on hFE scale with range switch set to R X 10
Accuracy:	± 3% of scale arc
Test Leads:	Special, supplied

GENERAL SPECIFICATIONS

Movement:	Jeweled pivots, 60 µA full scale
Scale Length:	3-1/2 inches, mirrored scale
Polarity:	+ or -, polarity reversal switch
Power Source:	Batteries: Two 1.5 V AA and one 9 V
Overload Protection:	250 volt ceramic fuse. Not for high energy power measurements above 250 volts.
Operating Temperature:	0 to + 40 °C
Dimensions: (H x W x D)	5-3/4" x 3-7/8" x 1-3/8" (147 x 99 x 35 mm)
Weight:	11 oz. (308 g) with batteries
Accessories Supplied:	Batteries Test leads, 1 red and 1 black Transistor test leads Instruction manual.
Optional Accessories:	Carrying case, LC-110

CONTROLS and INDICATORS



1. **Scale Mirror**
   Helps eliminate measurement errors caused by parallax when viewing scale.
2. **Ω Scale**
   Measurement scale for resistance readings.
3. **DCV, A & ACV Scale**
   Measurement scale for DC volts, DC amperes and AC volts above 6 volts.
4. **AC 6V Scale**
   Scale for measuring AC voltages up to 6 volts.
5. **BATT. 1.5V Scale**
   Scale for measuring condition (good/?/bad) of 1.5 volt batteries.
6. **hFE Scale**
   Scale for measuring transistor gain.
7. **I_{CEO}, LV and LI Scale**
   Measurement scale for transistor leakage.
8. **dB Scale**
   Measurement scale for decibels (dB).
9. **Conversion Table** for **dB**
   Shows compensation factors when 6 V AC range is not being used.
10. **Function/Range Selector**
    Rotary switch to select measurement range and function.
11. **ACΩ, DC+, DC- (Polarity) Switch**
    Polarity selector for DC voltage and current, must be in up position for AC and Ω measurements.
12. **0 Ω ADJust**
    Zero ohms adjust before taking resistance measurements (leads shorted).
13. **– COM Jack**
    Input for black, negative polarity (common or reference) test lead.
14. **+ Jack**
    Input for red, positive polarity, test lead for most measurements except 12 A range.
15. **Output Jack**
    Capacitively coupled to "+" jack. Allows measurement of AC voltage when superimposed on a DC voltage (such as the "output" of an amplifier). The capacitor blocks DC and passes AC above 20 Hz. It is rated to withstand 750 V.
16. **DC12A+ Jack**
    Red, positive polarity test lead input for current measurements up to 12 A.
17. **Meter Zero**
    Mechanical adjustment to set pointer of meter to exact zero position when power is off.

OPERATING INSTRUCTIONS

WARNING

Be sure to read, thoroughly understand and follow the practices given in the SAFETY section of this manual to reduce the risk of electrical shock.

GENERAL CARE and OPERATING TIPS

1. Make sure batteries are in good condition; see the MAINTENANCE section of this manual for battery replacement instructions.
2. Always view the meter pointer so that its reflection in the scale mirror is directly behind it. This eliminates parallax errors.
3. When the meter leads are removed, the pointer should be at exact zero. If needed, adjust the pointer to read zero by tapping the meter face gently while adjusting the mechanical zero screw.
4. The greatest accuracy is achieved when readings are in the upper part of the meter scale. As a general rule, select the next lower range when readings are less than half scale.
5. After completing your measurements, set the **Function/Range** switch to **ACV** and remove leads from the meter. Never leave the **Function/Range** switch in the Ω position to conserve battery power.

DC VOLTAGE MEASUREMENTS

CAUTION

Never try to measure voltages greater than 1200 V. Higher voltages could damage the meter and/or increase the risk of electrical shock.

*To prevent instrument damage, always set the **Function/Range** selector to a range higher than the maximum voltage you expect to measure. If the voltage is unknown, start with the highest range.*

1. Plug black test lead into the **– COM** jack and red test lead into the + jack.
2. Set **Polarity** selector to **DC+** or **DC–** as determined by polarity of voltage you intend to measure.

DC VOLTAGE MEASUREMENTS (cont.)

3. Set Function/Range switch to desired DCV range. If range is unknown, select 1200 V.
4. Connect black test lead to point of reference (common), red test lead to desired measuring point. The common should never exceed 600 V (DC + AC peak) with respect to earth ground.
5. Read voltage at related scale. For best accuracy, try to get a reading of at least 1/3 scale deflection.

AC VOLTAGE MEASUREMENTS

CAUTION

Never try to measure voltages greater than 1200 V. Higher voltages could damage the meter and/or increase the risk of electrical shock.

To prevent instrument damage, always set the Function/Range selector to a range higher than the maximum voltage you expect to measure. If the voltage is unknown, start with the highest range.

1. Plug black test lead into the **– COM** jack and red test lead into the + jack (plug the red test lead into the OUTPUT jack to measure only the AC portion when superimposed on a DC voltage).
2. Set **Polarity** selector to **ACΩ DC+** position.
3. Set **Function/Range** switch to desired **ACV** range. If range is unknown, select **1200 V**.
4. Connect black test lead to point of reference (common), red test lead to desired measuring point. The common should never exceed 600 V (DC + AC peak) with respect to earth ground.
5. Read voltage at related scale. For best results, try to get a reading of at least 1/3 scale deflection.

OPERATING INSTRUCTIONS

RESISTANCE MEASUREMENTS

CAUTION

Never apply a voltage to the input terminals when the resistance function is selected to avoid damage to the meter. Before taking a resistance measurement, make sure circuit under test is electrically "cold", power off and any capacitors discharged.

1. Plug black test lead into the **– COM** jack and red test lead into the + jack.
2. Set **Polarity** selector to **ACΩ**, **DC+** (up) position.
3. Set Function/Range switch to desired ohms/resistance range.
4. Short leads together firmly and verify that pointer rests on exact zero ohms. If needed, adjust the **0Ω ADJ** control to assure pointer rests on zero. Repeat this check each time range is changed. If pointer cannot be zeroed, one or both batteries may be weak. See the MAINTENANCE section of this manual to check and/or replace the batteries.
5. Connect test leads across component or circuit being measured. Obtain correct resistance value by multiplying scale reading by X factor (**X1**/**X10**/etc.) of **range selected**. For best accuracy, select a range that gives a reading as **close as possible to the zero end of the scale.**

NOTE

When making **resistance measurements**, be aware that the open circuit voltage between the **– COM** and + terminals is high enough to forward-bias typical semiconductors. This voltage is about 3V in the **X1**, **X10**, **X1K** ranges and about 12 V in the **X10K** range.

OUT-OF-CIRCUIT DIODE TESTS

The resistance function of this meter can be used to check the forward/reverse resistance ratio of diode devices. This is not a "fool-proof" test, but it's reasonably reliable in most cases. Also, see Transistor Tests for more semiconductor checks.

1. Remove diode or similar device being tested from circuit.
2. Select desired resistance range, typically **X1K**.

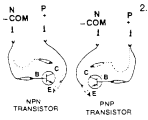
OUT-OF-CIRCUIT DIODE TESTS (cont.)

3. Connect test leads across diode, then reverse connections. Resistance ratio should be at least 10,000:1, near infinity in one direction and low resistance in other direction.
   - If meter reading is near infinity in both directions, the diode device is probably open.
   - If meter reading is very low in both directions, the diode device is probably shorted.

TRANSISTOR MEASUREMENTS

This meter provides three transistor measurements: leakage, amplification factor and good/bad condition. These measurements are made with the use of two special leads, resistance function and transistor scales of this meter. Both NPN and PNP transistors can be tested. The measurements are made out-of-circuit. If the transistor is not removed, a circuit component may cause a false reading. One of the transistor test leads has two connectors, one red and one black. The other test lead has a single black connector. All three connectors have small alligator clip ends. The meter jacks used with these connectors are determined by the polarity type (NPN or PNP) of the transistor being checked.

1. If you are testing an NPN transistor connect the test leads as follows: plug the dual connector lead into **– COM** (**N**) jack; plug the single black lead into the + (**P**) jack. If a PNP transistor is being tested, reverse these connections. These connections are shown in the following illustration:



METER TO TRANSISTOR CONNECTIONS

2. Set the Function/Range selector to **X10/15 mA**. Note reading on green **hFE** scale; next, disconnect lead from base (open) and note reading again. The difference between these readings is your approximate amplification factor. If all readings are low, set **Function/Range** selector to **X1k/150 mA** position.
   - Transistor good: Wide difference between readings, variance depends on amplification factor.
   - Transistor bad, leaking: Low reading, same value with base open or closed.

TRANSISTOR MEASUREMENTS (cont.)

   - Transistor bad, open: Zero (0) reading in both states, with base open or closed.
   - Transistor bad, collector-to-emitter short: High reading in both states, with base open or closed.
3. Germanium Transistors Note: The leakage current in these transistors always flows to the collector. This causes an error in the amplification factor reading. To compensate for this error, subtract the reading on the I_{CEO} scale from the reading on the **hFE** scale.

DC CURRENT MEASUREMENTS

WARNING

- *Always connect meter in series with load when measuring current. If you incorrectly connect it in parallel with the load, it provides a low impedance path, almost a short, shunting the load. This high current path could damage the meter and/or equipment under test.*
- *Always select a range high enough to pass the current you plan to measure. If current value is unknown, or in doubt, start with the +12V range. Never exceed the current range selected or range of the related jack.*
- *Only use this meter to measure dc currents; never try to use it to measure ac current.*

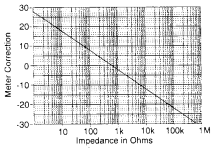
1. Plug black test lead into the **– COM** jack.
2. Plug rest test lead into appropriate jack for current level that you intend to measure. Use the **DC+12A** jack for current levels greater than 0.3 A (300 mA) but not exceeding **12 A**.
3. Set the **Function/Range** switch to appropriate range and **Polarity** selector to **DC+** (up).
4. Remove power from circuit under test, it must be electrically "cold". Open circuit at a point that does not exceed 600 V (DC + AC peak) from earth ground, or chassis of the equipment under test.

DC CURRENT MEASUREMENTS (cont.)

5. Connect meter in series with line opened; red test lead to positive (+) side, black test lead to negative (–) side of this line.
6. Apply power to circuit and obtain current value by reading related scale at meter. For best accuracy, make sure range selected gives a reading of at least 1/3 scale deflection.
7. Turn power off and restore circuit to its original condition.

dB MEASUREMENTS

The dB function of this meter is actually an ac voltage measurement scaled to read in dB. Zero dBm, labeled as 0 dB at this meter, equals 0.7746 V rms (1mW into 600 ohms). If the measurement is taken across an impedance other than 600 ohms, use the following table to determine the meter correction factor. Algebraically add the correction factor (in dB) to the meter reading (in dB) for the correct value in dBm.



1. Connect black test lead to **– COM** jack and red test lead to + jack.
2. Select the desired **ACV** range. The dB scale is calibrated for a direct reading on the 6 V AC range. Other ranges can be used by adding an appropriate factor as shown in the following chart.

ACV RANGE	6	30	120	300	1200
ADD dB	0	14	26	34	46

AC Range Compensation

3. Read value shown on dB scale and add any compensation factors as determined by your operating range and/or impedance if its value is not 600 ohms.