HIOKI

7010

DC SIGNAL SOURCE

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WARNING

This instrument is designed to prevent accidental shock to the 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 measurement. Failure to follow directions can result in a serious or fatal accident.

Introduction

Thank you for purchasing this HIOKI 7010 DC signal source.

We have made every effort to ensure that this equipment offers you the functions you need, with the best in reliability. In order to obtain optimum performance and longest service life, please read this manual thoroughly before operation.

Inspection

Please check the instrument carefully to ensure that it has not been damaged in shipment. The panel switches must be checked especially carefully.

If there is any damage, or if the equipment does not operate as it should, contact your vendor immediately.

⚠ **CAUTION**

The internal batteries are discharged for shipment, and must be recharged with the AC adapter before the equipment can be used.

1.Precautions

(1) **Take care in making direct connections to the input and output terminals. In particular, connection of a voltage line to the output terminal in the TC (thermocouple) range may destroy the circuitry.**

(2) The thermal protection function may operate if the unit is used for long periods of time in high temperatures, or if external power supplies (e.g., battery of 10V or higher, etc.) are used. In this case, turn off the equipment for a period of time and allow it to cool.

(3) When using the AC adapter, always turn off the power to the 7010 before connecting it to the adapter, or the adapter to the AC line.

(4) Do not turn the power on or off with a load connected.

(5) When the connected load is to be altered, always turn off the output first.

(6) If the output mark is indicated but no output is present, turn the output off for a moment and then back on.

(7) To prevent excess battery consumption, always turn off the power when the equipment is not in use.

(8) Never use the equipment is there is condensation present.

(9) If the LCD goes out during operation or the equipment operation is otherwise abnormal, turn off the power for a moment.

(10) Always wait 2~3 seconds before turning the power back on after turning it off.

(11) This equipment is not of explosion-proof construction, and therefore cannot be used in inflammable or explosive atmospheres.

2.General

2-1 Product description

The compact 7010 DC signal source has internal Ni-Cd (Nickle-Cadmium) batteries, and can output DC voltage and current, and thermocouple power equivalent to a preset temperature, as well as measuring DC voltage, DC current and temperature.

In addition to making testing of electronic equipment and circuits and checks of signal lines and thermoelectric thermometers easy, it is also capable of functioning as a DC voltmeter/ammeter and thermometer.

2-2 Features

(1) Measurement of DC voltage from $-12.100V \sim 12.100V$, and of DC current from $-81.00mA \sim 81.00mA$.

(2) Output of thermocouple power to a preset temperature for K(CA), E(CRC), J(IC), T(CC), R and S.

(3) Temperature measurement from $-25 \sim 60°C$.

(4) Storage of up to 20 steps of output data in memory.

(5) The monitor function can be used to directly read output values.

(6) Bipolar output can be used for load current synch.

(7) Ni-Cd battery power supply supports use in situations where AC power is not available.

3.Specifications

3-1 General specifications

(1) **Output generation**

bipolar synch source

(2) **A/D operation**

sequential comparison

(3) **Output impedance**

Approx. $50m\Omega$ (approx. 1mV/20mA)

(4) **Temperature coefficient**

$\pm(100ppm+100\mu V)/°C$: CV, V-METER

$\pm(100ppm+1\mu A)/°C$:   CC, A-METER

$\pm(100ppm+2\mu V)/°C$:   TC

(5) **Zero-adjust function (for V-METER, A-METER)**

all measurement ranges

(6) **Display**

LCD 5-digit, maximum value 12100

Minus polarity displayed with "-".

Unit symbols V, mA and °C displayed.

Thermocouple symbols K, E, J, T, R, and S displayed.

Output on "*" displayed.

"BATT LoW" displayed when battery power low.

(7) **Ambient temperature/humidity range (operation)**

0~40°C., 80% RH maximum (no condensation)

(8) **Ambient temperature/humidity range (storage)**

-20~50°C., 80% RH maximum

(9) In/Out protection

0.2A fuse protector

However, unit should not be connected to live circuits of ±15V or ±100mA or higher.

(10) Dielectric strength

AC500V, 1 minute (In/Out terminals to case, power supply to case)

(11) Power supply

internal Ni-Cd cells or AC adapter. Maximum battery charge about 2 hours of operation at 80mA load and about 4.5 hours at V-METER. Charging time about 15 hours (with AC adapter, 7010 off).

Adapter specifications: Output at 550mA load 8V± 10% max., maximum no-load voltage output 13V, plug diameter 2 mm., center common (-).

(12) Dimensions and weight

185H × 110W × 54D (mm), approx. 700g

(13) Included accessories

| 9168 Input cord | 1 unit |
| AC adapter | 1 unit |

Model	Specifications	Remarks
9141	100V ±10%	▽
9141-2	120V ±10%	UL, CSA
9141-3	220V ±10%	CEE
9141-4	240V ±10%	SAA

0.2A Midget fuse (5.2d × 20 non arcing) 1 unit

(14) Optional accessories

9184 RJ (Reference Junction Temperature) sensor

9356 Carrying case

3-2 Measurement and output ranges

(Accuracy is assured for a temperature of 23°C±5°C and a humidity of 80% RH or less.)

	Range	Resolution	Accuracy	Remarks
Signal generator ranges	Constant voltage CV 0~±12.1V	1mV	±0.1%rdg ±3dgt	Maximum output 80mA min. (at less than 8V) 50mA min. (at 8V or greater) 12V min. (at less than 50mA) 10V min. (at 50mA or greater)
	Constant current CC 0~±81mA	10μA		
	Thermoelectric power TC(0°C) K(CA) −100°C~1200°C E(CRC) −100°C~ 800°C J(IC) −100°C~ 750°C T(CC) −100°C~ 350°C R −40°C~1600°C S −40°C~1600°C	1°C	±0.25%rdg ±2°C	Load resistance: 100k ohms or greater Additional error when load resistance is less than 100k ohms: $$\left[100-\frac{100\times Rin}{10+Rin}\right]\%$$ (Rin:load resistance)
			±2°C added at less than 100°C.	
	Thermoelectric power · TC(RJ) : Six ranges (same as above)	1°C	±1°C added (0°C to 50°C) ±2°C added (other temperatures)	● Requires 9184 RJ sensor. ● Output compensation for RJ temperature takes place approx every 6.5 seconds.
	Generation from memory (MEMO OUT) : Can be used with one of the following ranges at a time: CV, CC, TC.(0°C), or TC(RJ) : Number of steps: Up to 20 : Step time: 1 to 100 seconds		● Accuracy of signal generated depends on accuacy of selected range. ● Accuracy of step length is not rated.	● Uses static memory. ● Operates endlessly when output is set to ON. ● Possible settings: Generation level, limiter, output ON/OFF, and step length
	Reference resistance: 100 ohms		±0.2%	50ppm/°C
Test ranges	Voltage: V-METER, 0~±12.1V	1mV	±0.2%rdg ±3dgt	Input resistance: Approx 200kohms
	Current: A−METER, 0~±81mA	10μA		Input resistance: Approx 10ohms
	Temperature: °C−METER, −25°C~60°C	1°C	±1°C(0°C to 50°C) ±2°C(other temperatures)	Requires 9184 RJ sensor.
Monitor	Load current monitor (with CV range):0~±81mA	10μA	±0.2%rdg ±10dgt	Including effects from output impedance
	Output voltage monitor (with CC range):0~±12.1V	1mV		
	Reference junction temperature monitor : −25°C~60°C	1°C	±1°C(0°C to 50°C) ±2°C(other temperatures)	With 9184RJ sensor
Limiter	Load current limiter (with CV range): 20mA, 40mA, 60mA and OFF		±15%	Not usable with thermoelectric power generation and test ranges.
	Output voltage limiter:2V, 4V, 6V and OFF			

4.Component names and functions

⑥ Reference resistance tarminal

⑧ Common terminal

⑦ Input tarminal

⑨ Output terminal

⑤ AC adapter jack

④ LCD display

③ Potarity select switch

② Output set switch

① Function switch

⑩ Monitor/ zero adjust

⑪ Output on/ off switch

⑫ Limiter set switch

⑬ Switch cover

⑰ RJ sensor jack

Fig. 1

(1) Function switch

When set to the POWER OFF position, the power supply to the 7010 is off. When the indicator is set to any other position, the power is turned on and the selected range is set automatically.

Individual output ranges are set to 0 when another range is selected, and the output turned off.

a. Voltmeter (V)

The voltmeter can measure DC voltage from in the range from -12.100V~12.100V. If input voltage is outside this range, the display will indicate "-DE V" or "DE V".

b. Ammeter (A)

The ammeter can measure DC current in the range from -81.00mA~81.00mA. If input current is outside this range, the display will indicate "-DE mA" or "DE mA".

c. Temperature meter (°C)

Connection of the 9184RJ sensor (option) supports temperature measurement in the range from -25°C ~60°C. If the temperature is outside this range, the display will indicate "-DE °C" or "DE °C". If the RJ sensor is not connected, the display will indicate "RJ Error".

d. TC (0°C) output (TC(0°C))

Output of thermocouple power to K, E, J, T, R and S thermocouples where the reference junction is 0°C.

e.TC(RJ) output (TC(RJ))

After reference junction compensation through the 9184RJ sensor measurement temperature, thermocouple power for K, E, J, T, R and S thermocouples are output. If the RJ sensor is not connected, the display will indicate "RJ Error".

f.Rated voltage output (CV)

The DC voltage indicated within the range -12. 100V~12.100V is output.

g.Rated current output (CC)

The DC current indicated within the range -81. 00mA~81.00mA is output.

h.Memory output (MEMO.OUT)

The data written to the internal memory is used to output any one of TC(0°C), TC(RJ), CV or CC. The display will indicate "Error" if the memory content has been destroyed, and "RJ Error" if TC(RJ) output is selected but the 9184RJ sensor is not connected.

(2) Output set switch

The digit increases or decreases by one count each time the switch is pressed. The setting is continuously variable within the supported range, but where the resulting value is outside the supported range, or where digit change and polarity change are made at once, the value will not be changed. Press and hold the switch to change the digit continuously.

(3) Polarity select switch

This is used to select the polarity of the output value.

The polarity is alternated repeatedly while the switch is pressed. However, the polarity of the display value does not change. The polarity does not change if alternation causes the output value to go out of the set range.

(4) LCD display

Displays essential characters and symbols, such as set values, measured values, polarity (- only), units, output mark (*), memory address, and error messages.

(5) AC adapter jack

Jack to insert the AC adapter.

(6) Reference resistance terminal

Connect a 100Ω reference resistor for the 0°C check of the 100Ω JIS-C1603 standard resistance thermometer.

(7) Input terminal

Connect signals for voltage and current measurement through this terminal and the common terminal. The input resistance is about 200kΩ for the voltmeter range, and about 10Ω for the ammeter range.

(8) Common terminal

This is the common (minus) terminal for input and output.

(9) Output terminal

When output is on, the value specified will be output across this terminal and the common terminal. This terminal is shorted to the common terminal with about

$50k\Omega$ resistance when output is off.

(10) Monitor/zero adjust

This switch offers the following functions:

● Monitor function

When the CC or CV range output is on, the load current or output voltage will be displayed while this switch is pressed. When the TC(RJ) range is selected, the temperature measured by the RJ sensor is displayed while the switch is pressed except in an error state. The limiter set switch and output ON/OFF switch are disabled while the monitor function is operating. The output set switch and polarity select switch are disabled while the monitor switch is pressed.

● Zero adjust function

When this switch is pressed in voltage or current measurement, it is possible to return the display to 0 for any input within the supported range. After that point, the value existing immediately before the switch was pressed is stored (until the function select switch is operated), and the difference between the input value and the stored value is displayed as the measured value. When the switch is pressed again, the stored value is updated to the most recent input, and the new measured value displayed.

When the difference between the input value and the stored value exceeds $\pm 12.100V$ or ± 81.00 mA,

"-DE" or "DE" is displayed.

When the input level is out of the measurement range, the zero adjust function is disabled.

(11) Output on/off switch

This switches the output on or off each time it is pressed. For data write to memory, output on/off can be set and used as the start/stop times for memory output (MEMO.OUT).

(12) Limiter set switch

In the CV range there are four load current limiters (20mA, 40mA, 60mA, and off), and in the CC range there are four output voltage limiters (2V, 4V, 6V and off). If the load current or output voltage exceeds the set value, the limiter will operate and cut off values above the setting. Except during memory output range and monitor use, these settings can be changed during operation.

(13) Switch cover

When this cover is removed the three internal switches indicated below can be seen.

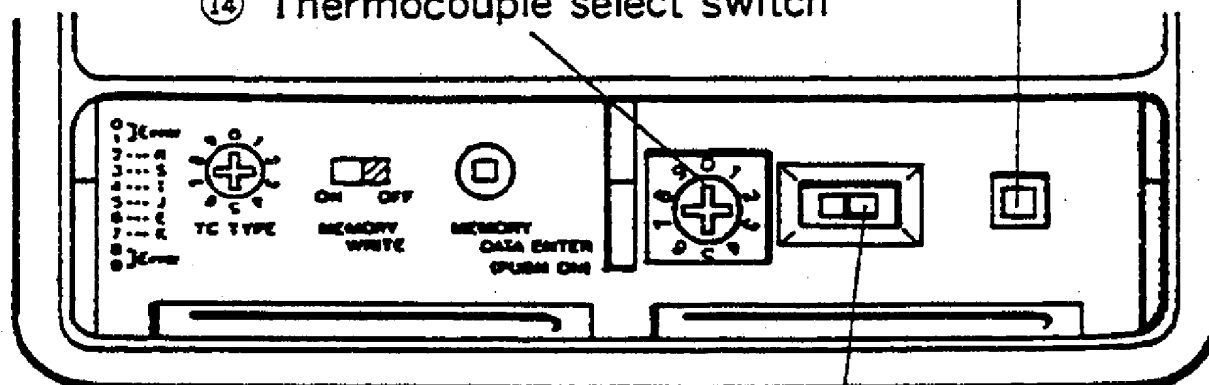Fig. 2

⑯ Memory data write switch
⑭ Thermocouple select switch
⑮ Memory write mode on/off switch

(14) Thermocouple select switch

This is used to set the thermocouple type to be output, for TC(0°C) and TC(RJ) ranges. If the switch setting is changed the output set value is changed to 0, and if the output is on it is automatically switched off. The message "TC Error" will be displayed if the switch is set to 0, 1, 8 or 9.

(15) Memory write mode on/off switch

When any of CV, CC, TC(0°C) or TC(RJ) ranges is switched on, the system switches from output mode to memory write mode, and writes the following data into memory each step, for a maximum of 20 steps.

- Limiter value (CV or CC range)
- Thermocouple type (TC(0°C) or TC(RJ) range)
- Output value
- Output on/off
- Time per step

When it is switched off, the system switches from memory write mode to output mode.

The settings existing immediately before the thermocouple type switch is turned on are written to memory, and cannot be changed during the write process.

(16) Memory data write switch

In the memory write mode after data has been set, it is written to memory when this switch is pressed.

(17) RJ sensor jack

This is used to connect the optional 9184RJ sensor.

5.Operation

5-1 "BATT LoW" display

When the voltage of the internal Ni-Cd battery drops to about 7V, the "BATT LoW" display on the LCD will begin to flash, and all functions except for off will be disabled. The "BATT LoW" flashing will end in approximately 2 minutes, but the system power will not be turned off unless the function switch is turned to the off position.

⚠ CAUTION

- If the system power is left on after the "BATT LoW" display ends flashing, the battery will be overdischarged, and battery life will be shortened.
- If the "BATT LoW" display begins flashing while writing memory data, no further data can be written and memory content will not be updated.

5-2 Recharging internal battery

Use the AC adaptor to charge the Ni-Cd battery in the main unit. Make sure that the power switch is OFF.
Charge the battery for more than 15 hours. Since a weak current is supplied to the battery even after it is fuuly charged, the AC adaptor should be disconnected when the batteres are not being charged.

```
┌─────────────── ⚠ CAUTION ───────────────┐
│                                          │
│  The battery will not be fully charged if the equip- │
│  ment is turned on during charging.      │
│                                          │
└──────────────────────────────────────────┘
```

5-3 Use of external battery

When using an external battery as the power supply, connect a battery with can supply 8 to 9 volts when the load corrent is 500mA to the AC adapter jack. Note that the center of the AC adapter jack in common (-).

```
┌─────────────── ⚠ CAUTION ───────────────┐
│                                          │
│  ● Always insert a fuse in the battery side. │
│  ● If the battery is connected with reverse polar- │
│    ity the internal circuitry will be destroyed. │
│  ● If a battery which supplies 10 V or more when │
│    the load current is 500mA is used, the thermal │
│    protection function will be activated and the │
│    system operation will stop.           │
│                                          │
└──────────────────────────────────────────┘
```

5-4 Voltage and current measurement

(1) Align the function switch with V or A positions.
(2) Connect the input cord to the input and common terminals.

(3) To measure voltage short out the ends of the input cord, and to measure current open them, and then press the monitor/zero adjust switch to adjust the zero.

(4) Connect the end of the input core to the circuit to be measured or the output equipment, and read the displayed value.

⚠ CAUTION

The maximum permissible inputs are ±15V and ±100mA. Never input values outside these limits. Do not set the function switch to the A range when inputting voltage, as it will blow the protective fuse.

5-5 Temperature measurement

(1) Connect the RJ sensor.

(2) Set the function switch to the (°C) position. Start measurement and read the results.

⚠ CAUTION

If the temperature measurement range is selected without the RJ sensor being connected, the message "RJ Error" will be displayed. If the RJ sensor is connected, the equipment can be used in this state.

5-6 Switch cover removal and mounting

(1) Press the sections of the switch cover marked with the words PUSH in the directions of the arrow, as shown in Fig. 3a.

(2) When attaching the cover to the unit, first hook the two tabs (A) into the slots (B), as shown in Fig. 3b, and then press the opposite side of the cover (C) down firmly.
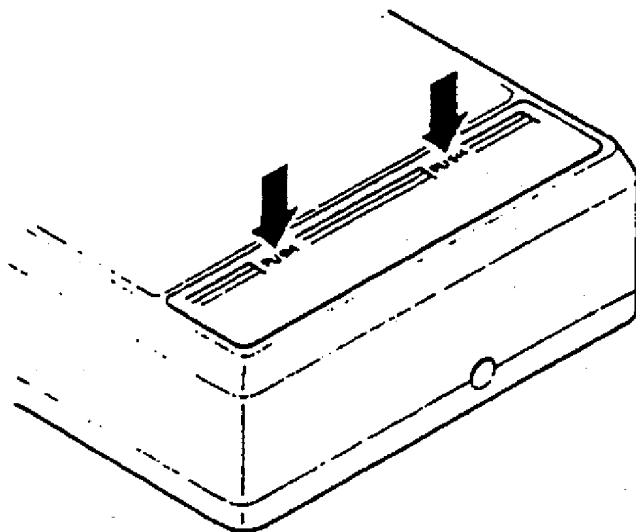
Fig. 3 (a)
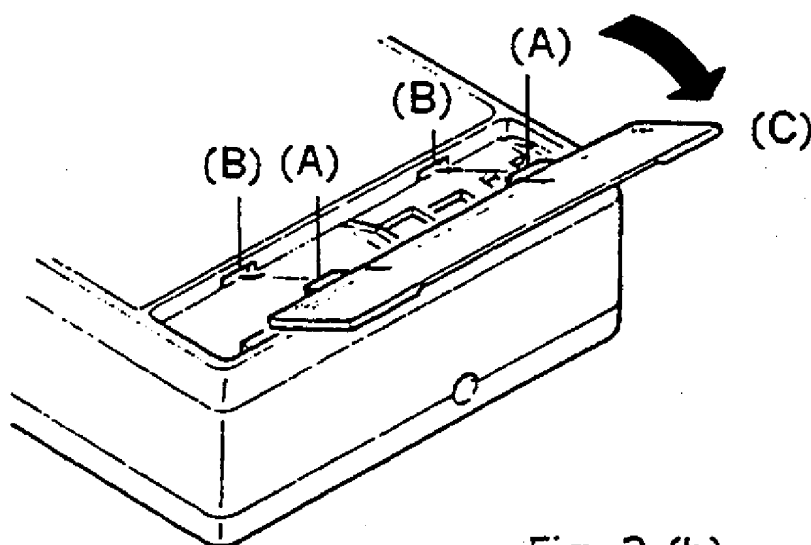
Fig. 3 (b)

5-7 Thermoelectric power output

⚠ CAUTION

- **In this range never apply an external voltage to the output terminal, as it will destroy the internal circuitry.**
- **When using R or S thermocouples in the range of -40~100°C, apply power for about 5 minutes before use.**

In the TC(0°C) and TC(RJ) ranges, use a thermoelectric themometer with an input resistance of at least 100 kΩ. If the input resistance is under 100kΩ, the following error will be added to the specification precision:

$$100 \times [1-Rin/(10+Rin)] \ \%$$

where Rin is the load resistance.

(1) **When using thermocouples without reference junction compensation, or with compensation functions, or where the reference junction temperature is compensated to 0°C with a vacuum bottle or similar system,** set the function switch to TC(0°C), and connect it as indicated in Fig. 4a. The RJ sensor may be connected or not, without effect.
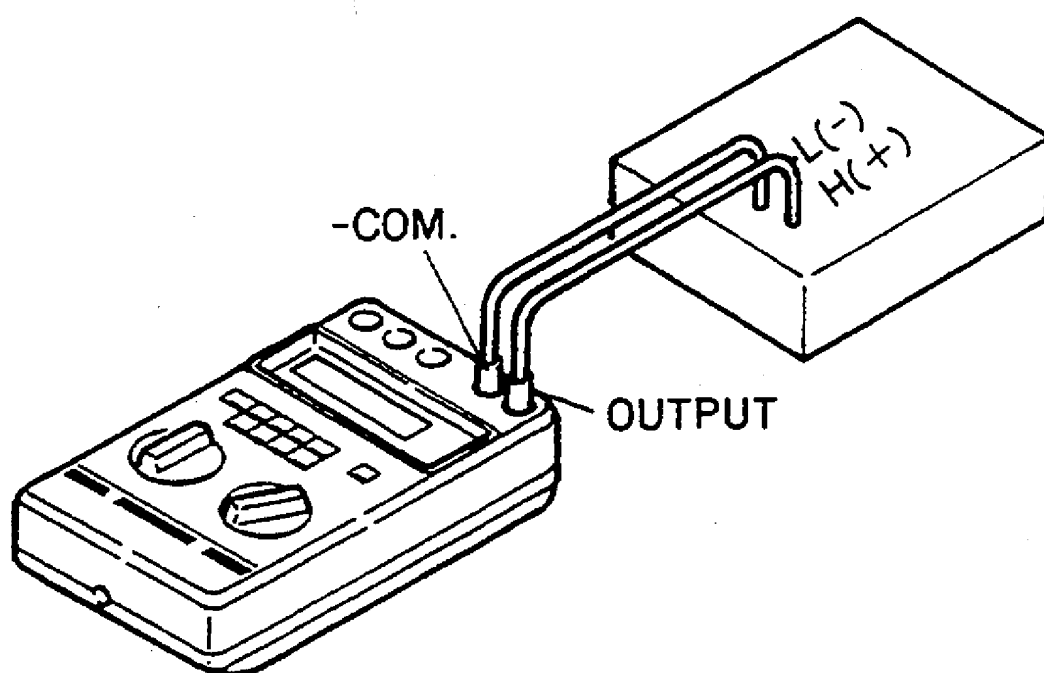
Fig. 4 (a)

(2) **When using thermocouples with reference junction compensation other than those covered in 1) above,** connect the RJ sensor, set the function switch to TC(RJ), and connect as indicated in Fig. 4b or 4c. As indicated in Fig. 4b, connect the RJ sensor close to the thermometer when using copper conductors, or close to the 7010 (Fig. 4c) when using a thermocouple the same type as the thermometer or compensated conductors.
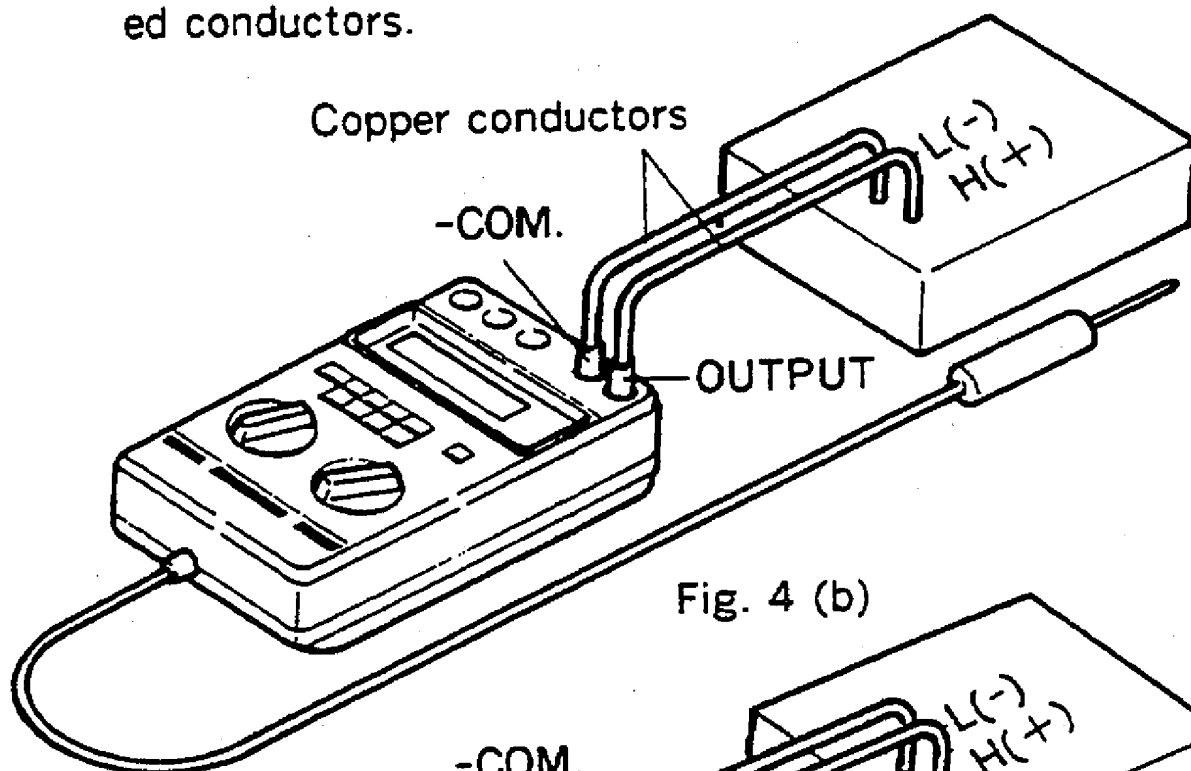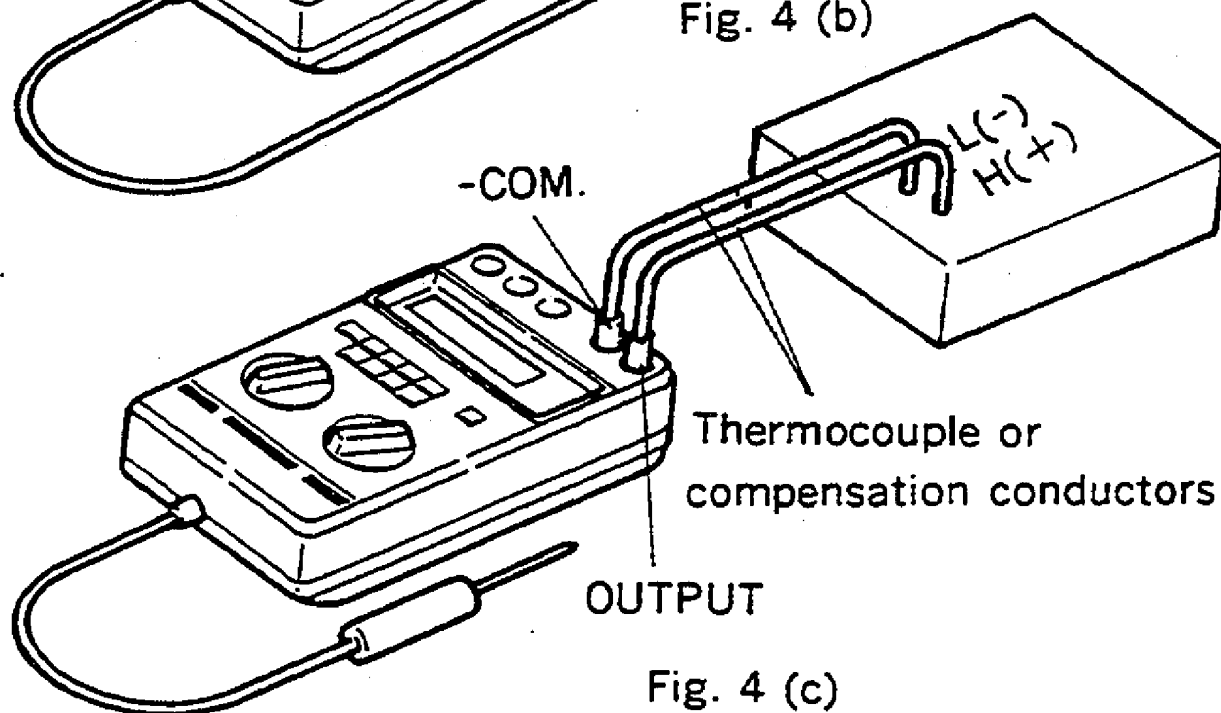
Copper conductors

-COM.

L(-)
H(+)

-OUTPUT

Fig. 4 (b)

-COM.

L(-)
H(+)

Thermocouple or compensation conductors

OUTPUT

Fig. 4 (c)

(3) Remove the switch cover, and use a screwdriver to set the thermocouple select switch to the required position.

Thermocouple select switch
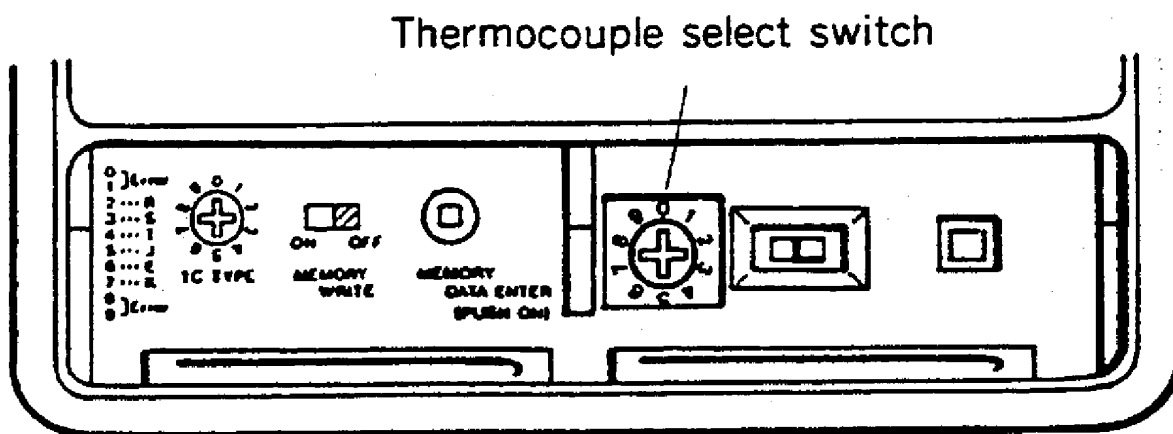
(4) The selected thermocouple type and the initial set temperature of 0 °C will be displayed. Set the desired temperature. The temperature which can be set differs according to the selected thermocouple type. Refer to the specifications for details.

(5) When the output on/off switch is pressed the set value will be output, and at the same time the output mark will be displayed in the left part of the LCD, as shown in Fig. 5a.

OUTPUT MARK　　MINUS MARK
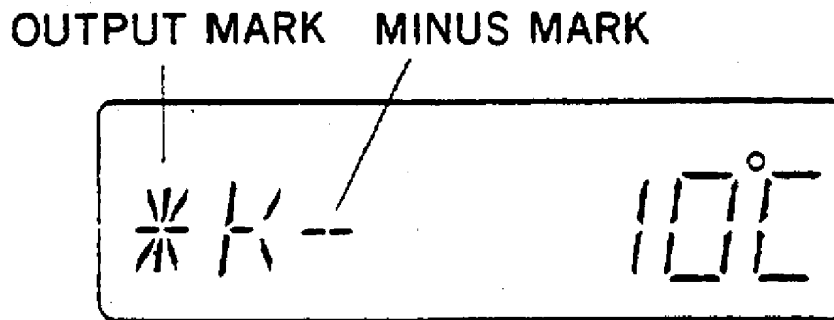
Fig. 5 (a)

○ When the output value is to be altered without halting output, merely change the setting. The displayed value will change, and so will the output. However, response in the TC(RJ) range will be slower.

○ When output in the TC(RJ) range is on, reference junction compensation will be performed about every 6.5 seconds, and the output value compensated. However, compensation will not be performed while the monitor is operating even if the output is on.

△ CAUTION

- In the TC(RJ) range where the detected temperature of the RJ sensor is outside the 0 ~50°C range, or if connection is incorrect, the messages "-DE" or "DE" will be displayed even when the output on switch is pressed, and output will remain off.
  To perform reference junction compensation at a temperature out of the operating temperature range of the main unit, be careful that the ambient temperature of the main unit.

- Pressing the output on/off switch once more will turn off the output, and the output mark will vanish. If an "-DE " or " DE " is displayed the selected value will be displayed again.

5-8 Voltage and current output

(1) Set the function switch to the CV or CC position, connect the load, and read the output value. The supported ranges are -12.100~12.100V in the CV range, and -81.00~81.00mA in the CC range. Where the limiter is off, the maximum load current in the CV range is about 90mA, and the maximum voltage in the CC range is about ±12V. Always set the limiter as needed for the load.

(2) Pressing the output on/off switch outputs the set value, and displays the output mark. The output will change if the set value is changed.

(3) Pressing the output on/off switch again will stop the output, and the output mark will vanish.

5-9 Data store to memory

The memory write flowchart is given below.

```
                    ( START )
                        |
    +-------------------+
    |   +---------------------------------+
    |   |  Set output range to be stored  |
    |   +---------------------------------+
    |                   |
    |   CV/CC    /------------------\    TC(0°C)/TC(RJ)
    |   +-------< Which range ?     >------------+
    |   |        \------------------/            |
    |   |                                        |
    |   |                      +------------------------+
    |   +--------------------->|  Set thermocouple type |
    |                          +------------------------+
    |                   |            |
    |           /---------------\
    +----------<      OK?        >
        NO      \---------------/
                        | YES
        +-----------------------------------+
        |  Turn ON memory write mode switch |
        +-----------------------------------+
                        |
    +-------------------+
    |   +-----------------------------------+
    |   |      Set limiter (CC, CV only)    |
    |   +-----------------------------------+
    |                   |
    |   +-----------------------------------+
    |   |    Turn ON memory data write switch |
    |   +-----------------------------------+
    |                   |
    |   +-----------------------------------+
    |   |          Set output value         |
    |   +-----------------------------------+
    |                   |
    |   +-----------------------------------+
    |   |         Set output on/off         |
    |   +-----------------------------------+
    |                   |
    |   +-----------------------------------+
    |   |   Turn ON memory data write switch |
    |   +-----------------------------------+
    |                   |
    |   +-----------------------------------+
    |   |         Set one-step time         |
    |   +-----------------------------------+
    |                   |
    |   +-----------------------------------+
    |   |   Turn ON memory data write switch |
    |   +-----------------------------------+
    |                   |
    |    NO    /-----------------------\
    +--------< Write completed          >
              \ for desired step ?     /
                        | YES
        +-----------------------------+
        |     Turn OFF memory         |
        |     write mode switch       |
        +-----------------------------+
                        |
                    (  END  )
```

Write part of one address.

In the memory write mode the data items indicated in entries a, b, c, and d of Table 1 are written to one address in memory by pressing the memory data write switch three times. When it is pressed three times, data write to that address is completed and it is possible to write data to the next memory address.

Addresses start from 1, sequence up to 20, and then return to 1 again. The displayed initial values are as indicated in Table 1, but if no data has been written to memory then all values will be 0 and the output on/off setting will be off.

		Displayed initial value
a	Limiter	Value selected by switch
b	Output value setting	Data stored in memory (value)
c	Output on/off setting	Data stored in memory (on or off)
d	1 step time	Data stored in memory (step time)

Table 1

⚠ CAUTION

● **When writing data into memory, it is recommended to use the provided AC adapter. If the "BATT LoW" indicator blinks, the written data will be lost.**

5-9-1 Data write preparation

(1) Set the function switch to any of TC(0°C), TC(RJ), CV or CC ranges.

- If TC(0 °C) or TC(RJ) is selected, set the thermocouple select switch to one of K, E, J, T, S or R types.
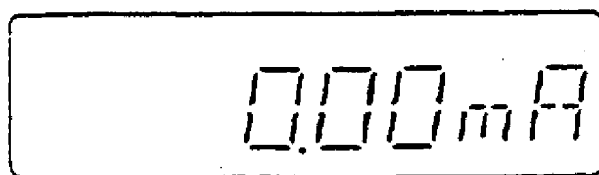
(2) Remove the switch cover and set the memory write mode on/off switch to the on position. The following display will appear:
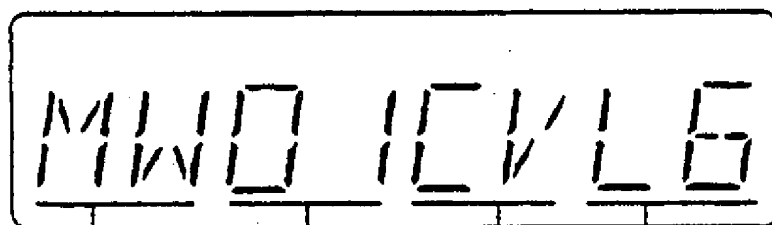
memory write mode display	address	range	limiter sisplay
	1	CV ···CV	L2 ···20mA/2V
	2	CC ···CC	L4 ···40mA/4V
	:	T0 ···TC(0°C)	L6 ···60mA/6V
	20	TR···TC(RJ)	LF···OFF

5-9-2 Limiter set

(1) Set the limiter if the CC or CV range is used.

(2) When the memory data write switch is pressed the display will change to the following (however, if the range is the same, the previously set value will be displayed).

```
 0.00mA          R        0C
```


⚠ CAUTION

○ **Even if data is written to memory, the output value will become 0 and the output on/off become off in the following situations:**

○ **If the range written to memory is different from the newly selected range.**

○ **If the thermocouple type written to memory is different from the newly selected thermocouple type, in the TC(0°C) or TC(RJ) ranges.**
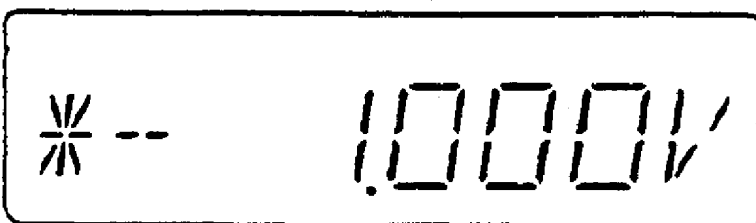

5-9-3 Setting output value
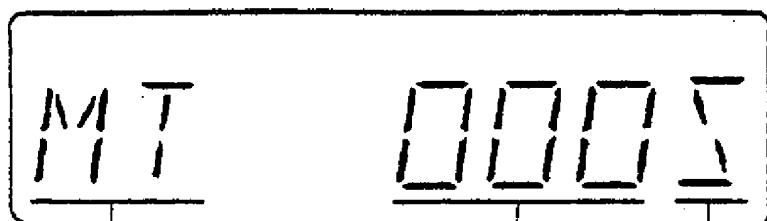
Example   CV -1,000V

(1) Set the output val-
ue with the output
set switch.
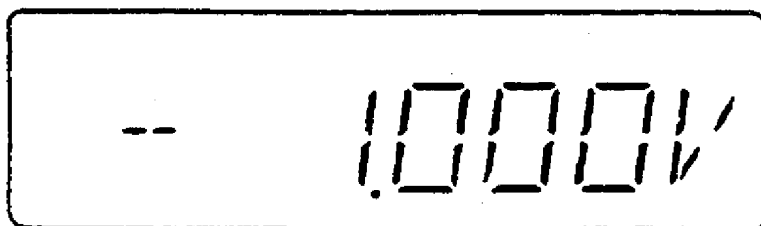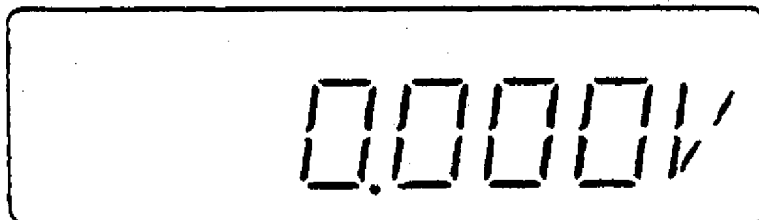
(2) Set the output on/
off with the out-
put on/off switch.
The output mark
will be displayed if
output is set to
on.

(3) Press the memory
data write switch
to change the dis-
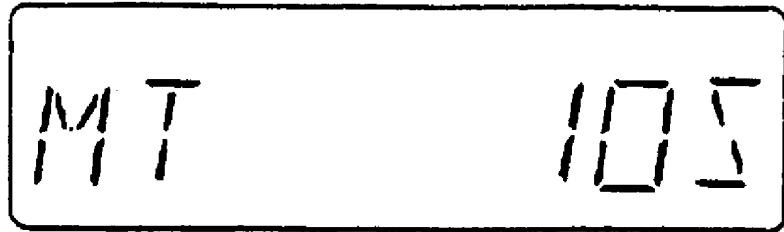play to the one to
the right, and
advance to 5-9-4
below.

Set time mark   Set timing   units
                                1~100sec   (sec.)

5-9-4 Step time set

(1) Set the step time with the output set switch (a time of 0 will be displayed, but memory write will not occur).

```
MT        105
```

(2) Press the memory data write switch. When data is written to one address, the system will wait for input to the next address. Repeat the above steps to write data to all address sequentially.

```
MW02CVL6
```
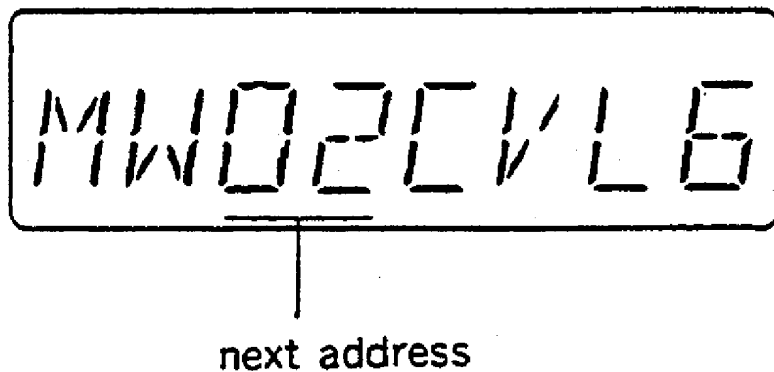
next address

5-9-5 Write termination

After data for the desired number of steps have been stored to memory, the memory write mode on/off switch can be turned to the off position when the next address is displayed. The last address data was stored to will be stored in memory as the last address of the run, and the system will shift to the output mode.

△ CAUTION

● **After data has been written to all 20 addresses, be sure to turn the memory write mode on/off switch to off at address 1. If the switch is turned to off at address 2 or later, the end address will change. When verifying or editing data, always turn the memory write mode on/ off switch to off at the address after the end address.**

● **If data content is to be verified without editing, set the limiter switch and thermocouple type select switch to the same settings as the data, and then press the memory data write switch.**

● **If the function switch is turned to TC(0°C), TC(RJ), CV or CC positions with the memory write mode on/off switch in the on position, the "Error" message will be displayed. If the function switch is then returned to the original position, data write may be continued nor-**

mally. If the function switch is turned to other positions, the end address will be written in memory and the memory write mode is terminated.

- If the data write for the first address has not been completed, memory content will not be altered even when the memory write mode on/off switch is turned to off.

- In the TC(0°C) or TC(RJ) ranges, it is impossible to change the thermocouple type selection in the memory write mode.

5-10 Memory data output

In the memory output range, output for any one of TC(0°C), TC(RJ), CV or CC ranges can be performed continuously from memory data.
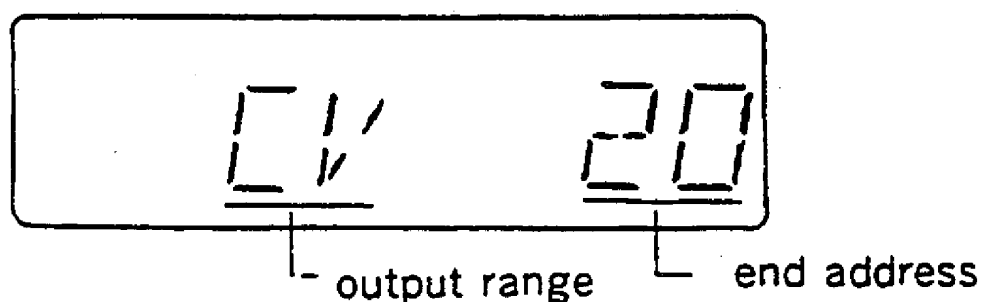
The operation is endless, sequencing up from address 1, and returning to address 1 after the end address. The output continues until either the output on/off switch is pressed or the range is changed.

For addresses where the output is set to off, there is no output, but the output value setting will be displayed.

⚠ CAUTION

If TC(RJ) range data is included in memory, connect the RJ sensor.

(1) Set the function switch to the MEMO.OUT position, and the display will indicate the range and end address written in memory, as indicated below.

```
 _____
|                           |
|    [ l /      ] [         |
|    L l/       C ] []      |
|    ‾‾|‾‾        ‾‾|‾‾      |
 ‾‾‾‾‾|‾‾‾‾‾‾‾‾‾‾‾‾‾|‾‾‾‾‾‾‾
      output range   end address
```

TO ···TC(0℃)
TR ···TC(RJ)
CV ···CV
CC ···CC

(2) When the output on/off switch is pressed, the set output value will be displayed. At the same time, output will be turned on, and the output mark displayed. If output has been set to off, the output value will be displayed only.

(3) When the time set in the memory passes, the set output value for the next address is displayed, then data stored in that address is displayed and output.

● Even if the function switch is set to the MEMO.OUT range, the load current, output voltage or temperature measured with the RJ sensor can be read with the monitor function. However, since the clock count stops while the monitor is operating, the operating time is elongated by 1 step.

(4) To stop output, press the output on/off switch.
   During output, output will be stopped, the output mark vanish, and the clock will halt. If output is set to off when the output off switch is pressed, the display will not change and clock operation will halt.

(5) To restart operation, press the output on/off switch. Operation will start from the same address the sequence was halted at, and the time for that output will be the time remaining from the preset output time.

┌──────────────── ⚠ CAUTION ────────────────┐
│ ● For data in TC(0°C) and TC(RJ) ranges, the │
│   actual output timing will differ from the set │
│   timing because of time required for calcula- │
│   tion, as indicated in Fig. 6. Where output time │
│   for the TC(RJ) range is set to over about seven │
│   seconds, the time required for reference junc- │

tion compensation will be added. The output mark will not be displayed during calculation, with the exception of compensation.

- Whenever possible, first stop operation before changing the function switch selection.
- If data is not written to memory correctly, the message "Error" may be displayed. In this case, verify the data in the memory write mode.
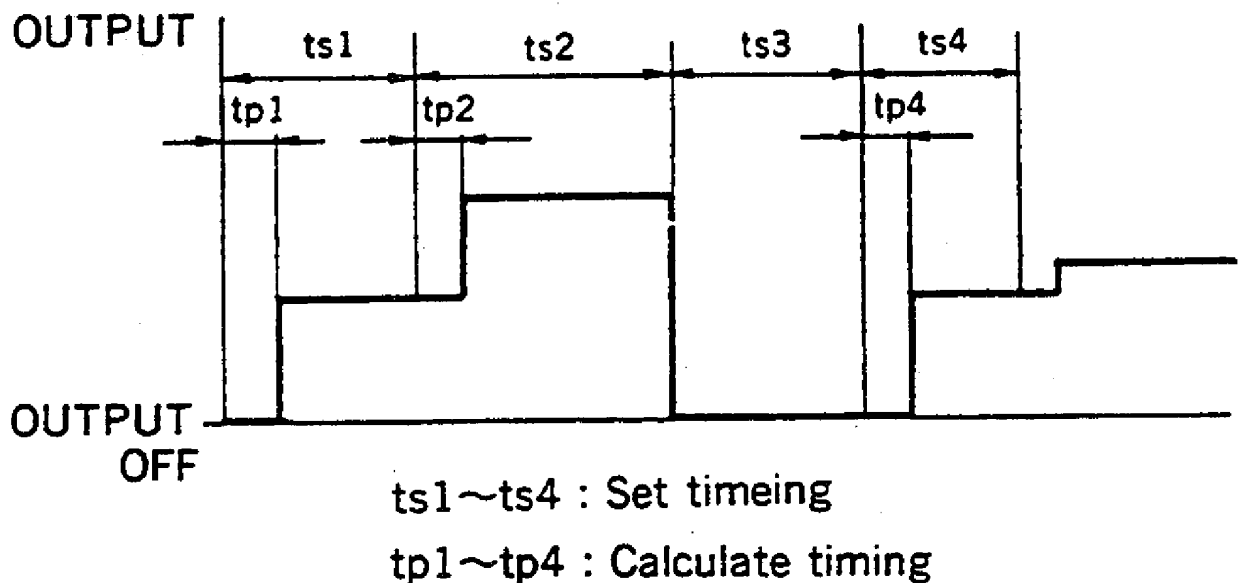
ts1~ts4 : Set timeing

tp1~tp4 : Calculate timing

Fig. 6

6.Application example: battery charge/discharge characteristics measurement

As indicated in Fig. 7, the 7010 can handle current supply (source) and use (synch) to the load.
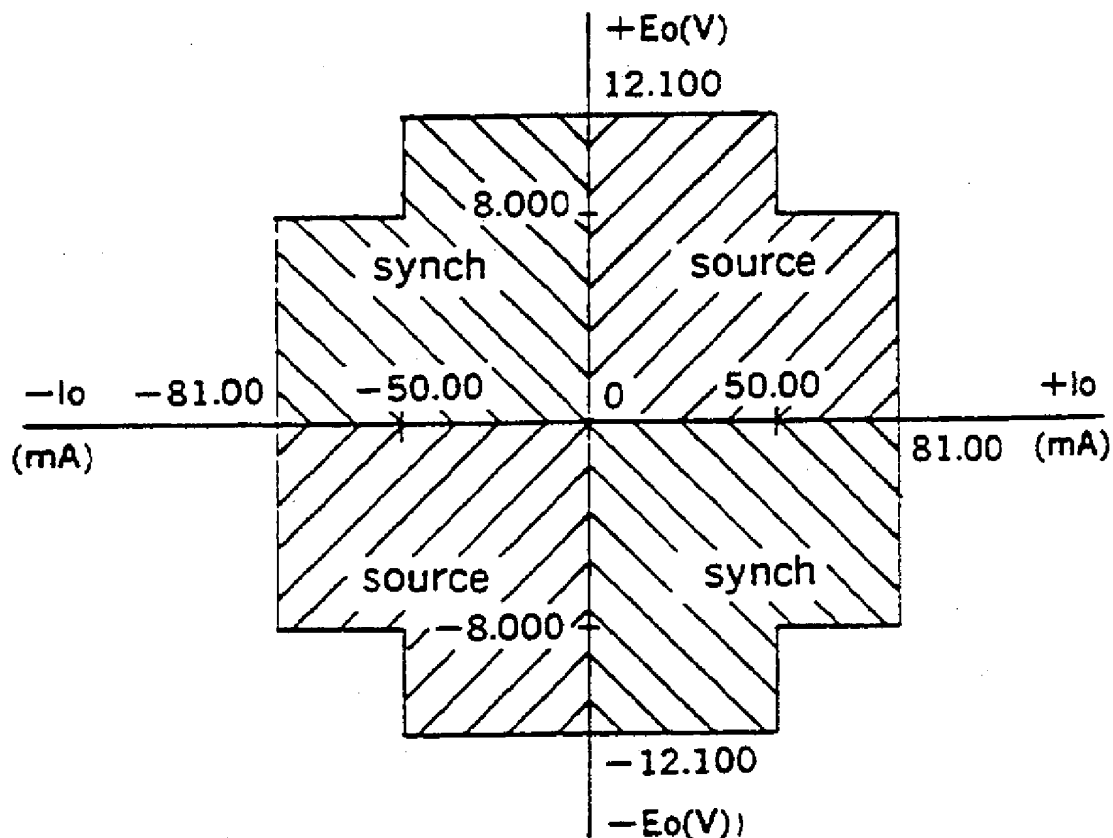

Fig. 7

As an example of 7010 application, the source function is used below to measure the charge characteristics of a small battery, and the synch function to measure the discharge characteristics.

```
┌─────────── ⚠ CAUTION ───────────┐
│                                        │
│  ● For charge and discharge tests, always use the │
│     accessory AC adapter.              │
│  ● When output is turned off the output terminal │
│     is shorted to the common terminal with about │
│     50kΩ, so do not leave the equipment with the │
│     battery connected.                 │
│                                        │
└────────────────────────────────────────┘
```

6-1 Rated voltage charge characteristics

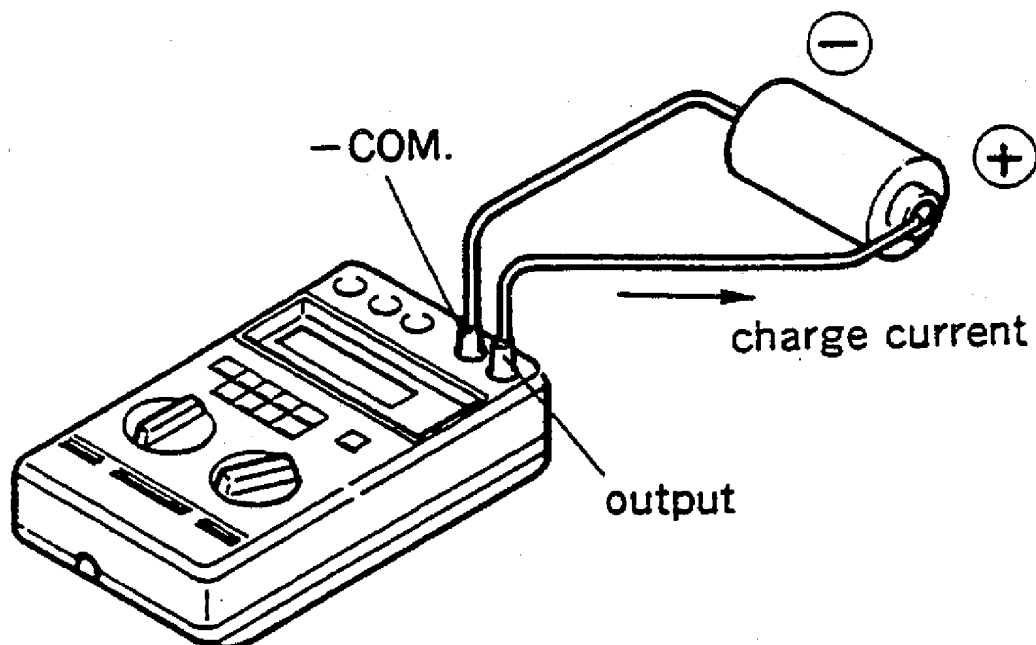(1) Set the function switch to CV, and connect the bat-
   tery as shown in Fig. 8.

Fig. 8

(2) Use the output set switch to set the output voltage (final battery charge voltage), and set the limiter for maximum charge current.

(3) Press the output on/off switch to start charging.

(4) Read the charge current with the monitor switch periodically, and plot the relation between voltage and charge time to determine charge characteristics.

┌─────────────── △ CAUTION ───────────────┐
│ ● **Always set the limiter to a value, not to off.** │
│ ● **If the set output voltage is lower than the** │
│   **voltage of the battery a discharge situation will** │
│   **be created, so always set the voltage higher** │
│   **than that of the battery.** │
└──┘

6-2   Rated current discharge characteristics

(1) Set the function switch to CC, and connect the battery as shown in Fig. 9.

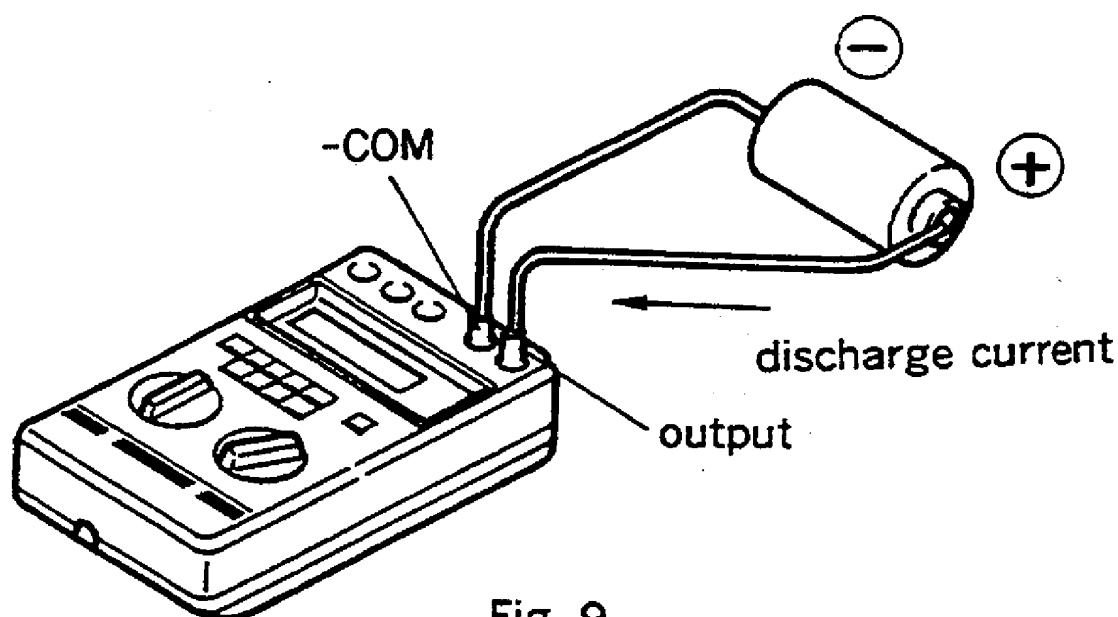Fig. 9

(2) Use the output set switch to set the discharge current (load polarity), and set the limiter to off.

(3) Press the output on/off switch to start discharging.

(4) Read the output voltage (battery terminal voltage) with the monitor switch periodically, and plot the relation between battery voltage and discharge time to determine discharge characteristics.
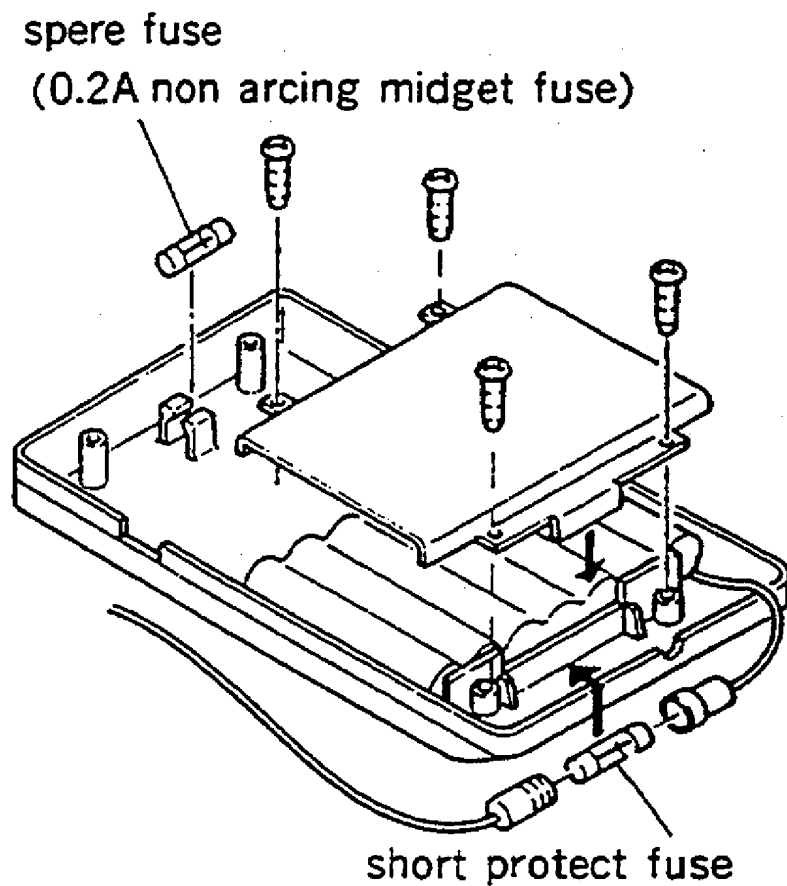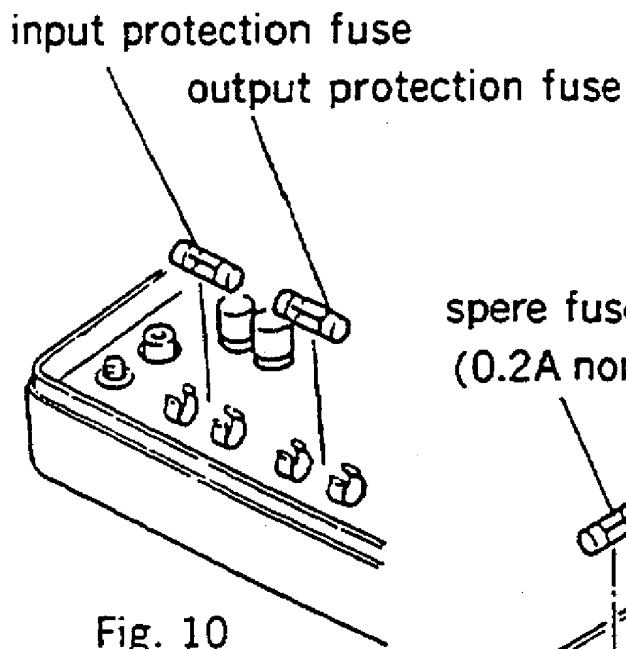

⚠ CAUTION

- **Always set the limiter to off.**
- **Where the set output current is plus the charge state will be created, so be sure to specify minus polarity.**
- **When current supply from the battery ends, the output terminal will generate a load voltage, and begin to charge. Terminate measurement when the monitor value approaches 0V.**

7.Fuse replacement

The 7010 is equipped with a total of three midget fuses (5.2d × 20 mm), two to protect the input and output circuits, and one to prevent battery short (see Fig. 11). Replace a blown fuse through the following procedure.

(1) Turn off the power and remove the AC adapter.

(2) Remove the two screws from the 7010, and open the lower case.

input protection fuse

output protection fuse

Fig. 10

spere fuse
(0.2A non arcing midget fuse)

short protect fuse

Fig. 11

.(3) For the I/O protection fuses, replace the blown fuse on the PCB with a spare of the same specifications (0.2A). For the battery short protection fuse, remove the battery mount and replace the inline fuse with a spare of the same specifications (2A).

(4) Mount the lower case and retighten the screws. Turn on the power and verify that operation is normal.

△ CAUTION

- **Never use fuses other than those of the specified size and ratings.**

- **If abnormalities such as no output, no measurement or no power when the AC adapter is removed are noticed, check the fuses.**

- **After replacing the short protect fuse, be sure to tighten the terminal connector from the PCB together with the battery mount.**

8.Ni-Cd battery replacement

The service life of the Ni-Cd cells mounted in the 7010 is about three to five years, but they may fail in shorter times due to use conditions. If they can only be used for a short period of time after being charged, it is possible that they have failed, and they should be replaced through the procedure outlined below. Be sure to replace them with Ni-Cd batteries for the 7010, available from your vendor or the manufacturer.
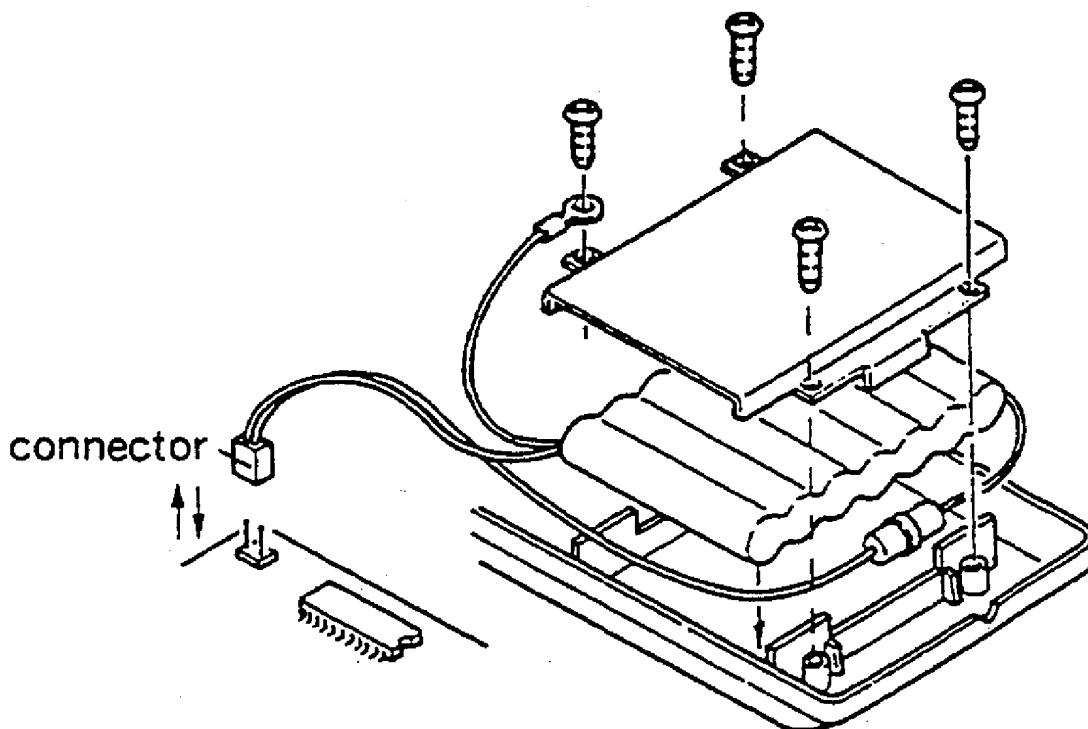
(1) Turn off the power, and remove the AC adapter.

connector

Fig. 12

(2) Remove the two screws from the rear of the 7010, open the lower case, and remove the battery connector from the PCB.

(3) Remove the four screws from the inside of the case, remove the old batteries, and insert the new ones.

(4) Connect the lead from the new batteries to the PCB, mount the lower case, and retighten the screws.

(5) Always charge the batteries before use.

△ **CAUTION**

● **Disassembling batteries or disposing of them in fire is extremely dangerous.**

● **Never use these batteries in other instruments, or use batteries intended for other instruments in the 7010.**

● **When the batteries have been replaced, be sure to tighten the connector from the PCB together with the battery mount.**

● **Battery must not disposed at other then the specified place.**

ATTENTION

The product that you have purchased contains a rechargeable battery. The battery is recyclable. At the end of it's useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream. Check with your local solid waste officials for details in your area for recycling options or proper disposal.

7010A981-03 94-2-002U 78320040