

kaise

INSTRUCTION MANUAL

**AUTOCYCLE
MULTIMETER**

SK-6166

KAISE CORPORATION

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KAISE CORPORATION

FOR SAFETY MEASUREMENTS

Prior to use, to avoid an electrical shock hazard to the operator and or damage to the instruments, read carefully the WARNINGS with the symbol  listed in [4. SAFETY PRECAUTIONS] , [5. MEASUREMENT PROCEDURES] and [6. MAINTENANCE] of this instruction manual.

Important Symbol

- :The symbol listed in IEC1010 and ISO 3864 means "Caution (refer to instruction manual)".
-  **WARNING** : The symbol in this manual advises the user of an electrical shock hazard that could result in serious injury or even death.
-  **CAUTION** : The symbol in this manual advises the user of an electrical shock hazard that could cause injury or material damages.

WARNING

Do not measure High Power Line with this instrument. High Power Line sometimes includes High Surge Voltage that could possibly induce dangerous arcs of explosive short in the instrument and could result in serious injury to the operator. When measuring dangerous voltages of High Voltage Circuit, always place the instrument away from your body without holding it with your hands.
Do not touch Multimeter, its Test Leads, or any part of the circuit while it is on.

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1. INTRODUCTION

1-1. GENERAL

The SK-6166 is an autoranging, 3.5 digit Autocycle Multimeter which has been designed small, lightweight and easy for testing/repairing Autocycles.

DC/AC Voltage, Resistance, Continuity and 20A are the basic measuring functions of SK-6166. In addition, this model can measure RPM and 200A CURRENT as an Autocycle multimeter. It is a very useful and reliable DMM for engineers and technicians in the field of Autocycle Industry.

1-2. FEATURES

1. Voltage DC/AC, Resistance, Continuity and 20A DC/AC are the basic measurements.
2. RPM, Leakage Current of batteries and 200A DC/AC by optional 660 Clamp Adapter as Autocycle tests.
3. Auto/Manual ranging, Display Hold and Auto Power Save functions are provided.

1-3. UNPACKING AND INSPECTION

1. Digital Multimeter
2. One pair of Test Leads and 940 Alligator Clips
3. 650 RPM Sensor
4. Two 1.5V (R6P) Batteries
5. One Spare Fuse 0.3A/250V and one 15A/250V (in the case)
6. Carrying Case
7. Instruction Manual

2. SPECIFICATIONS

2-1. GENERAL SPECIFICATIONS

1. DISPLAY;

Numerical Display; 1999 count LCD, 18mm high.

Unit and Symbol; V, A, Ω , k Ω , M Ω , \cdot), \times 10RPM, DH, \square , \sim and decimal point.

2. OPERATING PRINCIPLE:

 Dual Slope Integration.

3. RANGE SELECTION:

 Auto/Manual ranging.

4. OVERRANGE INDICATION:

 MSD "1" blinks.

5. POLARITY:

 Autopolarity, "-" symbol when minus.

6. BATTERY WARNING:

 \square symbol is shown when battery voltage is less than 1.2V \pm 0.1V.

7. SAMPLING RATE:

 2 times per second.

8. DISPLAY HOLD:

 DISPLAY is held and DH symbol is shown.

9. CONTINUITY TESTS:

 tested on 2k Ω range, buzzer sounds in case less than approx. 500 Ω .

10. OVERLOAD PROTECTION:

- a. V ; 1500V DC or AC peak for one minute
- b. Ω \cdot) ; 200V DC or AC peak for one minute
- c. RPM \cdot $^{\circ}$ C \cdot CLAMP; 200V DC or AC peak for one minute
- d. 20A; 20A DC or AC for 30 seconds, 15A fused.
- e. 20mA; 250V DC/AC for one minute, 0.3A fused.

11. DIELECTRIC STRENGTH:

 3kV AC for one minute (between input Terminal and Case).

12. OPERATING TEMPERATURE & HUMIDITY:

 0 to 40 $^{\circ}$ C, less than 80% RH in non-condensing.

13. STORAGE TEMPERATURE & HUMIDITY:

 -20 to 60 $^{\circ}$ C, less than 70% RH in non-dondensing.

14. POWER SUPPLY:

 Two 1.5V batteries type R6P or AA.

15. POWER CONSUMPTION:

 approx. 15mW (100 hour continuous operation).

16. DIMENSIONS & WEIGHT :

 75 \times 160 \times 34mm, 180g.

17. OPTIONAL ACCESSORIES:

 660 Clamp Adapter, 816-01 Sheath Type Temperature Probe.

2-2. MEASUREMENT SPECIFICATIONS

(23°C ±5°C, less than 80% RH in non-condensing)

1. VOLTAGE (= / ~ V)

1-1. DC VOLTAGE (= V)

Range	Resolution	Accuracy	Input Resistance	Max. Input Voltage
200.0mV	0.1mV	±1.2%rdg±2dgt	≥100MΩ	300V
2.000 V	1mV		≐11MΩ	
20.00 V	10mV		≐10MΩ	
200.0 V	100mV			
300 V	1 V			

1-2. AC VOLTAGE (~ V)

Average Rectification

Range	Resolution	Accuracy	Input Resistance	Max. Input Voltage
2.000 V	1mV	±2.3%rdg±7dgt	≐11MΩ	300V
20.00 V	10mV		≐10MΩ	
200.0 V	100mV			
300 V	1 V			

2. RPM (Revolutions per Minute)

Range	Resolution	Accuracy	Sparks
12,000 RPM (B)	10 RPM	±2%rdg±10dgt	1 spark / 1 revolution
6,000 RPM (A)			2 sparks / 1 revolution

3. CURRENT MEASUREMENTS (= / ~ 20A)

3-1. DC CURRENT (= 20A)

Range	Resolution	Accuracy	Voltage Drop	Max. Input Current
20.00A	10mA	0~10.00A: ±1.5%rdg±2dgt 10.01~20.00A: ±2.5%rdg±4dgt	<0.5V	20A (6A~20A 30 sec.)

Overload Protection: 20A Range 15A/250V Fuse Protection.

3-2. AC CURRENT (~20A)

Average Rectification

Range	Resolution	Accuracy (40Hz~500Hz)	Voltage Drop	Max. Input Current
20.00A	10mA	0~10.00A:±2%rdg±7dgt 10.01~20.00A:±3%rdg±10dgt	<0.5V	20A rms (6A~20A) 30 sec.)

Overload Protection: 20A Range 15A/250V Fuse Protection.

4. CURRENT(= / ~ 20mA)

4-1. DC CURRENT (= 20mA)

Range	Resolution	Accuracy	Voltage Drop	Max. Input Current
20.00mA	10 μA	±1.0%rdg±4dgt	≤0.5V	20mA

Overload Protection: 0.3A / 250V Fuse Protection.

4-2. AC CURRENT (~ 20mA)

Average Rectification

Range	Resolution	Accuracy (40Hz~500Hz)	Voltage Drop	Max. Input Current
20.00mA	10 μA	±2.0%rdg±8dgt	<0.5V	20mA rms

Overload Protection: 0.3A / 250V Fuse Protection.

5. RESISTANCE (Ω)

Range	Resolution	Accuracy	Measurement Current	Open Circuit Voltage
200.0Ω	0.1Ω	±1.5%rdg±4dgt	≤0.4mA	approx. 0.43V
2.000kΩ	1Ω		≤0.2mA	
20.00kΩ	10Ω		≤30 μA	
200.0kΩ	100Ω		≤3 μA	
2000 kΩ	1kΩ	±1.8%rdg±4dgt	≤0.3 μA	
20.00MΩ	10kΩ	±5%rdg±4dgt	≤0.03 μA	

Overload Protection: 200V DC/AC for one minute

6. CONTINUITY TESTS (···) / DIODE TESTS (⇄)

6-1. CONTINUITY TESTS (···)

Range	Resolution	Threshold Level	Measurement Current	Open Circuit Voltage
2.000kΩ	1Ω	≤500Ω	≤0.2mA	approx. 0.43V

Overload Protection: 200V DC/AC for one minute

6-2. DIODE TESTS (⇄)

Range	Resolution	Measurement Current	Open Circuit Voltage
2.000V	1mV	≤0.6mA	≤1.7V

Overload Protection: 200V DC/AC

7. CLAMP (= / ~ 20A, 200A) by 660 AC/DC Clamp Adapter

7-1. CLAMP = 20A/200A

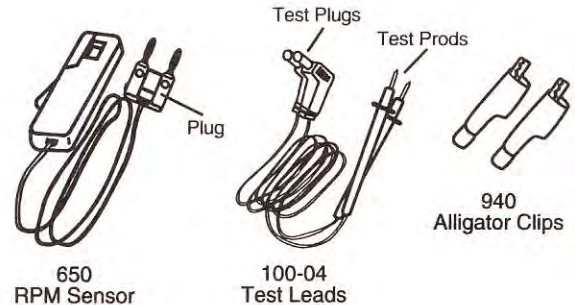
Range	Resolution	Accuracy	Input Resistance	Open Circuit Voltage
20.00A	10mA	±1.3%rdg±4dgt	≥100MΩ	2V DC/AC
200.0A	0.1A			

Overload Protection: 200V DC/AC for one minute

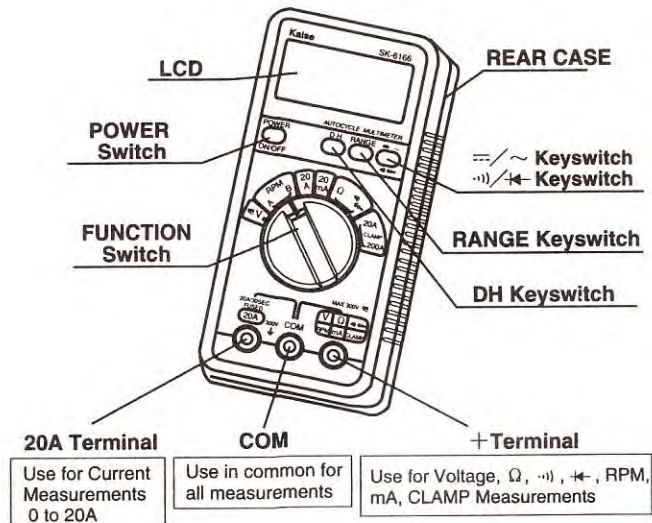
7-2. CLAMP ~ 20A / 200A

Range	Resolution	Accuracy	Input Resistance	Open Circuit Voltage
20.00A	10mA	±2.3%rdg±8dgt	≥100MΩ	2V DC/AC
200.0A	0.1A			

Overload Protection: 200V DC/AC for one minute



3. NAME ILLUSTRATION



3-1. LCD



- ⊖+ : Low Battery
- ~ : Alternating Current (AC) on Voltage and Current Measurements
- : - polarity
- MAN : Manual ranging
- |) : Continuity Tests
- ⚡ : Diode Tests
- DH : Display Hold
- V、mV : Voltage Units
- mA、A : Current Units
- Ω、kΩ、MΩ : Resistance Units
- MSD "1" blinks : Overrange Indication
- × 10 RPM : Revolutions Per Minute (multiply the value by 10)

3-2. POWER Switch

Press POWER Switch once to set power ON.
To set power OFF, press it again.

3-3. FUNCTION Switch

Set FUNCTION Switch to a desired position.

- a. $\overline{\sim}$ V position : 0 to 300V DC/AC Measurements
- b. RPM B position : 2 sparks per 1 revolution (500 to 12000 RPM)
- c. RPM A position : 1 spark per 1 revolution (500 to 6000 RPM)
- d. 20A position : 0 to 20A DC/AC Measurements
- e. 20mA position : 0 to 20mA DC/AC Measurements
- f. Ω position : 0 to 20M Ω Measurements
- g. \rightarrow / \leftarrow position : Continuity and Diode Tests
- h. CLAMP 20A : 20A DC/AC Measurements by 660 Clamp position Adapter
- i. CLAMP 200A : 200A DC/AC Measurements by 660 Clamp position Adapter

3-4. RANGE Keyswitch

Press RANGE Keyswitch to select Autoranging or Manual-ranging in VOLTAGE and RESISTANCE MEASUREMENTS. The instrument is usually used in Autoranging. But when RANGE SELECTION or RANGE HOLD is required, press RANGE Keyswitch once and "MAN" symbol appears.

RANGE SELECTION: When applying no input into the instrument, press RANGE Keyswitch several times watching the movement of the decimal point until desired range is selected. The decimal point and the range move from the lowest range to the highest one and circulate with each press of RANGE Keyswitch.

RANGE HOLD: When applying desired input value into the instrument, press RANGE Keyswitch. The range to which the input value belongs is held. For example, if 100V AC is applied and pressed, 400A AC range is held.
To cancel RANGE SELECTION or RANGE HOLD, press RANGE

Keyswitch for 3 second or longer. The selected or held range is cancelled and "MAN" symbol disappears on LCD.

3-5. $\overline{\sim}$ / \sim / \rightarrow / \leftarrow Keyswitch

1. Voltage and Current Measurements

Press $\overline{\sim}$ / \sim Keyswitch to select $\overline{\sim}$ (DC) or \sim (AC).
 $\overline{\sim}$ symbol is implied.

2. Continuity Tests or Diode Tests

Set FUNCTION Switch to \rightarrow / \leftarrow position and press \rightarrow / \leftarrow Keyswitch to select Continuity Tests (\rightarrow) or Diode Tests (\leftarrow).
In Continuity Tests, " \rightarrow " symbol shows and in Diode Tests, " \leftarrow " symbol shows on LCD.

3-6. DH Keyswitch

Press DH Keyswitch once when measuring and the display is held and "DH" symbol shows on LCD.
To cancel DH Keyswitch, press it again and "DH" symbol disappears.

3-7. INPUT Terminals

- 1. V, Ω , \rightarrow / \leftarrow , RPM, mA, CLAMP Terminal : Used for Voltage, Resistance, 0 to 20mA Current Measurements, Continuity Tests, Diode Tests, RPM and 0 to 200A Current Measurements by Clamp Adapter.
- 2. COM Terminal : Used in common for all Measurements.
- 3. 20A Terminal : Used for Current Measurements up to 20A DC/AC (for less than 30 sec.) .

4. SAFETY PRECAUTIONS

Correct knowledge about electric measurements is necessary because electric measurement is sometimes a very dangerous work. To eliminate possibility of injury to operator and damage to the instrument, the following precautions and measurement procedures must be taken. Mis-use, abuse and carelessness cannot be prevented by any written word and is fully the operator's responsibility. Observing the following warnings and cautions, take safe measurements.

4-1. WARNINGS ⚠

⚠ Warning 1. Checks of Body and Test Leads:

Before every measurement, do not fail to confirm that the body of this instrument and handle insulators of the attached test leads have no cracks nor any other damage on them.

Make sure that the body and the handle insulators are free of dust, grease and moisture.

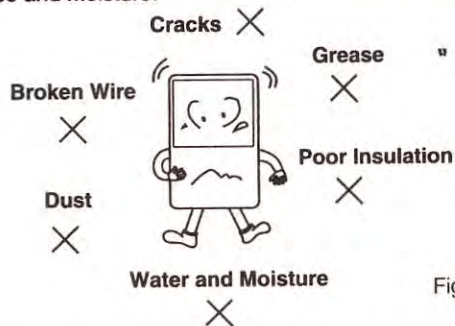


Fig. 1

⚠ Warning 2. Measurements of High Power Line Prohibited

Do not measure with this instrument High Power Line (High Energy Circuits) such as Distribution Transformers, Bus Bars, Power Line for Big Motors, etc. High Power Line is very dangerous as it sometimes includes high Surge Voltage that will induce short in the instrument and results in shock hazard. Use the special instrument designed to measure High Power Line.

X Distribution Transformer X Power Line for Big Motor

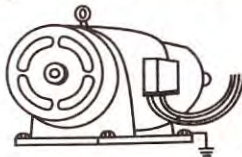
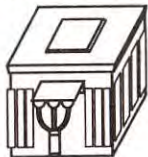


Fig. 2

⚠ Warning 3. Warning for High Voltage Measurements

Even if to measure Low Energy Circuits of electric/electronic appliances, heating elements, small motors, line cords and plugs, etc., High Voltage Measurements are very dangerous.

Do not touch the Multimeter, its Test Leads or any part of the Circuit while it is on.

Generally, shock hazard shall be considered to exist at any part involving a potential in excess of 30V rms or 42.4V DC or peak and where a leakage current from that part to ground exceeds 0.5mA.

⚠ Warning 4. Dangerous Voltage Measurement Procedure

When measuring a circuit that will possibly be dangerous, keep strictly the following measuring procedures.

1. Before Measurement, turn off power to the circuit to be measured.
2. Insert Black Test Plug of Test Leads into COM Terminal and Red Test Plug of Test Leads into V Terminal.
3. Attach Black and Red Alligator Clips to both Test Prods of Test Leads.
4. Press POWER Switch on.
5. Set FUNCTION Switch to $\overline{\sim}$ V position.
6. Press $\overline{\sim}$ / \sim Keyswitch to select $\overline{\sim}$ or \sim .
7. Confirm that the power of the circuit to be measured is OFF. Then, connect Black Alligator Clip to - (earth) side and Red Alligator Clip to + (positive) side of the circuit to be measured.
8. Place the instrument away from your body, and do not touch it with your hands. Also, take safety distance from the power source or the circuit to prevent any part of your body from touching dangerous voltage.
9. Turn on power to the circuit to be measured and read the voltage on LCD. Refer to the figure 3.

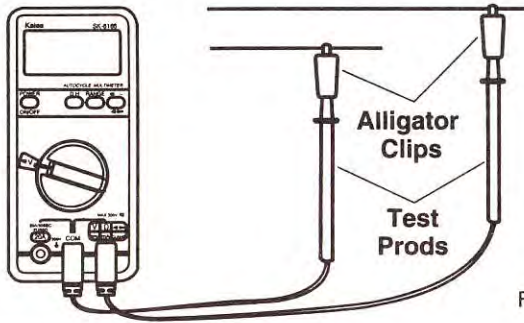


Fig. 3

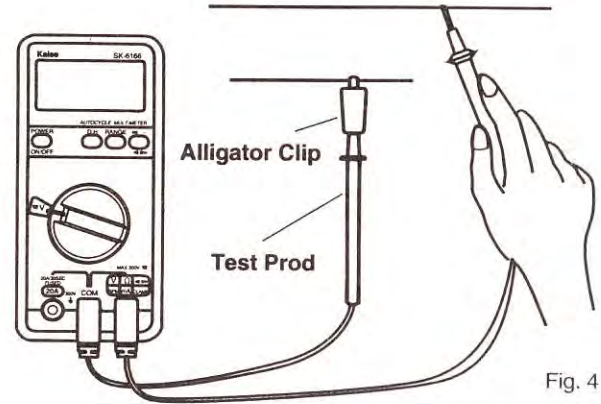


Fig. 4

10. Turn off power to the circuit to be measured and discharge all capacitors in the circuit.
11. Disconnect Alligator Clips of Test Prods from the circuit.

9. Disconnect Red Test Prod from the circuit and then disconnect Black Alligator Clip from the circuit.

In case you want to measure live line, observe the following procedure.

1. Place the instrument away from your body.
 2. Press POWER Switch on.
 3. Set FUNCTION Switch to $\overline{\sim}$ V position.
 4. Press $\overline{=}$ / \sim Keyswitch to select $\overline{=}$ or \sim .
 5. Take safety distance from the power or the circuit to be measured to prevent any part of your body from touching dangerous voltage.
 6. Attach Black Alligator Clip to Black Test Prod. Then, connect Black Alligator Clip to - (earth) side of the circuit to be measured.
 7. Hold Red Test Prod with one hand and connect it to + (positive) side of the circuit to be measured.
 8. Read the voltage on LCD.
- Refer to the figure 4.

Warning 5. Correct Selection of FUNCTION Switch
 When taking measurements, always confirm that FUNCTION Switch is set to correct position. Do not measure voltage on RPM, 20A, 20mA, Ω , $\overline{=}$ / \sim and CLAMP positions.

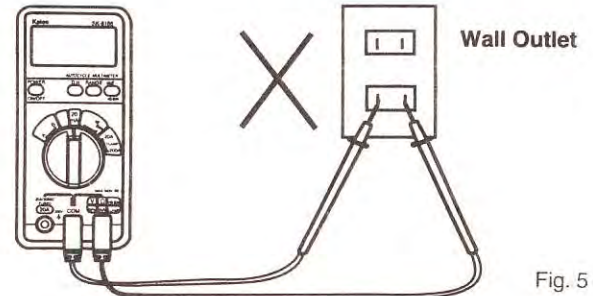


Fig. 5

⚠ Warning 6. Maximum Input Observance

Do not attempt to measure voltage or current that might exceed the specified maximum input of this instrument.

⚠ Warning 7. Test Leads Disconnection

Prior to changing FUNCTION Switch to another position when measuring, or opening Rear Case for replacement of batteries or fuse, always disconnect Test Leads from the circuit being measured.

⚠ Warning 8. Cares of 20A Measurements

When measuring 20A, pay attention to the following points as they often cause troubles.

Confirm that Black and Red Test Plugs are inserted into COM and 20A Terminals, and FUNCTION Switch is set to 20A position.

This 20A range is fused. But, do not measure current that might exceed 20A (for less than 30 seconds) to avoid electrical shock hazard and/or damage to the instrument.

Do not measure Car Battery directly or 100V to 110V power in the home on this 20A range.

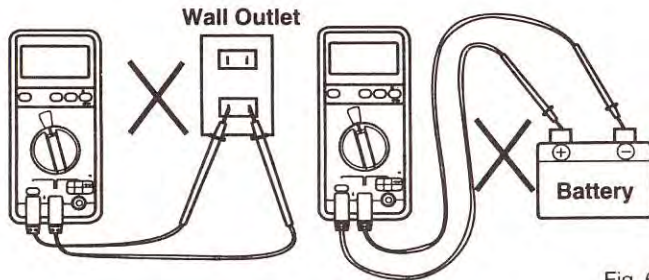


Fig. 6

4-2. CAUTIONS IN HANDLING ⚠

⚠ **Caution 1.:** Do not polish the meter case, or attempt to clean it with any cleaning fluid, gasoline, benzene, etc. If necessary, use silicon oil or anti-static fluid.

⚠ **Caution 2.:** Avoid severe mechanical shock or vibration extreme temperature or very strong magnetic fields.

⚠ **Caution 3.:** Remove the batteries when not in use for an extended time since the exhausted batteries might leak electrolyte and corrode the internal components.

⚠ **Caution 4.:** The points of Test Prods are sharp and dangerous. Do not get hurt with them.

⚠ **Warning 5.:** Do not let the children use the instrument or those people who have no knowledge and experience of electric measurements.



Avoid severe mechanical shock or vibration.

Fig. 7

5. MEASUREMENT PROCEDURES

5-1. PREPARATION FOR USE

1. INSTRUCTION MANUAL

Prior to use, read INSTRUCTION MANUAL carefully and acquaint yourself with the specifications and functions of the instrument. Especially, read and observe strictly the 「4. SAFETY PRECAUTIONS」

2. BATTERY INSTALLATION

Two 1.5V R6P batteries are furnished with this instrument. Prior to operating the instrument for the first time, place the batteries in the following procedure.

1. Unscrew the screw on Rear Case by Plus Screwdriver and remove Rear Case.

NOTE: Do not open Rear Case in the dusty place.

NOTE: Do not touch the parts on PC Board when opening Rear Case.



Fig. 8

2. Install the two batteries in Battery Case.

Make sure that the batteries must be placed in the correct polarity. See the battery figure on the bottom of Battery Case.

3. Replace Rear Case and screw.

NOTE: If POWER Switch is turned on with the batteries placed in the wrong polarity, the display is not shown. Do not leave the instrument in this condition as it results in battery consumption.


NOTE: If the instrument is taken out of service for an extended time, remove the batteries from the battery case and store separately.

3. FUSE

1. Two removable fuses are installed in this instrument to protect 20A and 20mA ranges against overload.

When installing the batteries, make certain that the fuses are installed properly and the fuse clips are tight.

2. For replacement use any fast acting glass tube fuses 15A/250V 6 × 30mm or 0.3A/250V 5 × 20mm rating.
3. Refer to 「6-3. FUSE REPLACEMENT」 page 30 to 31.

 **WARNING:** Do not jump fuse or use a fuse with different specifications.

4. If the instrument is used with blown fuse or without fuse, 20A and 20mA ranges become null.

4. TEST LEADS

1. One pair of Test Leads which consists of a Red Test Lead and a Black Test Lead is furnished with this instrument.

2. Each Test Lead consists of one Test Plug of a short insulator and one Test Prod of a long handle insulator.

3. The Test Plugs fit in the Terminals on the lower side of the case and the Test Prods are used to make contact with the circuit to be measured.

It is good practice to use Black Test Lead for - COM Terminal (- polarity) and Red Test Lead for + Terminal (+ polarity).

5. POWER Switch on

Press POWER Switch on. All segments are displayed on LCD and Buzzer sounds.

NOTE: If LCD is not turned on, check the batteries if they are alive and set in the correct polarity or their contacts might be good.

6. OVERRANGE INDICATION

If an input value greater than 1999 digit is applied on 20A, 20mA or CLAMP 20A/200A range, MSD 1 blinks and buzzer sounds. In Ω or $\text{m}\Omega$ range, MSD 1 blinks but buzzer does not sound.

NOTE: When measuring on Voltage (in autorange) or RPM range, MSD 1 does not blink nor buzzer sound.

NOTE: When \approx V, CLAMP 20A or 200A is selected with the both Test Prods put open, random numerals appear on LCD. But this phenomenon is the normal one caused by the high input impedance of this instrument and not the symptom of troubles.

7. AUTO POWER SAVE

After 15 minutes of last operation of FUNCTION Switch with POWER Switch pressed on, power goes down automatically into sleep condition of 0.01mW consumption with LCD turned off. This function prevents battery consumption when power off is forgotten.

8. SYMBOL MARK

The following symbols shown on the instrument and in the instruction manual are listed in IEC 1010 and ISO 3864.

- \triangle : Caution (refer to instruction manual).
- \approx : Direct Current (DC)
- \sim : Alternating Current (AC)
- \approx/\sim : DC and AC
- \blacktriangleleft : Diode
- \perp : Earth (Ground) Terminal
- \square : Fuse
- \square : Double insulation

5-2. VOLTAGE (\approx/\sim V) MEASUREMENTS

\triangle WARNING

Do not measure High Power Line with this instrument. Maximum Input Voltage is ≈ 300 V. To avoid electrical shock hazard and/or damage to the instrument, do not measure voltages that might exceed 300V. Prior to use, read carefully [4. SAFETY PRECAUTIONS] of this instruction manual.

1. Insert Black Test Plug into COM Terminal and Red Test Plug into V Terminal
2. Press POWER Switch on.
3. Set FUNCTION Switch to \approx V position.
4. Press \approx/\sim Keyswitch to select \approx or \sim . \approx symbol is implied and not shown on LCD.
5. Connect Black Test Prod to the negative (earth) side of the circuit being measured and Red Test Prod to the positive (high potential) side of the circuit.

\triangle **WARNING:** When measuring dangerous circuit more than 100V, turn off power to the circuit to be measured and connect Test Prods to the circuit using Alligator Clips.

Do not touch the multimeter, its Test Leads or any part of the circuit while it is on. Refer to [\triangle Warning 4. Dangerous Voltage Measurement Procedure] on page 11 to 13.

NOTE: When taking voltage measurements, always connect the instrument IN PARALLEL with the circuit being measured.

6. Read the voltage on LCD.
 7. **Display Hold:** Press DH Keyswitch once and the display is held with DH symbol shown on LCD. To cancel Display Hold, press it again.
- When measurements are finished, remove Test Prods from the circuit and turn off POWER Switch.

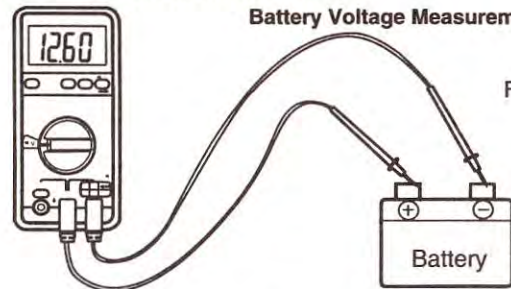


Fig. 9

5-3. REVOLUTIONS PER MINUTE (RPM)

WARNING

The ignition system can create an electrical shock hazard. Turn off the engine before connecting or removing the RPM Sensor. Prior to measurements, read carefully [4. SAFETY PRECAUTIONS] of this instruction manual.

1. Turn off the engine.
2. Insert Plug of RPM Sensor into COM and RPM Terminals with projection side to COM Terminal.

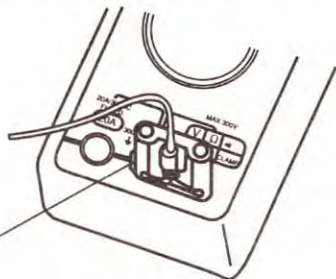


Fig. 10

3. Press POWER Switch on.
4. Set FUNCTION Switch to RPM A or RPM B.
RPM A : 2 sparks per 1 Revolution of Crank Shaft
RPM B : 1 spark per 1 Revolution of Crank Shaft
5. Clamp on the High Tension (Spark Plug) Cord with RPM Sensor.

NOTE: Clamp on High Tension Cord with labeled side of RPM Sensor faced to Spark Plug.

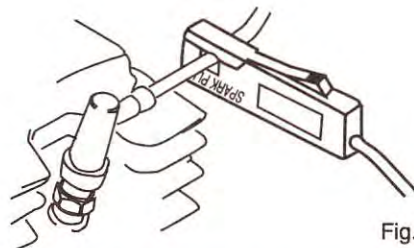


Fig. 11

6. Turn on the engine and read the value on LCD.
7. DH Keyswitch is available to hold display.

When measurements are finished, turn off the engine, remove the RPM Sensor from the Cord and turn off POWER Switch.

5-4. CURRENT (\equiv / \sim 20A) MEASUREMENTS

WARNING

Maximum Input Current of 20A range is 20A DC or AC for less than 30 seconds.

Do not attempt to measure current that might exceed 20A (for less than 30 seconds) to avoid electrical shock hazard and/or damage to the instrument. Use extreme care not to measure voltage on the current range. Prior to measurements, read carefully [4. SAFETY PRECAUTIONS] of this instruction manual.

1. Insert Black Test Plug into COM Terminal and Red Test Plug into 20A Terminal.
2. Press POWER Switch on.
3. Set FUNCTION Switch to 20A position.
4. Press \equiv / \sim Keyswitch to select \equiv or \sim .

⎓ symbol is implied and not shown on LCD.

5. Turn off power to the circuit being measured and discharge all capacitors in the circuit. Then, open the circuit in which current is to be measured.
 6. Connect Black Test Prod to the negative (earth) side of the circuit being measured and Red Test Prod to the positive (high potential) side.
- NOTE:** Use Alligator Clips connected to Test Prods.
NOTE: When taking current measurements, always connect the instrument **IN SERIES** with the circuit being measured.
7. Turn on power to the circuit being measured and read the current on LCD.

⚠ WARNING: Make measurements of 6A to 20A within 30 seconds.

8. When measurements are finished, turn off power to the circuit being measured and discharge all capacitors in the circuit.
9. Remove Test Prods from the circuit and reconnect the circuit that was being measured.
10. DH Keyswitch is available to hold display.

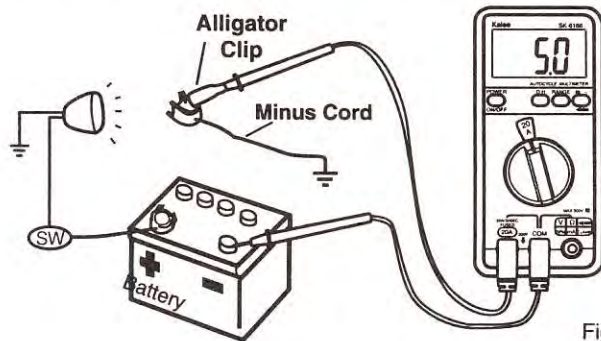


Fig. 12

5-5. CURRENT (⎓/⎓ 20mA) MEASUREMENTS

⚠ WARNING

Maximum Input Current of 20mA range is 20mA DC or AC . Do not attempt to measure current that might exceed 20mA to avoid electrical shock hazard and/or damage to the instrument. Use extreme care not to measure voltage on the current range. Prior to measurements, read carefully [4. SAFETY PRECAUTIONS] of this instruction manual.

1. Insert Black Test Plug into COM Terminal and Red Test Plug into 20mA Terminal.
 2. Press POWER Switch on.
 3. Set FUNCTION Switch to 20mA position.
 4. Press ⎓/⎓ Keyswitch to select ⎓ or ⎓ .
⎓ symbol is implied and not shown on LCD.
 5. Turn off power to the circuit being measured and discharge all capacitors in the circuit. Then, open the circuit in which current is to be measured.
 6. Connect Black Test Prod to the negative (earth) side of the circuit being measured and Red Test Prod to the positive (high potential) side.
- NOTE:** Use Alligator Clips connected to Test Prods.
NOTE: When taking current measurements, always connect the instrument **IN SERIES** with the circuit being measured.
7. Turn on power to the circuit being measured and read the current on LCD.
 8. When measurements are finished, turn off power to the circuit being measured and discharge all capacitors in the circuit.
 9. Remove Test Prods from the circuit and reconnect the circuit that was being measured.
 10. DH Keyswitch is available to hold display.

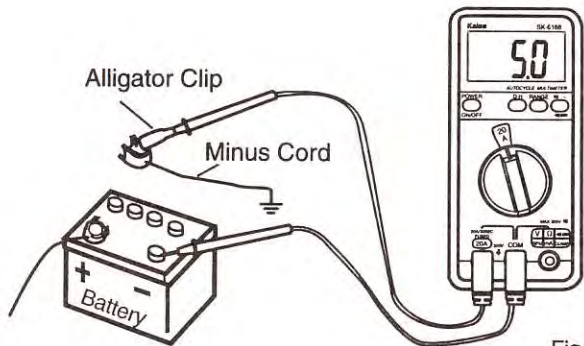


Fig. 13

5-6. RESISTANCE (Ω) MEASUREMENTS

⚠ WARNING

Do not measure Voltage on Ω position. This will cause electrical shock hazard to the operator and damage to the instrument.

If the resistor is connected in a circuit or in-circuit resistance is measured, turn off power to the circuit being measured and discharge all capacitors in the circuit.

Prior to measurements, read carefully [4. SAFETY PRECAUTIONS] of this instruction manual.

1. Insert Black Test Plug into COM Terminal and Red Test Plug into Ω Terminal.
2. Press POWER Switch on.
3. Set FUNCTION Switch to Ω position.
4. If the resistor to be measured is connected in a circuit, turn off power to the circuit and discharge all capacitors in the circuit.
5. circuit.

Open one side of the resistor to be measured and connect Test Prods to both sides of the resistor (or circuit).

6. Read the resistance on LCD.

If measurements are unstable when measuring high resistance more than $1M\Omega$, use Test Leads with shield.

7. DH Keyswitch is available to hold display.
8. When measurements are finished, remove Test Prods from the resistor (circuit) and turn off POWER Switch. Then restore the circuit as it was.

Testing Water Temperature Sensor

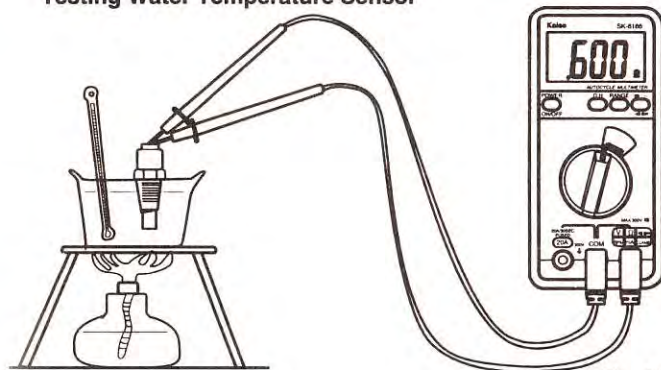


Fig. 14

5-7. CONTINUITY (·))) TESTS

⚠ WARNING

Do not measure Voltage on (·))) position. This will cause electrical shock hazard to the operator and damage to the instrument.

Before making Continuity Tests, turn off power to the circuit being tested and discharge all capacitors in the circuit.

Prior to measurements, read carefully [4. SAFETY PRECAUTIONS] of this instruction manual.

1. Insert Black Test Plug into COM Terminal and Red Test Plug into \rightarrow Terminal.
2. Press POWER Switch on.
3. Set FUNCTION Switch to \rightarrow / \leftarrow position.
4. Press \rightarrow / \leftarrow Keyswitch to select \rightarrow . \rightarrow symbol is shown on LCD.
5. Confirm that the circuit being tested is not live (de-energized). Then, connect Black and Red Test Prods to both sides of the circuit.
6. Buzzer sounds if resistance value is less than approx. $500\ \Omega$
7. When continuity tests are finished, remove Test Prods from the circuit being tested and turn off POWER Switch.

Testing in Stop Light Switch

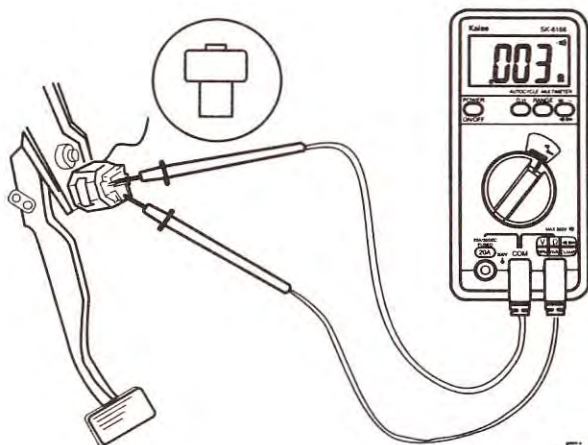


Fig. 15

5-8. DIODE TESTS

⚠ WARNING

Do not measure Voltage on \leftarrow position. This will cause electrical shock hazard to the operator and damage to the instrument.

When testing the diode in a circuit, turn off power to the circuit being tested.

Prior to measurements, read carefully [4. SAFETY PRECAUTIONS] of this instruction manual.

1. Insert Black Test Plug into COM Terminal and Red Test Plug into \leftarrow Terminal.
2. Press POWER Switch on.
3. Set FUNCTION Switch to \rightarrow / \leftarrow position.
4. Press \rightarrow / \leftarrow Keyswitch to select \leftarrow .
5. **In case of diode**, connect Black Test Prod to Cathode and Red Test Prod to Anode of the diode being measured.
In case of transistor, connect Test Prods to Emitter Pin and Base Pin depending on PNP or NPN type transistor being measured. Refer to the following figures.

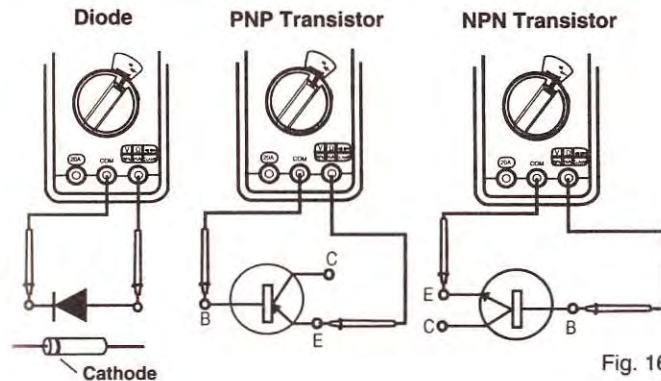


Fig. 16

In case of an ordinary diode, the display shows 0.5V to 0.8V. If the diode is defective and in short condition, the display shows nearly 0V, and if the diode is in open condition, the display shows OL symbol.

NOTE: In case of germanium diode (except point contact type diode), Forward Voltage is approx 0.2V to 0.4V. Point Contact Type Diode shows different value from its electrical characteristic.

- Reverse Test Prod connections to the device being measured. If the diode is good, the display shows OL symbol, the same value in open condition, and if the diode is defective and in short condition, the display shows nearly 0V.

5-9. CLAMP (= / ~ 20A, 200A) MEASUREMENTS

⚠ WARNING

Maximum Input Voltage of Clamp Range is 2V.
Do not attempt to measure Current or Voltage directly on this range.

- Insert Black Plug of 660 Clamp Adapter into COM Terminal and Red Plug into CLAMP Terminal.
- Press POWER Switch on.
- Set FUNCTION Switch to CLAMP 20A or 200A position.
- Set Range Switch of Clamp Adapter to 40A (20A position of Multimeter) or 400A (200A position of Multimeter) position.

NOTE: Maximum Measuring Value of Clamp Position is 200A DC or AC, though 660 Clamp Adapter itself has 400A range.

- Press = / ~ Keyswitch of Multimeter to select = or ~ .
When measuring DC Current, adjust DCA 0 ADJ Knob of Clamp Adapter to display 0.00A ± 3 digit.
- Open Clamp Head of Clamp Adapter and clamp on a single conductor.

NOTE: When measuring DC Current, take care of the polarity. Minus symbol is displayed if a conductor is clamped on contrary to ↓ mark on Clamp Head.

- Read the current on LCD.
- DH Keyswitch is available in the same way as in Voltage Measurements.
- After measurement, remove Clamp Head from the conductor and turn off power of the Clamp Adapter and the Multimeter.

Example : Measurement of Maximum Current of Battery (approximate value) when Starter starts.

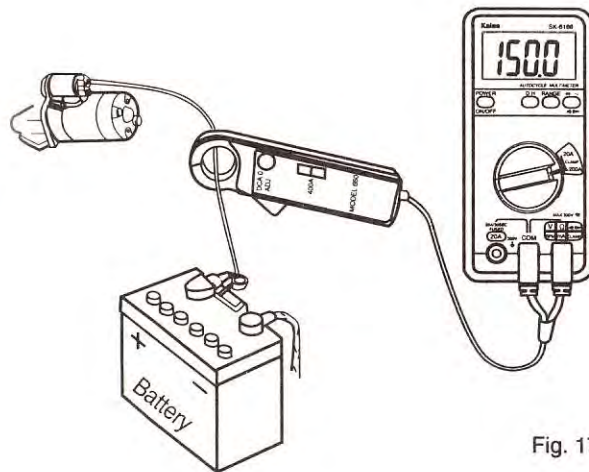


Fig. 17

6. MAINTENANCE


6-1. WARRANTY STATEMENT

The warranty statement for the Autocycle Multimeter SK-6166 is printed on the last page of the manual. Read it carefully before requesting a warranty repair

6-2. BATTERY REPLACEMENT

WARNING

Remove both Test Leads from external circuit connections and from the Input Terminals before removing Rear Case to replace the batteries.

1. If the batteries are consumed and  symbol is shown on LCD, replace the batteries.
2. Remove both Test Leads from the circuit and from the Terminals.
3. Press POWER Switch off.
4. Unscrew the screw on Rear Case and remove Rear Case.
5. Replace the consumed batteries with fresh ones, 1.5V R6P type.

NOTE: Place the batteries in the correct polarity.

6. Replace Rear Case and screw. Refer to 「5-1. 2. BATTERY INSTALLATION」.

6-3. FUSE REPLACEMENT

WARNING

Remove both Test Leads from external circuit connections and the Input Terminals before removing Rear Case to replace the fuse.

1. 20A and 20mA ranges are protected against overload with 15A and 0.3A fuse. If the fuse is blown, replace the fuse.
2. Remove both Test Leads from the circuit and from COM and 20A or 20mA Terminals.
3. Press POWER Switch off.
4. Remove Rear Case by unscrewing the screw.
5. Replace the blown fuse with fresh one.

Fuse specification: Fast acting 0.3A/250V $\phi 5 \times 20\text{mm}$
15A/250V $\phi 6 \times 30\text{mm}$.

NOTE: Install the fuse tightly in the Fuse Clips. Do not use a fuse other than specified one.

6. Replace Rear Case and screw.

6-4. PERIODICAL CHECK AND CALIBRATION

Periodical check and calibration are necessary to make safety measurements as well as to maintain the specifications described on page 3 to 6.

It is recommended that the instrument may be checked and calibrated once each year and/or after it is repaired. Periodical Check and Calibration services are available at KAISE AUTHORIZED SERVICE AGENCY through your local dealer at a cost basis charge.

Pack the instrument securely in its original carton together with descriptions of your name, address, telephone number and the service required, and ship prepaid to your local dealer.

6-5. REPAIR

Repair service, warranty or non-warranty, is available at KAISE AUTHORIZED SERVICE AGENCY through your local dealer.

Warranty repair is executed free of charge, but, non-warranty repair is charged on the cost basis.

Pack the instrument securely in its original carton together with descriptions of your name, address, telephone number, problem encountered and the service required, and ship prepaid to your local dealer.

When the instrument does not operate properly, the following steps should be taken before returning the instrument for repair, warranty or non-warranty.

1. Check the battery and fuse connections.
2. Check the batteries if they are installed in the correct polarity.
3. Check the batteries if they are alive and usable.
4. Check the fuses if they are not blown.
5. Make sure that FUNCTION Switch and the other Keyswitches are selected correctly.
6. Make sure that the body of this instrument and the handle insulators of the test leads have no cracks nor any other damage on them.
7. Be careful of noise from the equipment under test or the ambient environment in which the instrument is being used. The instrument is fully shielded against noise, but may read error due to very strong noise.

WARRANTY

The Autocycle Multimeter SK-6166 is warranted in its entirety against any defects of material or workmanship under normal use and service within a period of six months after the date of purchase of the instrument by the original purchaser. This warranty is extended by KAISE AUTHORIZED DEALER only to original purchaser or original user of the instrument on condition that the Warranty Registration Card is completed and returned to the authorized dealer within two weeks after the purchase of the instrument new from the dealer. The obligation under this warranty to be executed by KAISE AUTHORIZED DEALER is limited to repairing or replacing the Autocycle Multimeter SK-6166 returned intact to it, with transportation charge prepaid, and which to its satisfaction is judged by it to have been thus defective. KAISE AUTHORIZED DEALER and KAISE CORPORATION, the manufacturer shall not otherwise be liable for any damages or loss, consequential or otherwise. The foregoing warranty is exclusive and in lieu of all other warranties including any warranties of merchantability, whether expressed or implied.

This warranty shall not apply to any instrument or other article of equipment which shall have been repaired or altered outside KAISE AUTHORIZED SERVICE AGENCY, nor which has been subject to misuse, negligence or accident, incorrect wiring by users, or installation or use not in accord with instructions furnished by the manufacturer.

KAISE AUTHORIZED DEALER