OPERATION MANUAL

DIGITAL STRAINMETER

TC-31M

Tokyo Sokki Kenkyujo Co., Ltd.

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NOTICE

Thank you for having purchased our Digital Strainmeter TC-31M. Please read this operation manual thoroughly to familiarize yourself with the functions and operating procedures of this product. This will enable you to make maximum use of all its functions and ensure efficient and accurate measurement.

Each user is requested to note the followings.

1. Follow the "Caution" in this manual to ensure stable performance and a long service life.
2. We have made every effort to provide accurate information in this manual. However, if you should have any questions or comments, please feel free to contact us.
3. The contents of this instruction manual are subject to change without notice for the purpose of product improvement.
4. Tokyo Sokki Kenkyujo Co., Ltd. shall not take any responsibility, despite item 2 above, for claims of loss and/or damage arising from the operation of this product.
5. Reproduction or reprinting of this instruction manual, either partially or totally, without permission from Tokyo Sokki Kenkyujo Co., Ltd. is strictly prohibited.
6. Please keep this manual always ready to use.

GUARANTEE

This product has been carefully examined by our in-house inspection division before delivery. If it malfunctions due to a manufacturing fault or an accident during shipment, please report on the condition to your nearest dealer or directly to Tokyo Sokki Kenkyujo Co., Ltd. The guarantee period of this product is twelve months from the date of delivery. If the product goes out of order or is broken during this period, we will repair it free of charge. However, this free guarantee repair service will not apply in the case of trouble or damage caused by improper handling of the product, remodeling or modification by the user, or an act of God.

The company and product names referred to in this manual represent trade names or registered trademarks.

This operation manual applies to software version 1.0A.

⚠ CAUTION

Observe the following instructions to ensure stable and reliable operation of this instrument.	
◎ **Operating temperature and environment**	Operate the instrument at a temperature between 0 and +50℃. If the operating site is exposed to direct sunlight or an extremely low temperature, arrange for shade or a thermal insulating material.
◎ **Drip-proof characteristics**	This instrument applies to IP-54 level of drip-proofing (stands for spray from all directions) with its cap put on the connector. Never submerge the unit in water. Be careful that the unit is not drip-proof if the connector cap is removed.
◎ **Flammable environment**	Do not operate the instrument in a place where there is flammable gas or flammable steam. This may cause a fire.
◎ **Other environmental conditions**	Sudden changes in outside temperature may cause dew condensation. Leave the instrument in the desired operation site for a certain length of time before turning on the power supply. Do not leave it for long in direct sunlight or freezing temperatures.
◎ **Powder, dust, etc.**	Powder or dust inside the instrument may cause poor contact or a lowered insulation effect in the connector. Pay special attention, during use and storage, not to allow dust to enter the instrument.
◎ **Vibration or impact**	Do not subject the instrument to excessive vibration while in operation. Do not subject it to strong impacts, such as by dropping, during transportation. Strong impacts or vibrations may cause malfunctioning of the instrument.
◎ **Protective measures for transportation**	When transporting the instrument, use the packaging materials that were used in delivery to protect it from vibration and impacts.
◎ **Strong electromagnetic field**	The instrument may malfunction if either the unit or its wiring is placed near such machines as a large motor, crane, transformer, or welding machine. When extending the sensor to a place subject to a strong electric field, such as near a power substation or radio transmission station, use a special cable such as a shielded cable.
◎ **Thunderbolts**	The instrument is vulnerable to the dielectric effect of thunderbolts. Take preventive measures against thunderbolts where applicable. Contact your dealer or Tokyo Sokki Kenkyujo for details.
◎ **AC Power supply**	If the instrument is used where there is a chance of lowered or fluctuating voltage or power failure, use a constant voltage unit or a commercial synchronous type UPS (uninterruptible power supply).
◎ **Switching Power ON/OFF**	When switching the power supply from OFF to ON or vice versa, keep an interval of at least 5 seconds. Otherwise, there may be too much of a load on the instrument.
◎ **Grounding cable**	Never connect the grounding cable to a gas pipe. In addition, make it a rule to disconnect the power supply cable before connecting or disconnecting the grounding cable so as to prevent a fire or electric shock.
◎**Connection cables**	Do not forcibly pull any connection cable. Otherwise, the cable will be disconnected or the connector will be pulled out. Be careful not to subject the connector elements to strong impacts. The connector elements must be free of soil, mud, water, and oil.

CAUTION (Continued from the previous page)

◎ **Disassembly**	It is not recommended for the user to disassemble or remodel the instrument. Such a do-it-yourself action may cause an electric shock or a malfunction.
◎ **Do not place heavy object**	Do not place a heavy object on the instrument.
◎ **Battery**	Use alkaline dry batteries LR6 (AA size) on the market. Do not mix new and old or different types of batteries, since it may cause electrolyte leakage or explosion which gives damage to the instrument. Remove batteries if this instrument may not be operated with batteries for a long time.
◎ **Cleaning**	When the housing of this instrument needs cleaning, wipe it with a soft cloth soaked in a dilute solution of neutral detergent, then dry it well with a cloth. Never use strong solvents such as thinner, which may melt or change the color of the surface coating.

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1. STANDARD ACCESSORIES

This equipment includes the following standard accessories. After opening the package, confirm that all the accessories come with the equipment.

TC-31M Standard accessories	
1. Operation manual	1 copy
2. AA size alkaline battery(LR6)	4 pcs.
3. Strap	1 pc.
4. Accessory box	1 pc.
5. Certificate of guarantee	1 copy
6. Inspection sheet	1 copy

2. GENERAL

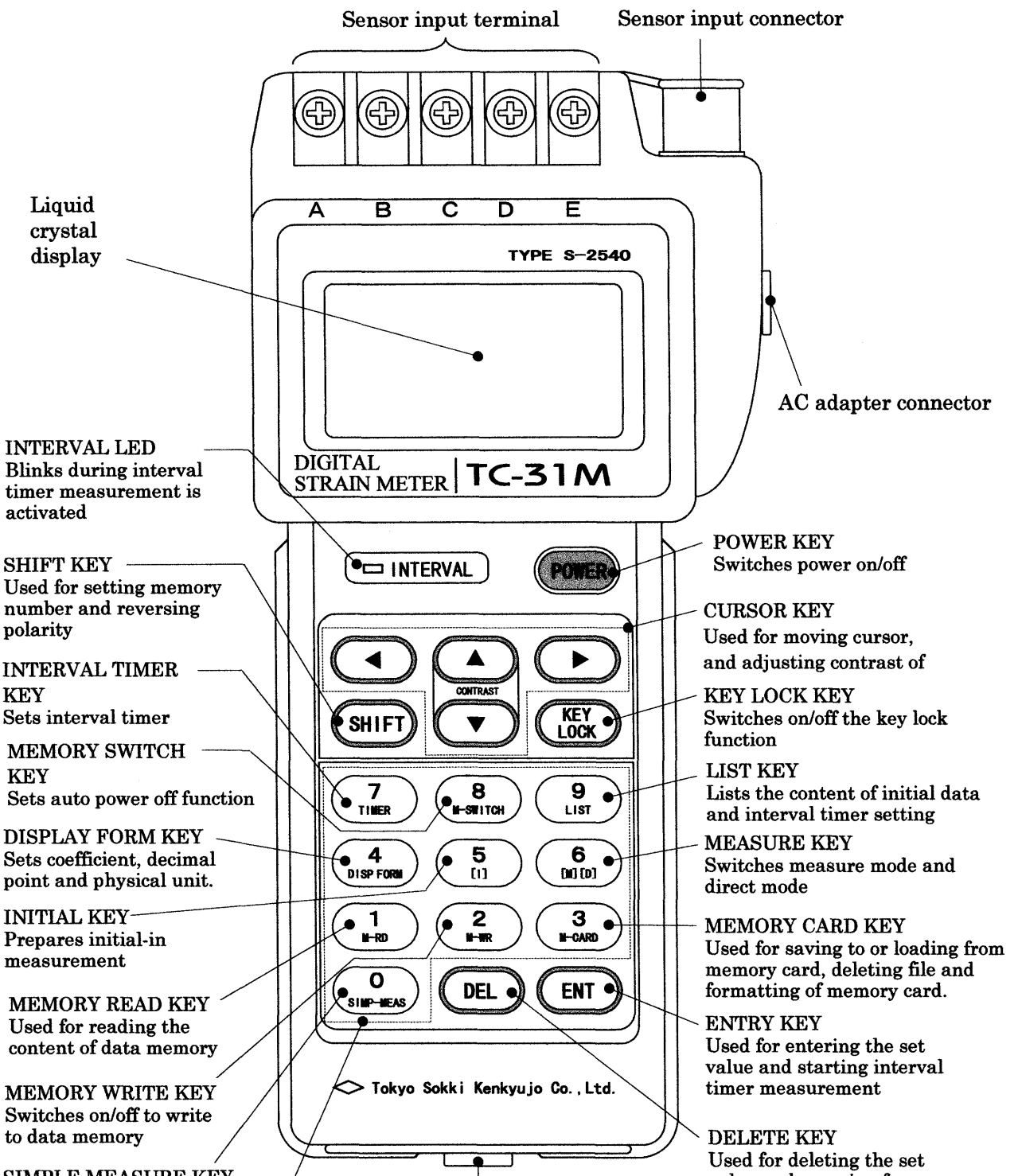
2. 1 GENERAL

This equipment is a portable hand held strainmeter dedicated to the measurement of full bridge method.
Even though it is constructed light and small, it enables measurement up to $\pm 30000 \times 10^{-6}$ strain with resolution of 1×10^{-6} strain, which equals to the accuracy that of upper grade model. Data memory function for storing the measured data and interval timer function for starting automatic measurement are also provided. Stored data can easily be transferred to the personal computer or equivalent using flash memory card (optional item).
It is powered by AA size alkaline dry batteries for use where AC power source is not available. Optional AC adapter can also be used as a power source.

2. 2 FEATURES

- Best suited for on-site measurement with its hand held construction
- Measurement accuracy equals to that of upper grade instrument
- Data memory function for storing 10000 data at maximum
- Sleep interval function for long term unmanned measurement
- Content of data memory can be transferred to flash memory card
- Operated by AA size alkaline dry batteries
- Drip proof construction (IP-54)

2. 3 NAME OF EACH PART

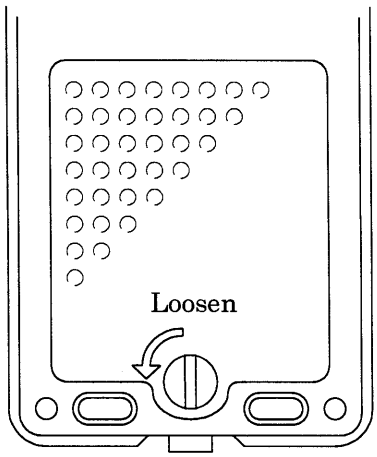


3. BEFORE OPERATION

3.1 BATTERIES

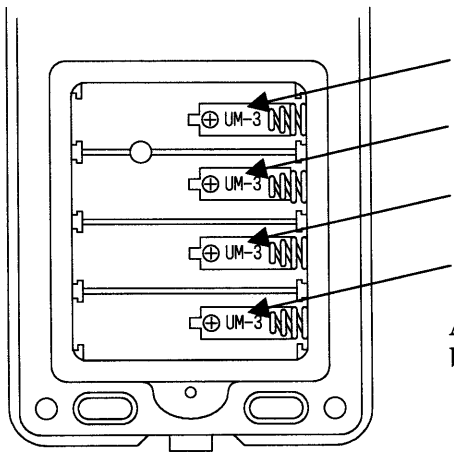
3.1.1 INSTALLING BATTERIES

Remove the battery cover.



Loosen the screw with a coin or a screw driver and remove the battery cover.

Install four AA size alkaline dry batteries (LR6) in the battery case. Be sure to orient each battery properly as indicated.



AA size alkaline dry batteries (LR6) × 4

⚠ CAUTION

Improper handling of batteries may cause explosion or electrolyte leakage.
Be sure to observe the following rules.

- Orient each battery correctly as indicated.
- Do not mix different types of batteries or new and old batteries.
- Remove batteries from the instrument when it is not operated by batteries for long time.

3.1.2 DURATION OF BATTERIES

Operative time using batteries depends on the conditions such as the type of connected sensors and environmental temperature.
Following charts indicate the standard operative time using new alkaline batteries.

Operative time

Continual measurement	1 minute interval measurement	10 minutes interval measurement	1 hour interval measurement	3 or more hours interval measurement
8 hours	60 hours	500 hours	2800 hours	7200 hours

☆ On condition that the resistance of connected sensor is 350Ω and environment temperature is +25℃±5℃.
☆ Interval measurement should be operated with sleep interval function.
If sleep interval function is not activated, operative time may be same as that of continual measurement.

If  mark blinks on the upper side of the display, battery voltage is low. Replace all four batteries with new ones.

3.1.3 BACKUP DURATION OF DATA MEMORY

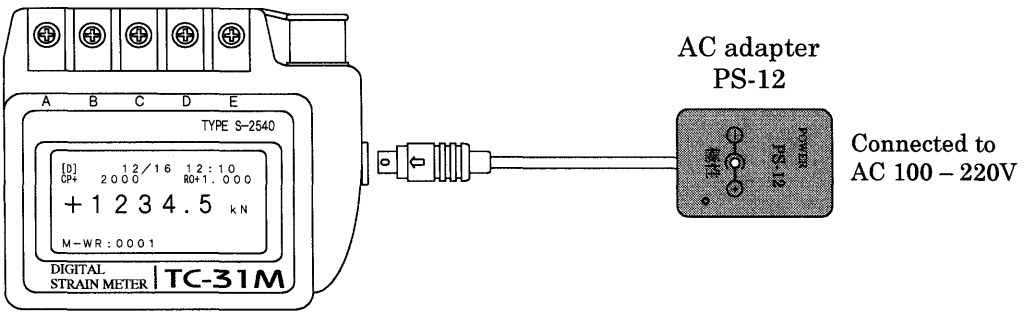
Contents of data memory and set programs are maintained by power source battery. In addition, this instrument has a rechargeable battery inside to maintain the memory while the power source battery is exhausted or removed. Backup duration by this battery is approximately 10 days after power source battery is exhausted or removed.
If this instrument is left without power source battery for a long time, backup battery may be fully discharged and the set programs may become a meaningless value. In this case, press and hold (DEL) key and turn on the power to initialize the instrument. Each setting will be as follows after this operation.

Initial value	: ＊＊＊＊＊＊＊	Measure mode	: [D]
Cap. value	: +2000	Point value	: 0
Unit value	: 0 (με)	RO value	: +1.000mV/V
Auto power off	: on	Simple measure	: No
Interval program	: S1 01:00:00 N00		
	S2 00:00:00 N00		
	S3 00:00:00 N00		
	S4 00:00:00 N00		
	S5 00:00:00 N00		

However, content of data memory is not cleared by this initializing operation. To clear the content of data memory, refer to 5.3 CLEARING DATA IN DATA MEMORY.

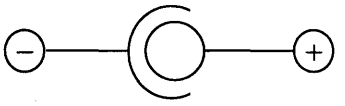
3.2 CONNECTING AC ADAPTER

AC adapter PS-12 is an optional item used to operate TC-31M with AC 100 - 220V (50Hz or 60 Hz) power source.



Connector specification of CONT input

Connector	EIAJ standard	No.RC-5320A	Applicable to JSAJ3
Polarity	Center plus		



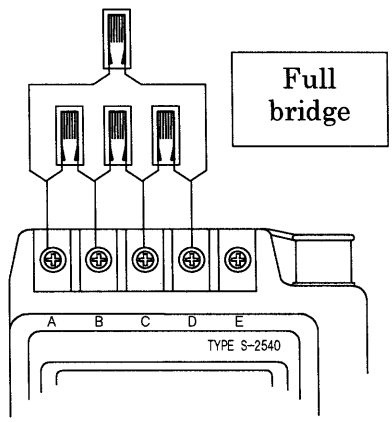
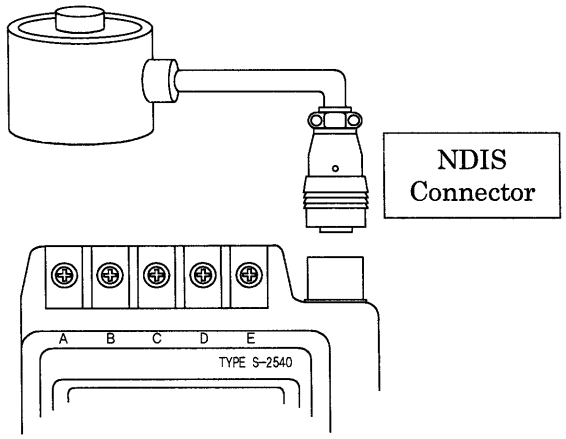
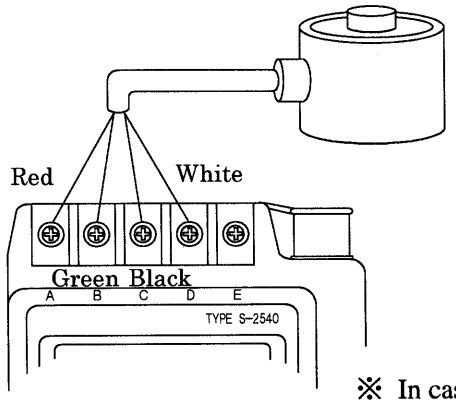
⚠ CAUTION

Be sure to observe the following rules to avoid malfunctioning of TC-31M.

- Never connect an AC adapter other than PS-12.
- Connect AC adapter to TC-31M prior to connecting it to AC power source.

3.3 CONNECTING SENSOR

Method of connection depends on the type of sensor. Refer to the following figure for connection.

Sensor	Connection
Strain gauge (Full bridge only)	
Strain gauge based transducer (With NDIS connector attached to the end of the cable)	
Strain gauge based transducer (With loose end)	 ※ In case of TML's transducer

⚠ CAUTION

Color code of cable depends on the manufacturer. In case of connecting other transducer than TML's, refer to the operation manual of used transducer for connection.

3.4 COUNTERMEASURE TO THUNDERBOLT

In an on-site measurement where connection cable between TC-31M and sensor are extended, surge voltage induced by lightning often affects the sensor and/or TC-31M, even if they are not struck by direct thunderbolt. As this surge voltage sometimes gives serious damages to the instruments, suitable countermeasures is indispensable.

Instrumentation arrester

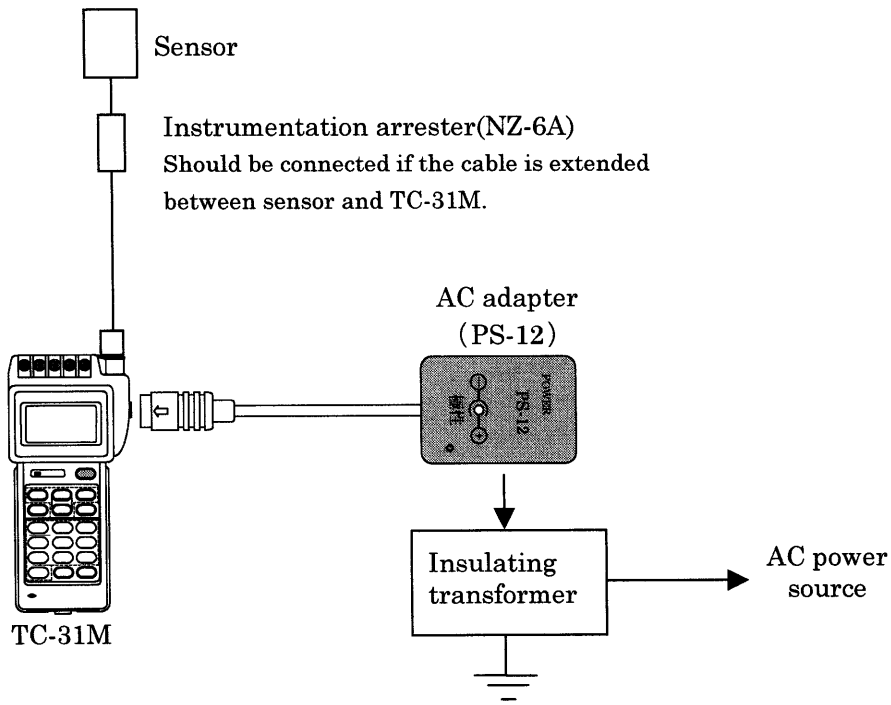
Instrumentation arrester NZ-6A is connected between a strainmeter and a sensor. It reduces incoming surge voltage from the sensor to protect the strainmeter.

NZ-6A should be connected as near to the sensor as possible.

Insulating transformer

Surge voltage induced by lightning comes not only from the sensor connection cable but also from the commercial power source.

In case of supplying power from commercial AC power source by using AC adapter, it is recommended to connect insulating transformer between AC adapter and power source to reduce the effect of incoming surge voltage from power source.

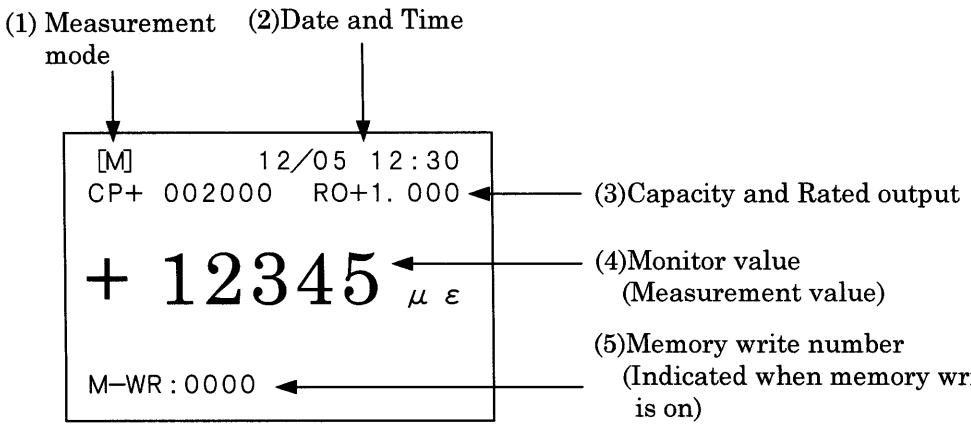


4. POWER ON AND EASY MEASUREMENT

4.1 POWER ON

4.1.1 DISPLAY AFTER POWER ON

The following display will be indicated and measurement will be started after turning power on by pressing (POWER) key.



Monitor display

(1)Measurement mode	This is selected measurement mode. [M] : Measure mode (initial value is deducted) [D] : Direct mode (initial value is not deducted)
(2)Date and Time	This is date and time at present
(3)Capacity and Rated output	This is set capacity and rated output
(4)Monitor value (Measurement value)	This is measured value " ＊＊＊＊＊＊＊" is indicated if sensor is not connected or connected sensor is broken "+＊＊＊＊＊＊＊" is indicated if value is +over. "−＊＊＊＊＊＊＊" is indicated if value is −over.
(5)Memory write number	This is indicated when memory write is set on.

Power will be turned off by pressing (POWER) key again.

⚠ CAUTION

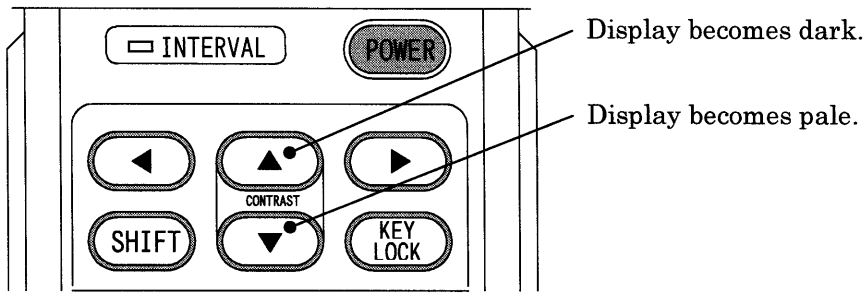
Power is not turned off in the following conditions even though pressing (POWER) key.

- Interval measurement is activated with interval of 10 seconds or less.
- It is 10 seconds or less until next start of interval measurement.

4.1.2 CONTRAST ADJUSTMENT OF DISPLAY

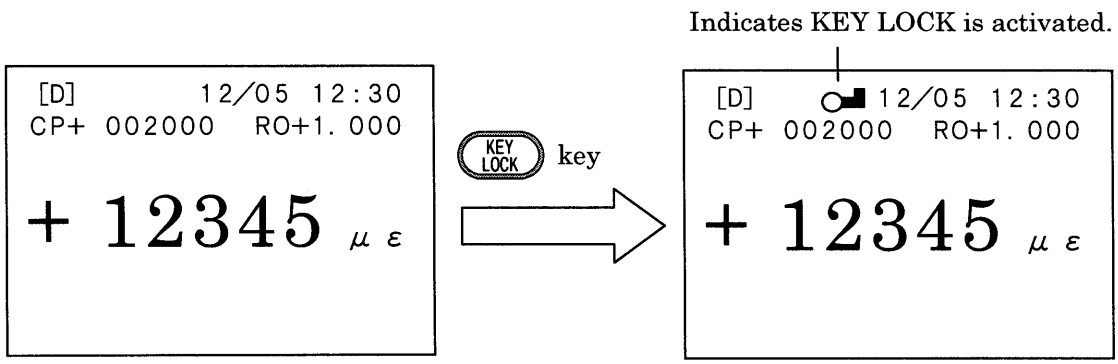
Contrast of display can be adjusted in eight degrees. Adjust it in adequate degree since the contrast may vary with ambient temperature. Adjustment procedure is as follows.

Contrast is increased by pressing (△) key in monitor display.
Contrast is decreased by pressing (▽) key in monitor display.
Adjust it in legible contrast.



4.1.3 KEY LOCK FUNCTION

Key lock is a function to inhibit key operations except (POWER), (△) and (▽) keys. It is effective to prevent the set content being carelessly changed during interval measurement for example.
To activate key lock function, press and hold (KEY LOCK) key for two seconds of more. To deactivate key lock function, press and hold (KEY LOCK) key again for two seconds of more.



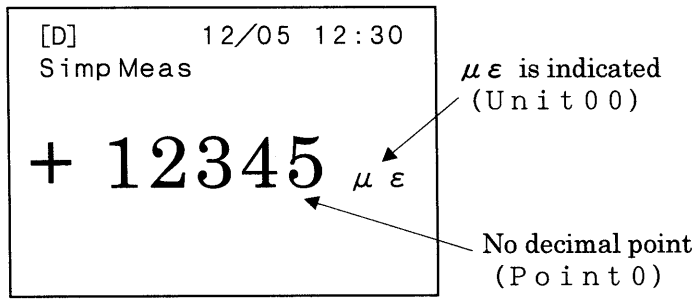
Monitor display　　KEY LOCK display

4.2 EASY MEASUREMENT

4.2.1 INDICATING STRAIN VALUE ON THE DISPLAY

Here explained is a method for simply indicating a strain value of connected sensor on the display. To indicate a measured value in physical quantity, refer to 4.3 SETTING DISPLAY FORM and make appropriate settings.

Press (POWER) key to turn on. Then, monitor display appears. Press (0 SIMP-MEAS) key to set simple measure mode. Simp Meas is indicated on the upper part of the display instead of CP(capacity) and RO(rated output). This setting makes strain measurement with coefficient of 1.000 and no decimal point.



Monitor display of simple measure mode

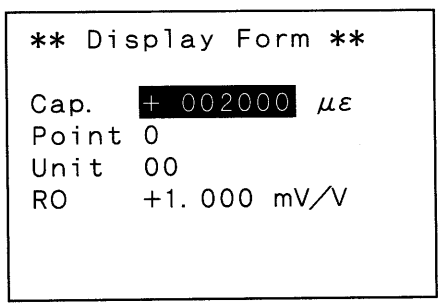
To stop simple measure mode, press (0 SIMP-MEAS) key again. Former settings of capacity, rated output, decimal point and physical unit are still effective.

Another method of simple strain measurement

Press (4 DISP FORM) key in monitor display. Display Form display appears. Then press (KEY LOCK) key, and it will be set as follows.

Cap 2000, Point 0, Unit 00, RO1.000mV/V

These settings make strain measurement with coefficient of 1.000, and it is same as simple measure mode.



Settings for strain value indication

Press (ENT) key to enter above settings and return to monitor display.

To cancel settings, press (DEL) key. Former settings remain effective and display returns to monitor display.

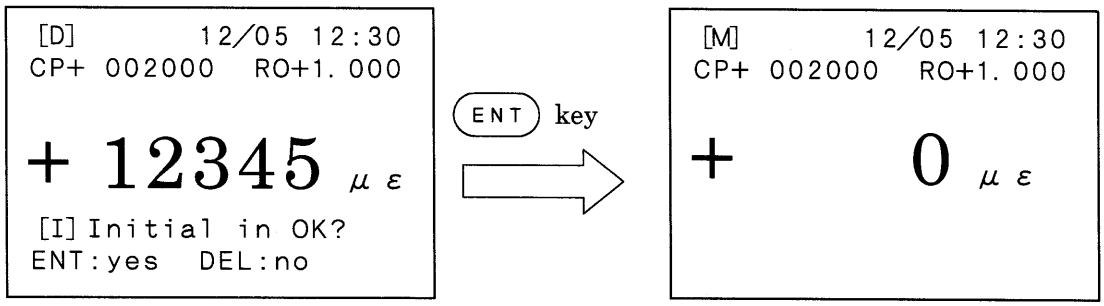
To set arbitrary coefficient, obtain Cap value using following expression and set it. Refer to 4.3 SETTING DISPLAY FORM for detail.

$$\text{Coefficient to be set} = \frac{\text{Cap value}}{\text{RO value} \times 2000}$$

4.2.2 BALANCING (INITIAL-IN)

Initial unbalance of bridge circuit of connected sensor yields some value which is not zero, even if no load is applied to the sensor. This initial unbalance value is stored in TC-31M by executing initial-in measurement. After initial-in measurement, stored initial value is deducted from the measured value by setting TC-31M to measure mode. Thus the initial unbalance value can be canceled.

To execute initial-in measurement, press (5 [I]) key in monitor display to call initial-in display.



Before initial-in measurement

After initial-in measurement

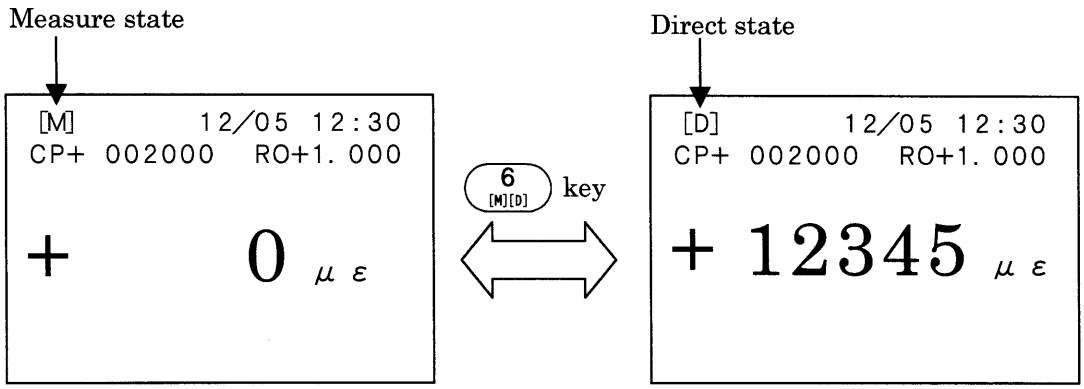
Press (ENT) key to execute initial-in measurement.

To escape from initial-in display, press (DEL) key.

After executing initial-in measurement, measure mode will be set to Measure [M] automatically.

4.2.3 SELECTING MEASURE MODE

Measure or Direct is selected alternately by pressing (6 [M][D]) key in monitor display.

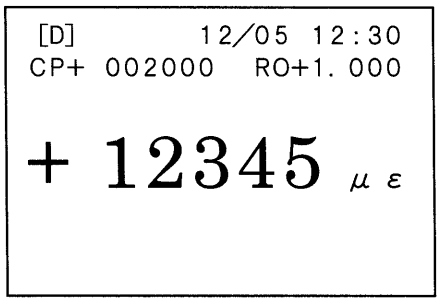


Measure [M] : Initial unbalance value is deducted from measured value.

Direct [D] : Initial unbalance value is not deducted and measured value is indicated as it is.

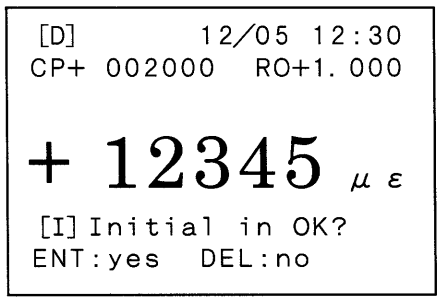
4.2.4 WRITING INITIAL VALUE

This is a way to rewrite stored initial value to arbitrary value. Press (5 [I]) key in monitor display to call initial-in display. Then press (SHIFT) key to call write-initial (rewriting initial value) display.



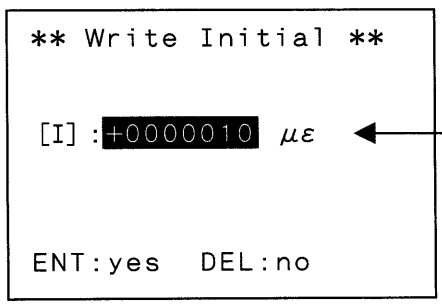
Monitor display

(5 [I]) key



Initial-in display

(SHIFT) key



Input value using numerical keys.
Press (SHIFT) key to change polarity.

Write-initial display

Press (ENT) key to store the input value as initial value.

To escape from write-initial display, press (DEL) key.

Display form settings (decimal point, physical unit and coefficient) are reflected to the indicated initial value. However in case of simple measurement is selected, decimal point, physical unit and coefficient are fixed to 0, 00(με) and 1.000 respectively.

4.3 SETTING DISPLAY FORM

Measurement in physical quantity is available by setting Cap and RO values which are indicated in test data sheet of the strain gauge based transducer.

> Cap **value** : This is a capacity of the transducer. This is maximum load that the transducer can measure and still maintain specifications.
> RO **value** : This is a Rated Output of the transducer. This is output at the rated load minus output under no load conditions. It is expressed per volt applied to the transducer.(mV/V)

4.3.1 DIRECT READING IN PHYSICAL QUANTITY USING STRAIN GAUGE BASED TRANSDUCER

Here explained is a method for directly indicating a physical quantity using strain gauge based transducer. Call Display Form display by pressing (4 DISP FORM) key in monitor display.

<Example 1> Measuring load cell having capacity of 10kN and rated output of 1.534mV/V

Strain output of this load cell is 3068×10^{-6} strain when load of 10kN (equals to capacity) is applied, since rated output of 1mV/V equals to 2000×10^{-6} strain. ($1.534 \times 2000 = 3068$)

Physical quantity per 1×10^{-6} strain is

Exponent corresponds to Point value

$$1 \times 10^{-6}\ \text{strain} = \frac{10\text{kN}}{3068 \times 10^{-6}\ \text{strain}} = 3.259 \times (10^{-3})\ \text{kN}$$

Physical quantity is directly measured by the following setting.

```
** Display Form **

Cap.   + 010.000  kN
Point  3
Unit   11
RO     +1.534 mV/V
```

Display Form display

<Example 2> Measuring displacement transducer with capacity of 50mm and rated output of 5mV/V

Strain output is $5 \times 2000 = 10000 \times 10^{-6}$ strain. Physical quantity per 1×10^{-6} strain is

$$1 \times 10^{-6}\ \text{strain} = \frac{50\text{mm}}{10000 \times 10^{-6}\ \text{strain}} = 5 \times 10^{-3}\text{mm}$$

```
** Display Form **

Cap.   + 050.000  mm
Point  3
Unit   01
RO     +5.000 mV/V
```

Display Form display

<For reference> Other Point values may be accepted in some cases. In example 2 above, Cap. +0050.00 and Point 2 are also available. However these settings give smaller resolution.

4.3.2 HOW TO SET DIPLAY FORM

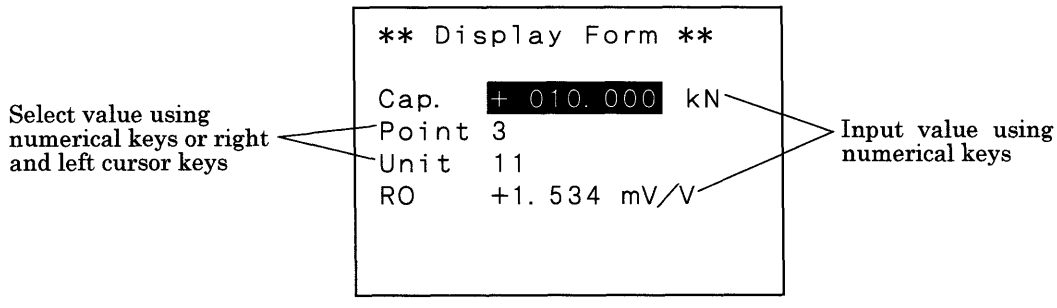
Input values using numerical keys to set Cap. and RO.
Select items using numerical keys or (◁) (▷) keys to set Point and Unit.

Press (ENT) key to set all items. Display will return to monitor display.
Press (DEL) key to quit setting and return to monitor display.

Setting procedure of load cell in <Example 1> is as follows.

(1) Input Cap value (capacity) of transducer

Move cursor to the position of Cap. using (△) (▽) keys, and input as 010000 using numerical keys.



Display Form display

Polarity of Cap and RO is reversed by pressing (SHIFT) key.

Output polarity of TML's load cell is "minus" for compression load in both compression type and tension/compression universal type load cells.
If you like to have "+" indication for compression load, set the Cap. value in "−" polarity.

<For reference> By pressing (◁) (▷) keys when cursor is on the position of Cap., value is selected among following values. ±(500, 1000, 2000, 5000, 10000, 20000, 30000)

(2) Set Point value (decimal point) of Cap value

Move cursor to the position of Point using (△) (▽) keys, and input 3 using numerical key or (◁) (▷) keys.
Point number and position of decimal point are as follows.

0 : xxxxxx
1 : xxxxx. x
2 : xxxx. xx
3 : xxx. xxx
4 : xx. xxxx
5 : x. xxxxx
6 : . xxxxxx

(3) Set Unit (physical unit) for indication

Move cursor to the position of Unit using (△) (▽) keys, and input 11 using numerical keys or (◁) (▷) keys.
Unit number and corresponding physical unit are as follows.

Number	Unit	Number	Unit	Number	Unit	Number	Unit
00	με	09	tf	18	V	27	ppm
01	mm	10	N	19	mA	28	Tor
02	cm	11	kN	20	A	29	(None)
03	m	12	MN	21	Ω	30	Nm
04	℃	13	kg/mm	22	MΩ	31	###
05	°F	14	kPa	23	Hz	32	kΩ
06	deg	15	MPa	24	G	33	m/S²
07	gf	16	kgm	25	%	34	kg/cm
08	kgf	17	mV	26	rpm	35	HPa

(4) Set RO value (rated output) of transducer

Move cursor to the position of RO using (△) (▽) keys, and input 1534 using numerical keys.

```
** Display Form **

Cap.   + 009.810 kN
Point  3
Unit   11
RO     +1.534 mV/V
```

Polarity is reversed by pressing (SHIFT) key.

<For reference> By pressing (◁) (▷) keys when cursor is on the position of RO, value is selected among following values. ±(1.000, 1.500, 2.000, 2.500)

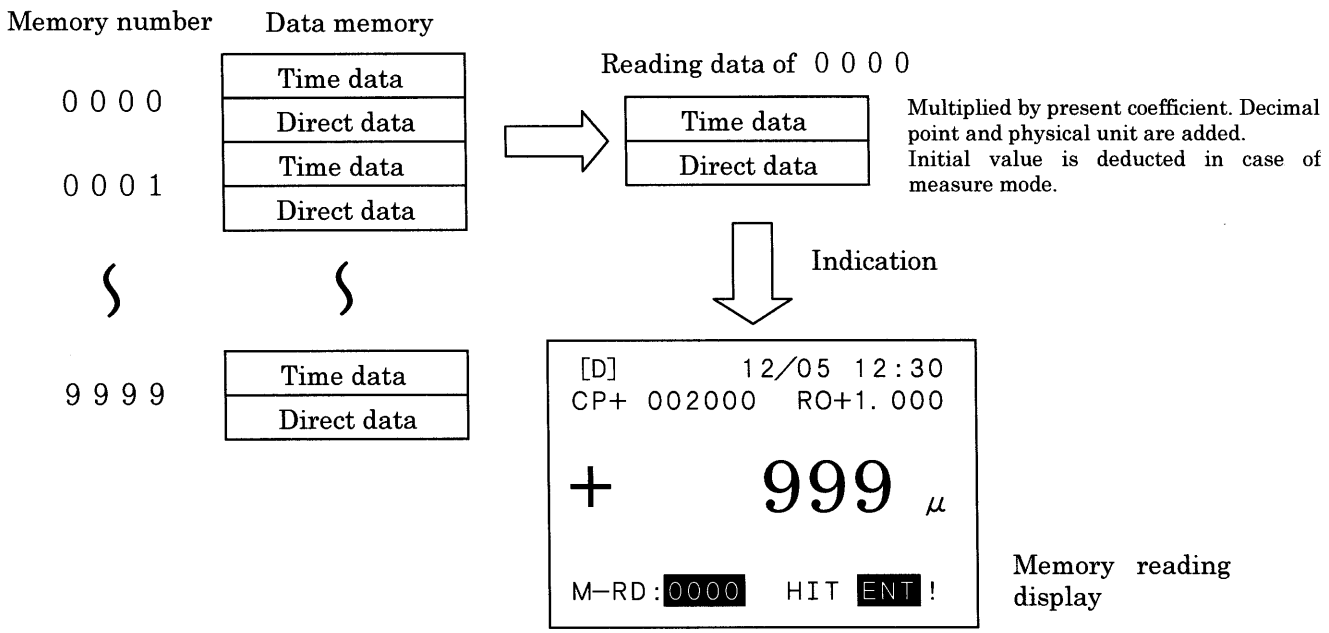
Monitor value is obtained in direct reading of physical quantity by completing four settings above.

⚠ CAUTION

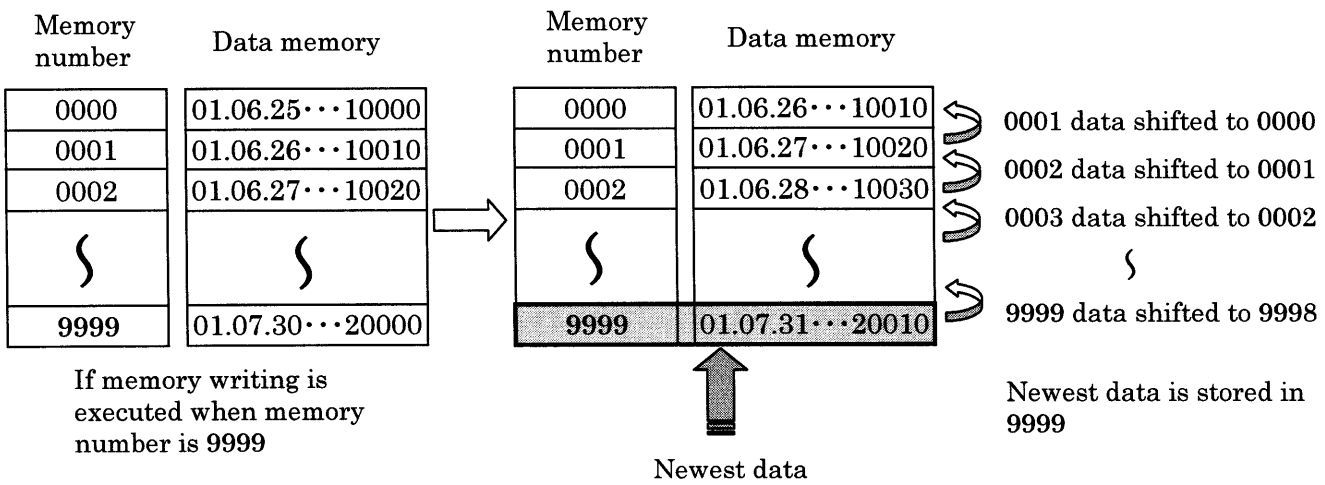
Physical quantity per 1×10^{-6} strain obtained from Cap. and RO must be within ±9.999. Otherwise, "Coef over" is indicated.

5. USING DATA MEMORY

TC-31M is equipped with data memory function for storing and reading measured data.
Stored data consists of measurement starting time and direct data (initial unbalance value is included).
Coefficient (Cap value and RO value), decimal point, physical unit and initial value already set and stored are reflected in memory data reading.



Storing range of data memory is from 0000 to 9999. If data are fully stored up to 9999, oldest data (0000) is erased and whole memory area is shifted. In this way, newest data is always stored in memory number 9999.



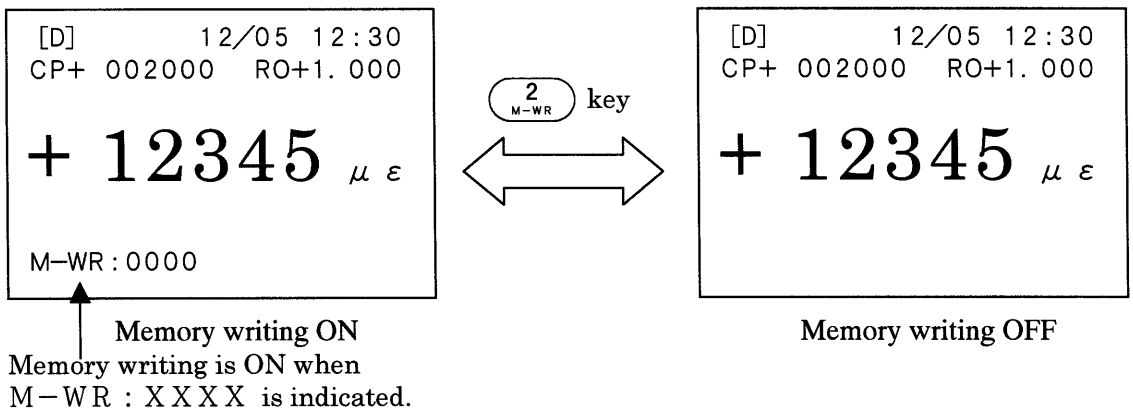
5.1 STORING DATA INTO DATA MEMORY

There are two ways to store data in data memory. One is manual writing method to press (ENT) key while measurement. Measured data at that time is stored in data memory. Another is automatic writing method, in which measurement and storage are triggered by interval timer.

Followings are method of manual writing.
For automatic writing, refer to 6. AUTOMATIC MEASUREMENT USING INTERVAL TIMER.

5.1.1 DATA MEMORY ON/OFF

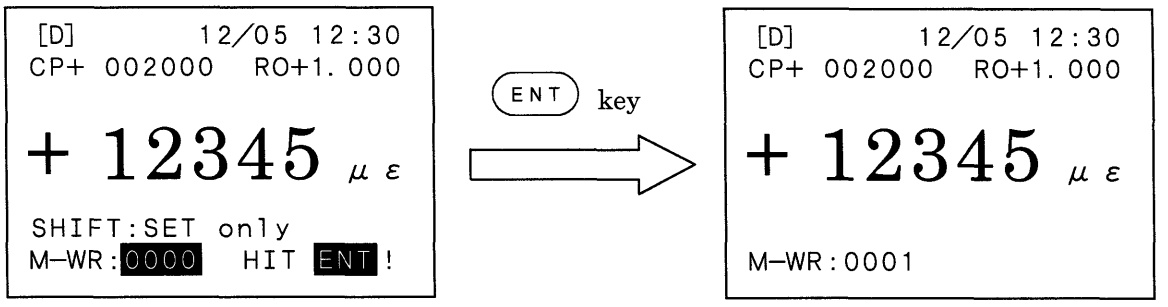
To set memory writing on, press (2 M-WR) key in monitor display. "M-WR : ×××× " will be indicated in the lower side of display, and memory writing is set on. (×××× indicates memory number.)
To set memory writing off, press (2 M-WR) key again.



Memory number : 10000 data can be stored in data memory (internal memory) at maximum. Stored data consists of time data and monitored value. Memory number indicates an address of memory, and it is a number among 0000 and 9999. Number indicated in the display is the memory number where the next data will be stored.

5.1.2 DATA STORING

To store data, press (ENT) key while memory writing is set on, and the memory number is highlighted and HIT ENT ! is indicated in the lower part of the display.



Measurement data is stored in the indicated memory number by pressing (ENT) key.

Memory number becomes the next number after storage.

Memory writing is quitted by pressing (DEL) key.

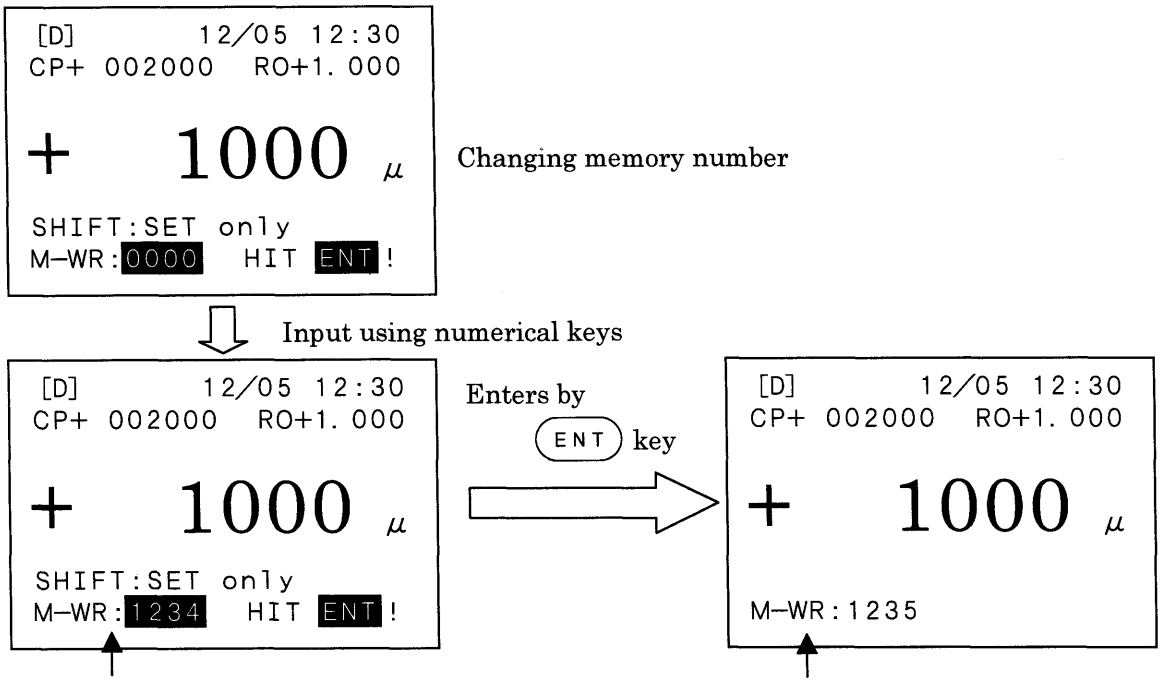
5.1.3 STORING DATA IN ARBITRARY MEMORY NUMBER

Data can be stored in arbitrary memory number by specifying the memory number when storing data. Operation method is as follows.

Press (2 M-WR) key and set memory writing on in monitor display. Press (ENT) key, and the memory number is highlighted and HIT ENT ! is indicated in the lower part of the display.
Input arbitrary memory number using numerical keys.

⚠ CAUTION

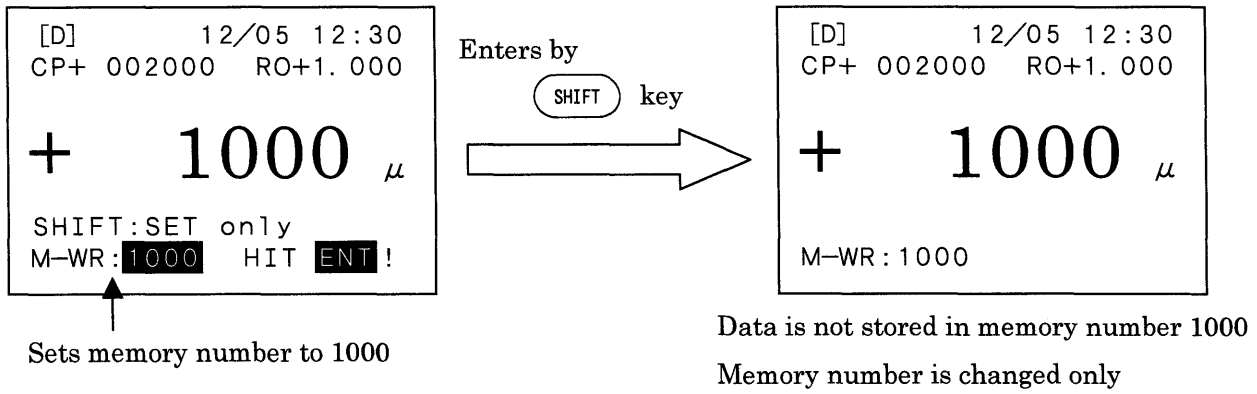
- If you specify a memory number where data has already been stored and store new data, former data cannot be reproduced.



Data is stored in data memory by pressing (ENT) key simultaneously with change of memory number. As in the figure above, if memory number is set to 1234 and (ENT) key is pressed, data is stored in memory number 1234 and memory number advances to 1235.

5.1.4 CHANGING MEMORY NUMBER

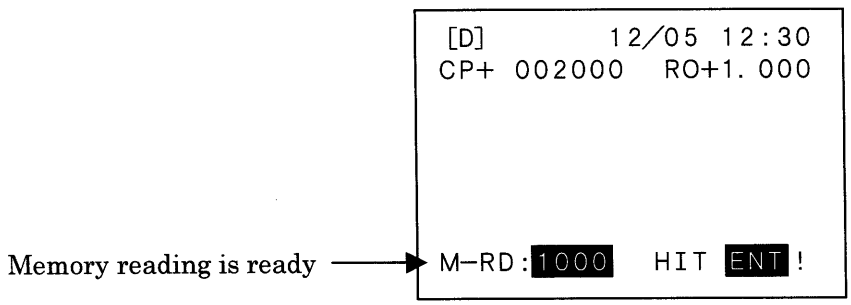
When changing memory number, if (SHIFT) key is pressed instead of (ENT) key, memory number is changed but data is not stored in data memory.
For example, this function is convenient to start storing data from right number in interval measurement.



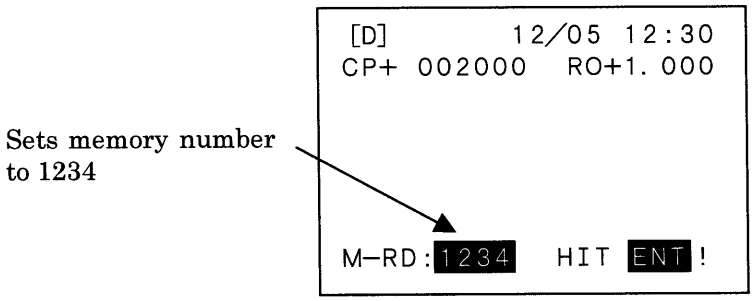
5.2 READING DATA FROM DATA MEMORY

Data stored in data memory (internal memory) can be read and indicated in the display.
Operation method is as follows.

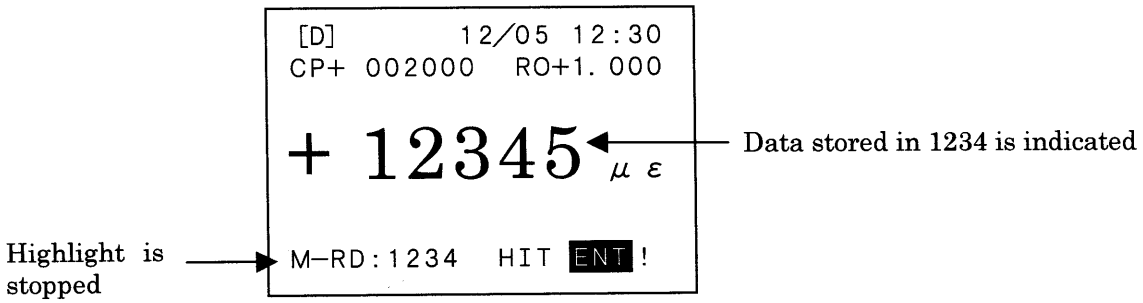
Press (1 M-RD) key in monitor display. "M-RD : ×××× HIT ENT ! " will be indicated in the lower part of the display. (×××× indicates memory number.)



Input memory number to read using numerical keys.



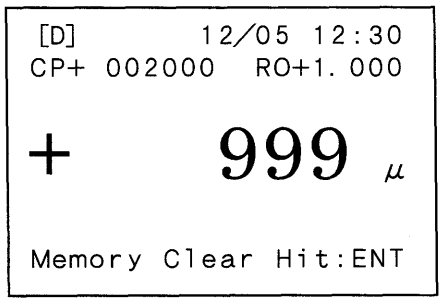
As in the figure above, if memory number is set to 1234 and (ENT) key is pressed, data stored in memory number 1234 is read. Coefficient, decimal point, physical unit and initial value at present are reflected to the indicated data.



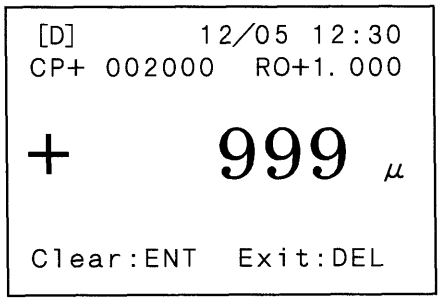
Memory number advances to the next number and highlighted by pressing (ENT) key again.
To indicate data stored in the memory number, press (ENT) key.
Repeat these operations to continue data reading.
To stop data reading, press (DEL) key while memory number is not highlighted. Display returns to monitor display.

5.3 CLEARING DATA IN DATA MEMORY

All of stored data in data memory can be cleared.
Press both (2 M-WR) key and (SHIFT) key simultaneously in monitor display while memory writing is set on.
Message as "Memory Clear Hit:ENT" will be indicated in the lower part of the display.



Press (ENT) key again, and message as "Clear : ENT Exit:DEL" will be indicated.



Data stored in memory number from 0000 through 9999 are cleared by pressing (ENT) key.
After cleared, data will be as follows.

Memory number : 0000
Time data : 00 : 00 : 00
Measurement data : ＊＊＊＊＊＊＊ (Open data)

To stop clearing data and return to monitor display, press (DEL) key.

⚠ CAUTION

- All data become open data and former data cannot be reproduced after data clearing operation.

6. AUTOMATIC MEASUREMENT USING INTERVAL TIMER

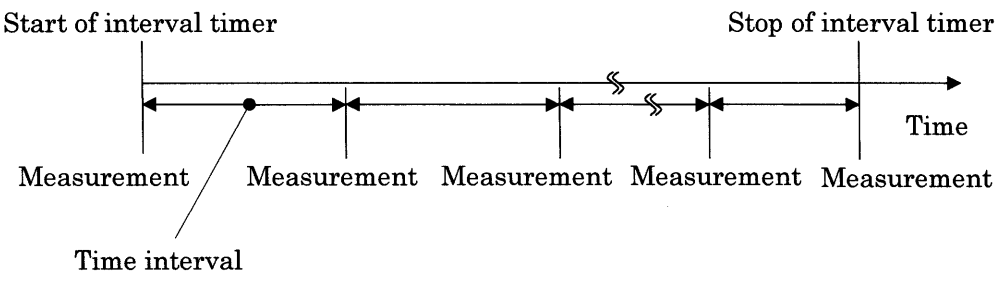
6.1 SETTING INTERVAL TIMER

Measurements are automatically started at specified intervals and measured data are stored in data memory (internal memory) by interval timer function. Interval between measurements can be set among one second and 99 hours 59 minutes 59 seconds in one second step.

Also available are real time start function which starts measurement according to real time, and just time start function which starts measurement at even time. Five steps at maximum can be programmed including these functions.

Interval timer

Time interval : Interval between measurement



Setting method of interval timer is as follows.

Press (7 TIMER) key in monitor display, and Timer Set display appears.

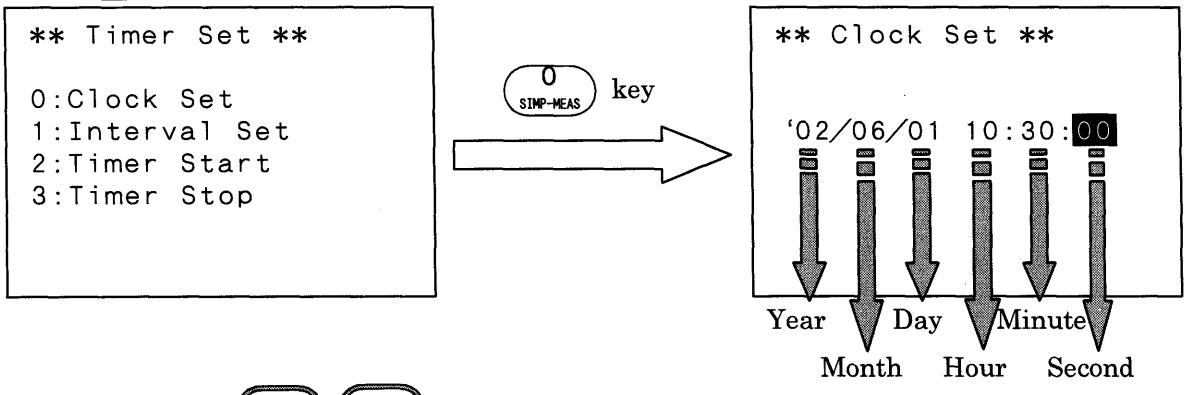
```
** Timer Set **

0:Clock Set
1:Interval Set
2:Timer Start
3:Timer Stop
```

Timer Set (menu) display

0 : Clock Set	Sets present time
1 : Interval Set	Sets time interval
2 : Timer Start	Starts measurement by interval timer
3 : Timer Stop	Stops measurement by interval timer

6.1.1 SETTING PRESENT TIME

Press (0 SIMP-MEAS) key in Timer Set (menu) display, and Clock Set display appears.



Move cursor using ◀ ▶ keys, and input value using numerical keys.

Set time is entered (clock is changed) by pressing (ENT) key.

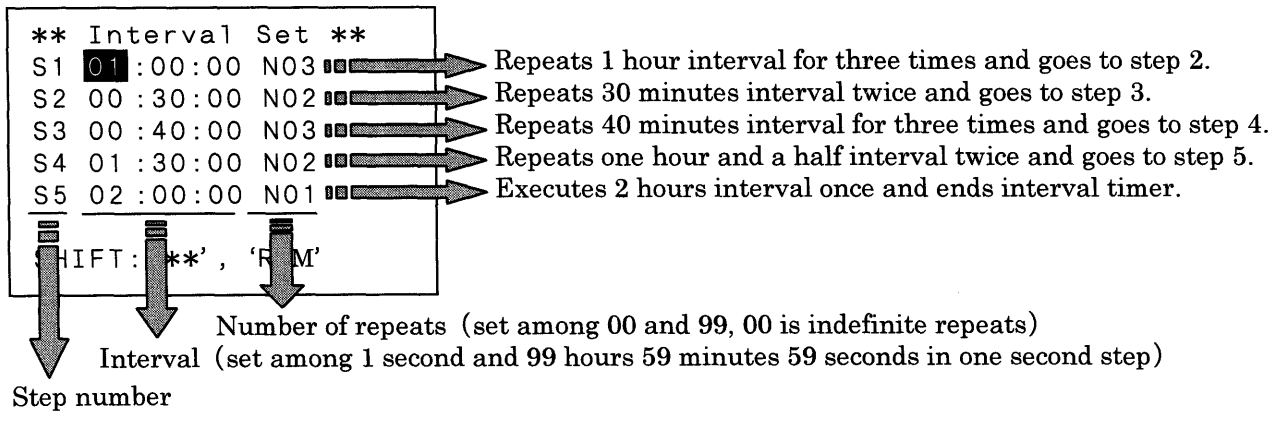
Set time is canceled (clock is not changed) by pressing (DEL) key.

Display returns to Timer Set display in both cases.

> **⚠ CAUTION**
>
> Present time cannot be set during interval timer measurement is activated (INTERVAL LED is blinking). Deactivate interval timer measurement to set present time.

6.1.2 SETTING TIME INTERVAL

Interval Set display appears by pressing (1 M-RD) key in Timer Set (menu) display.



Cursor moves in every direction by pressing ▼ ▲ ◀ ▶ keys.

Settings of all steps are entered simultaneously by pressing (ENT) key.

Interval timer setting is quitted and display returns to Timer Set display by pressing (DEL) key.

If (SHIFT) key is pressed when cursor is on the position of minute, that step is changed to just time start. (Indication changes to ＊＊.) Also, if (SHIFT) key is pressed when cursor is on the position of repeat number, that step is changed to real time start. (Indication changes to ＲＴＭ.)

There are three types of starting measurement by interval timer as follows.

Normal start : Starts measurement at specified time interval.

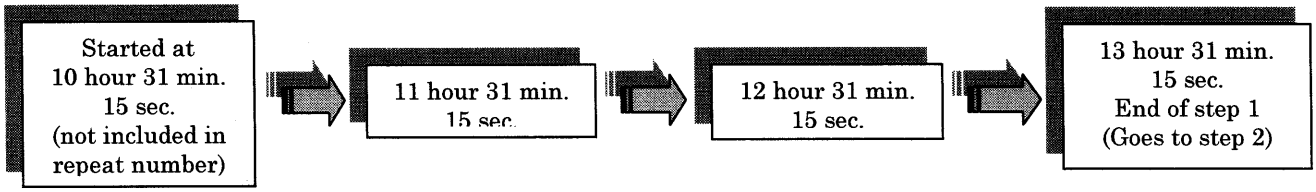
Real time start : Starts measurement according to real time.

Just time start : Starts measurement at even time (00 minute 00 second).

(1) Normal start

Setting S 1 0 1 : 0 0 : 0 0 N 0 3

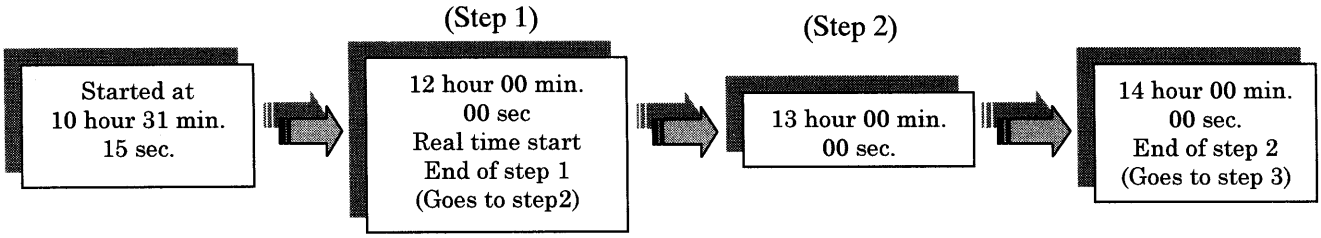
※ Measures four times at intervals of one hour.



(2) Real time start

Setting S 1 1 2 : 0 0 : 0 0 R T M ("R T M" means real time start)

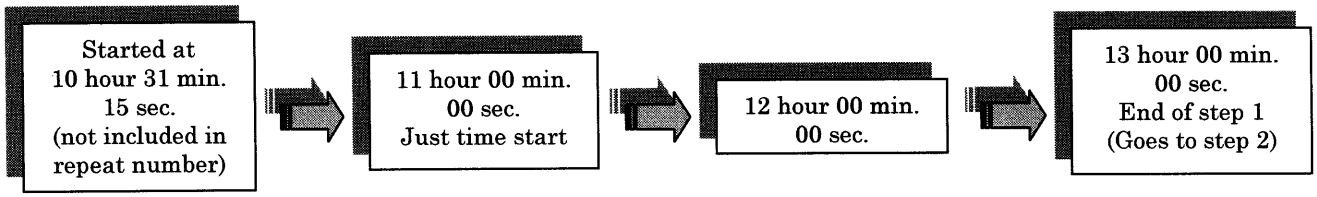
S 2 0 1 : 0 0 : 0 0 N 0 2



(3) Just time start

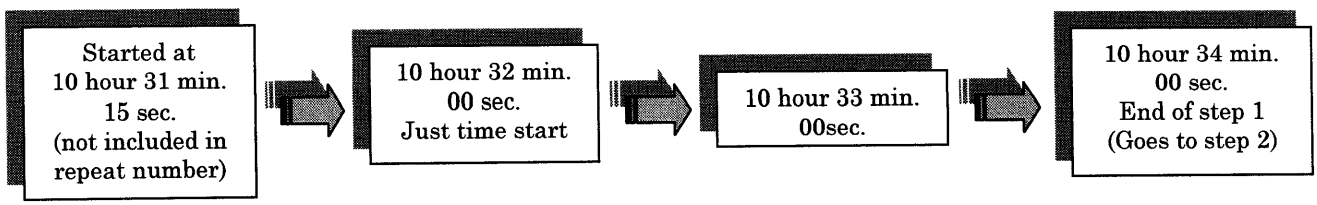
(Example 1) Setting S 1 ＊＊ : 0 0 : 0 0 N 0 3

※ Measurement is started at every 00 min. 00 sec. (Measures at intervals of one hour.)



(Example 2) Setting S 1 ＊＊ : ＊＊ : 0 0 N 0 3

※ Measurement is started at every 00 sec. (Measures at intervals of one minute.)

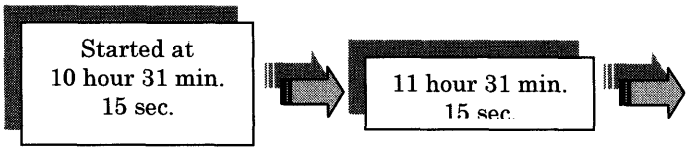


(4) Other settings

- **Interval timer measurements for infinite times**

Setting S 1 0 1 : 0 0 : 0 0 N 0 0 (N 0 0 specifies measurements for infinite times)

※ Measurement is started at intervals of one hour for infinite times (until stopped by timer stop).

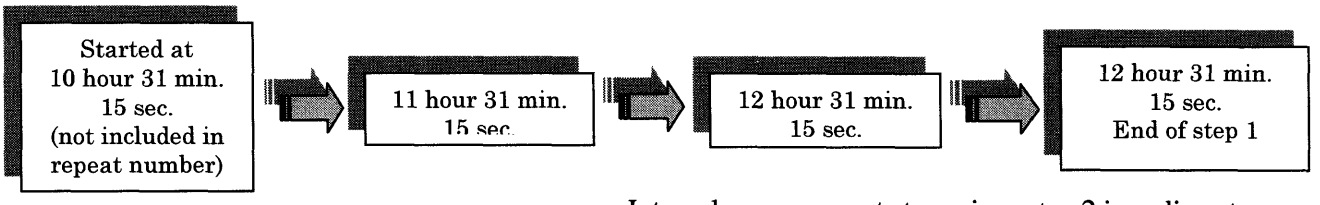


Continued until stopped by timer stop operation.

- **End of interval timer measurement**

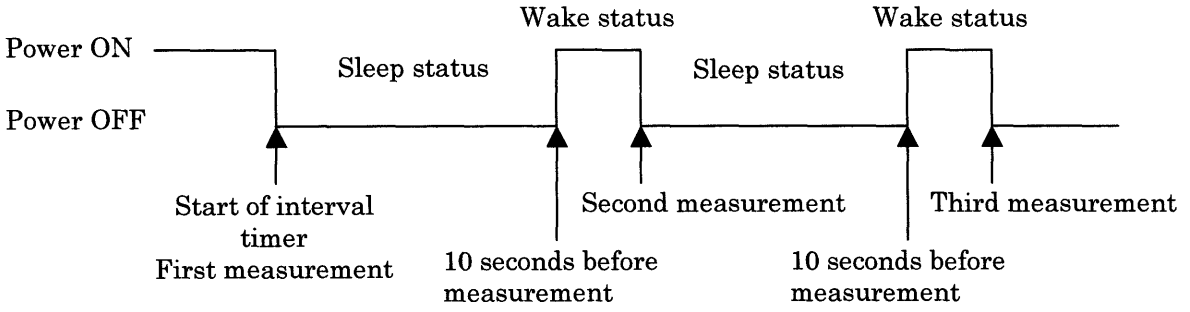
Setting S 1 0 1 : 0 0 : 0 0 N 0 3
S 2 0 0 : 0 0 : 0 0 N 0 0
(Interval measurement stops if all of hour, minute and second are set 00.)

※ Interval measurement stops after measuring at intervals of one hour for four times.



Interval measurement stops since step 2 is ending step.

Sleep interval operation (for saving power consumption) is available by setting sleep mode to "YES" when starting interval timer measurement.
If sleep interval operation is activated, main power of TC-31M is automatically turned on before 10 seconds of starting measurement and turned off after measurement.

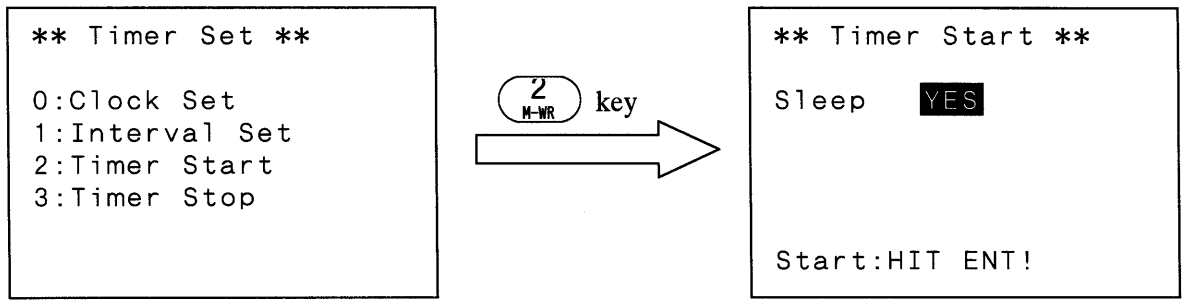


⚠ CAUTION

- If you press (POWER) key before 10 seconds of scheduled measurement time (wake status in the above figure), power is not turned off. It will be turned off after measurement.
- Sleep function is not available if time interval is 30 seconds or less.

6.1.3 STARTING INTERVAL TIMER MEASUREMENT

Press (2 M-WR) key in interval timer menu display, and Timer Start display appears.
Select between YES and NO of sleep interval function using (◀) (▶) keys.



Timer Set display　　Timer Start display

Interval timer measurement is started by pressing (ENT) key. Then display returns to monitor display.
TC-31M is set as follows during interval timer is activated.

- Memory write on
- INTERVAL LED blinking
- Power off after measurement (sleep status) in case of setting Sleep to YES.

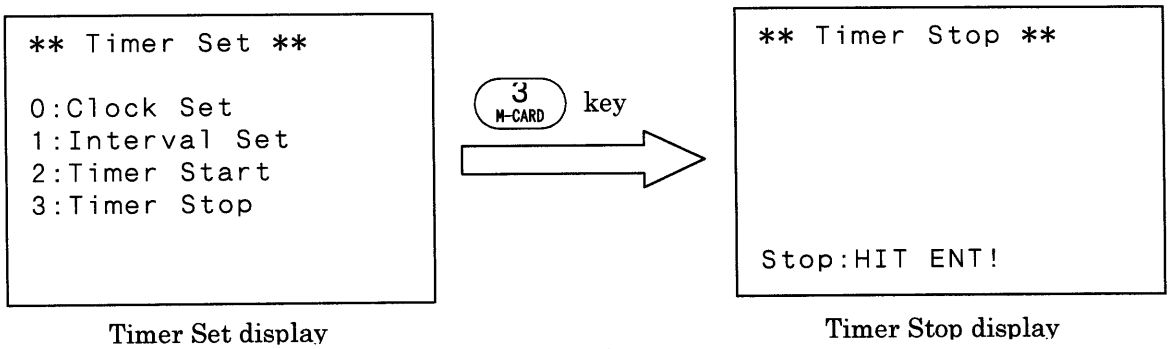
If (DEL) key is pressed in Timer Start display, interval timer measurement is not started and display returns to Timer Set display.

⚠ CAUTION

- Confirm the set content of interval timer in Interval List display before starting interval timer measurement. (Interval List is explained in 8.2.2.)

6.1.4 STOPPING INTERVAL TIMER MEASUREMENT

Press (3 M-CARD) key in Timer Set display. Then Timer Stop display appears.

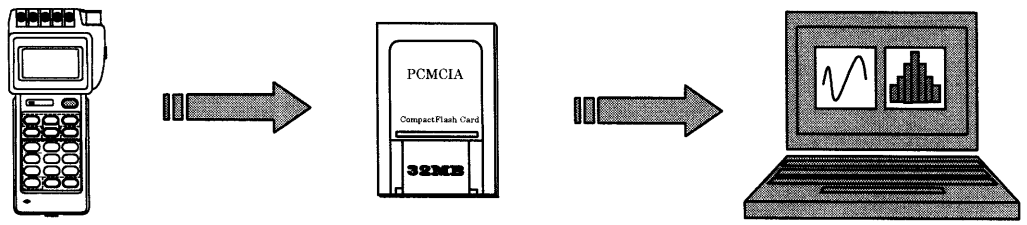


Timer Set display　　Timer Stop display

Press (ENT) key to stop interval timer measurement. Display returns to Timer Set display.
If (DEL) key is pressed, interval timer measurement is not stopped. Display returns to Timer Set display.

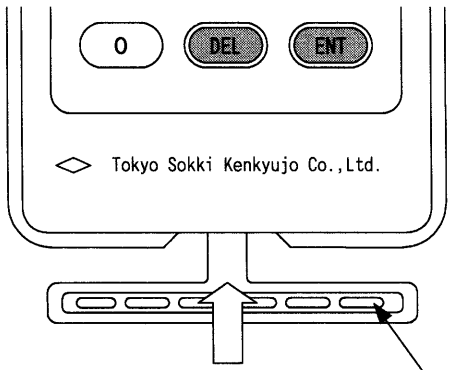
7. USING MEMORY CARD

Data stored in data memory of TC-31M can be saved into flash memory card. Data saved in flash memory card can be read, edited and analyzed by personal computer.



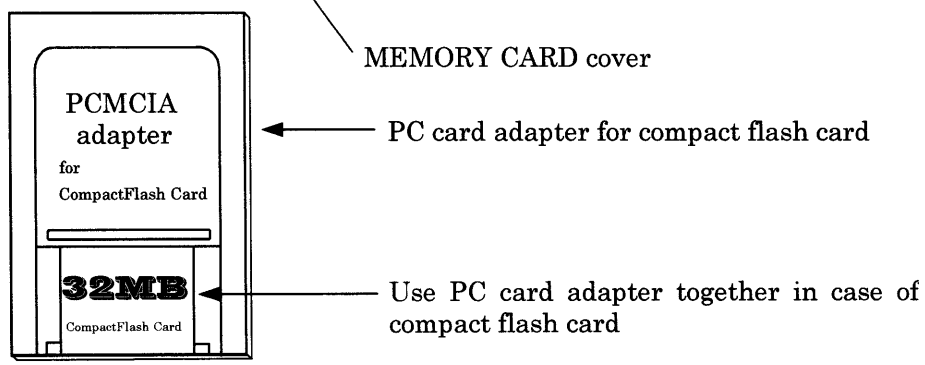
Measurement data of TC-31M　　Saved in memory card　　Edited and analyzed by personal computer

7.1 MEMORY CARD



Remove MEMORY CARD cover on the lower part of TC-31M while power is off, and insert memory card with its type name facing **upward**.

Operation of memory card should be made while memory card is inserted into TC-31M. If operation is made without memory card, message will be indicated as "No Card !!" .



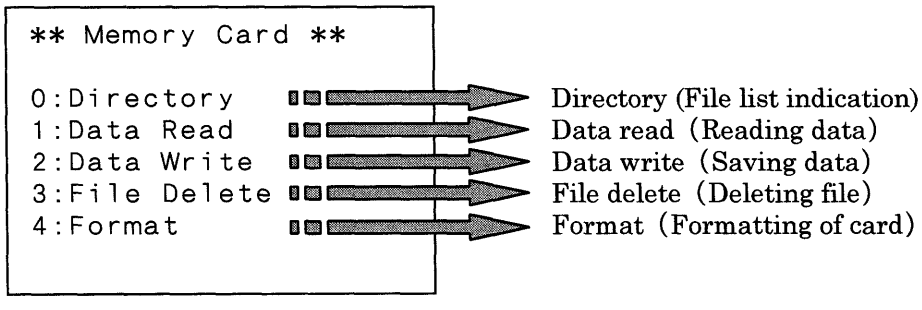
Memory card usable in TC-31M is flash memory card and compact flash card with capacity of 8 to 128MB.
In case of compact flash card, connect it to TC-31M using PC card adapter.
Memory card other than above (SRAM card, smart media, memory stick etc.) cannot be used in TC-31M.
If inserted, "Format Error" will be indicated.

⚠ CAUTION

- To avoid malfunction, do not remove memory card while accessing nor turn off TC-31M.
- Do not save a file made by other instruments than TC-31M in memory card. Also, measurement data edited and saved by personal computer cannot be read normally by TC-31M. Copy the data to other media for editing etc.
- Directory may not be indicated in order of time (date and time of file creation).

7.2 MEMORY CARD OPERATION

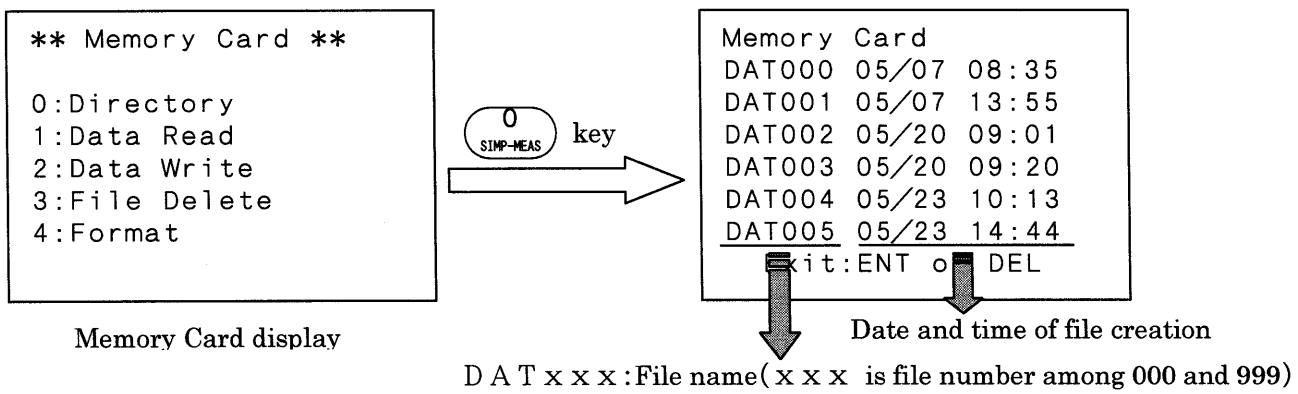
Press (3 M-CARD) key in monitor display to call Memory Card display.



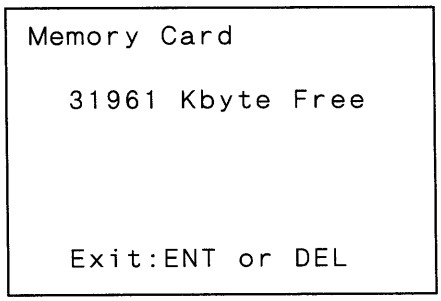
Memory Card display

7. 2. 1 INDICATING FILE LIST

This is an operation to indicate list of files stored in memory card.
Press (0 SIMP-MEAS) key in Memory Card (menu) display to select Directory.



Display scrolls up and down by (▲) (▼) keys.
Display scrolls up and down by every six files by (◀) (▶) keys.
Top file is indicated by (SHIFT) key.
Last file is indicated by (KEY LOCK) key.
Indication of file list is closed and residual capacity of card is indicated by (ENT) or (DEL) key.



Capacity of a file storing 10000 data is approximately 270 kbyte.

Press (ENT) key or (DEL) key to return to Memory Card (menu) display.

7. 2. 2 READING DATA

This is an operation to read data stored in file of memory card.

Press (1 M-RD) key in Memory Card (menu) display to select Data Read.

Memory Card display

```
** Memory Card **

0:Directory
1:Data Read
2:Data Write
3:File Delete
4:Format
```

1 : Selects Data Read

(1 M-RD)

Memory Card (file selection) display

```
Memory Card
== Data Read ==
DAT000 05/07 08:35
DAT001 05/07 13:55
DAT002 05/20 09:01
DAT003 05/20 09:20
DAT004 05/23 10:13
DAT005 05/23 14:44
```

Display scrolls up and down by (▲) (▼) keys.

Display scrolls up and down by every six files by (◀) (▶) keys.

Top file is indicated by (SHIFT) key.

Last file is indicated by (KEY LOCK) key.

Data of selected file is indicated by (ENT) key.

Display returns to Memory Card (menu) display without reading file by (DEL) key.

(ENT) key

Memory Card Read (data indication) display

```
Memory Card Read
== DAT000 ==      0000
06/25 10:00 +0010000
06/25 10:01 +0010001
06/25 10:02 +0010002
06/25 10:03 +0010003
06/25 10:04 +0010004
06/25 10:05 +0010005
```

Month Day Hour Minute Measured data

Data number of top data. In this example, this is data number of data 06/25 10:00 +0010000

Display scrolls up and down by (▲) (▼) keys.

Display scrolls up and down by every six lines by (◀) (▶) keys.

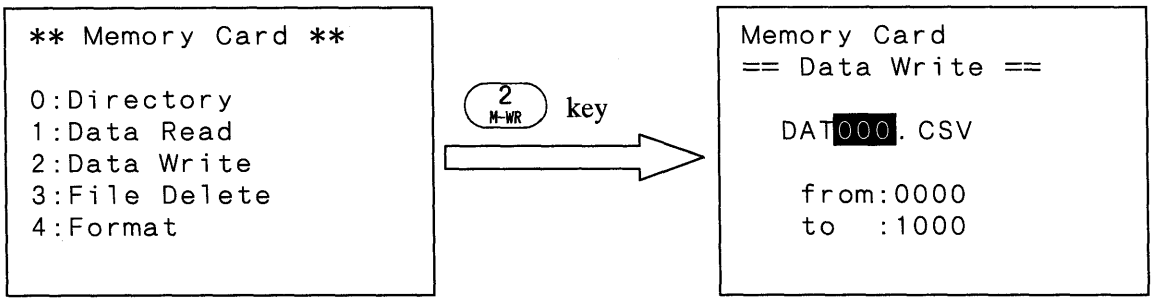
Top data is indicated by (SHIFT) key.

Last data is indicated by (KEY LOCK) key.

Display returns to Memory Card (file selection) display by (ENT) or (DEL) key.

7. 2. 3 WRITING DATA

This is an operation to write the content of data memory into memory card.
Press (2 M-WR) key in Memory Card (menu) display to select Data Write.



DATxxx.CSV: This is a file name to save data. xxx is an arbitrary number among 000 and 999.

from、to : These are data numbers of data memory. Stored data between from and to are saved in memory card.

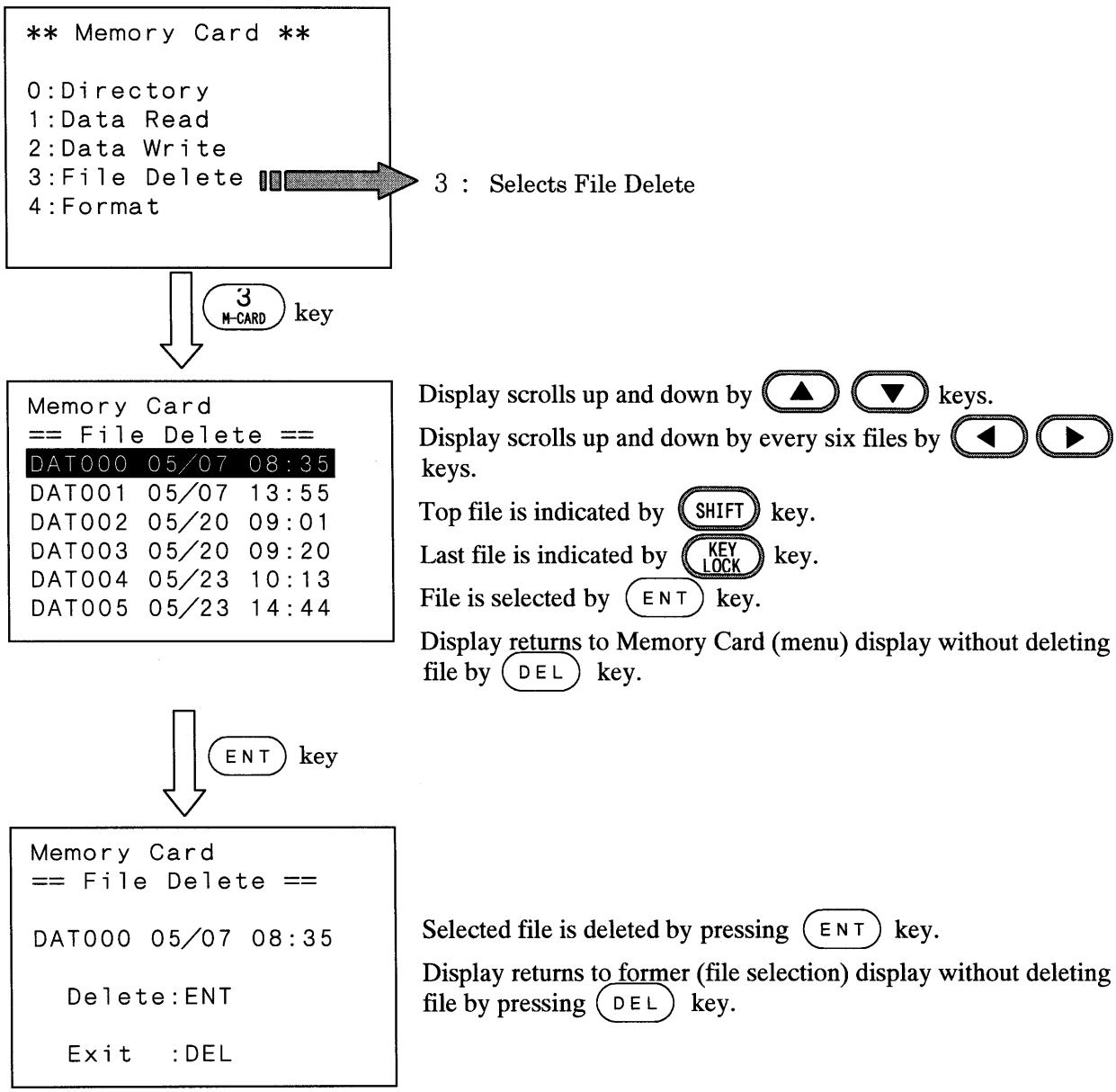
Move cursor by pressing (▲) (▼) keys, and specify file name, from and to number using numerical keys. After specifying these numbers, press (ENT) key to start writing. Data reflecting coefficient, decimal point, physical unit and initial value at present are saved into memory card. If specified file name already exists, writing is not started but indicated as "Same File Exist!!". After writing is completed, display returns to Memory Card (menu) display.
Error message concerning to memory card are as follows.

No Card!!	Memory card is not connected to TC-31M
Same File Exist!!	File with same file name exists in memory card
Miss Set!!	"to" number is bigger than "from" number
Card Full!!	Memory card capacity is fully occupied, or number of files is 512.
Format Error!!	Memory card format is not DOS format, or memory card type is not acceptable by TC-31M
Memory Empty!!	Memory write number (M-WR) is 0

7. 2. 4 DELETING FILE

This is an operation to delete a file in memory card.

Press (3 M-CARD) key in Memory Card (menu) display to select File Delete.



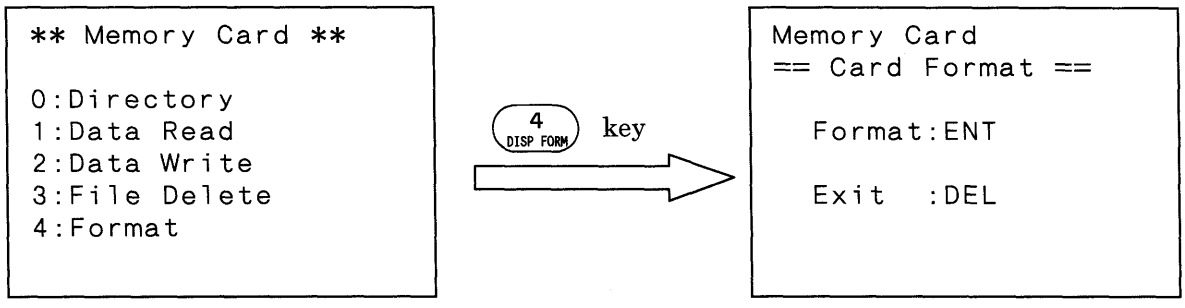
⚠ CAUTION

- Deleted file cannot be recovered.

7. 2. 5 FORMATTING

This is an operation to format memory card. Be sure to format the memory card when you use it for the first time.

Press (4 DISP FORM) key in Memory Card (menu) display to select Format.



Press (ENT) key to execute formatting.

If (DEL) key is pressed, formatting is not executed and display returns to Memory Card (menu) display.

> **⚠ CAUTION**
>
> • All data stored in the memory card are erased and cannot be recovered if the card is formatted.

7. 2. 6 MEMORY CARD STORING FORMAT

Data are stored in memory card with the following format.

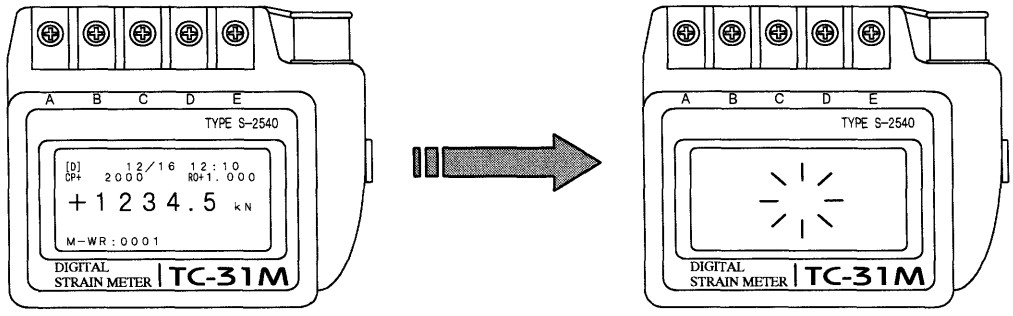
File format	CSV format (1 data consists of 28 byte)
File name	DATxxx. CSV ("xxx" is a value among 000 and 999)
Data format	2002/06/25 10:00:00, +0010000 2002/06/25 10:01:00, +0010001 2002/06/25 10:02:00, +0010002 2002/06/25 10:03:00, +0010003 2002/06/25 10:04:00, +0010004 2002/06/25 10:05:00, +0010005 Year Month Day Hour Minute Second Measured data

Date (Year/Month/Day) and time (Hour:Minute:Second) are divided by space.
Time and measured data are divided by comma.

8. OTHER FUNCTIONS

8.1 AUTO POWER OFF FUNCTION

For the purpose of saving battery consumption, TC-31M is equipped with Auto power off function which automatically turns the power off if no key is pressed for 10 minutes.

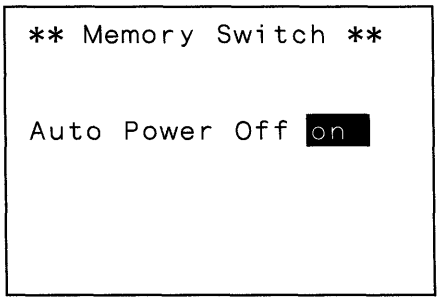


If no key is pressed for 10 minutes

Automatically turns the power off.

How to activate or deactivate this function

Press (8 M-SWITCH) key in monitor display to select Memory Switch (menu) display.



Auto power off function is activated if it is set "on", and the function is deactivated if it is set "off".

Select between on and off by pressing ◀ ▶ keys.

Indicated setting is entered and display returns to monitor display by pressing (ENT) key.

Indicated setting is not entered and display returns to monitor display by pressing (DEL) key.

⚠ CAUTION
• Auto power off function is deactivated during interval timer measurement regardless of its setting.

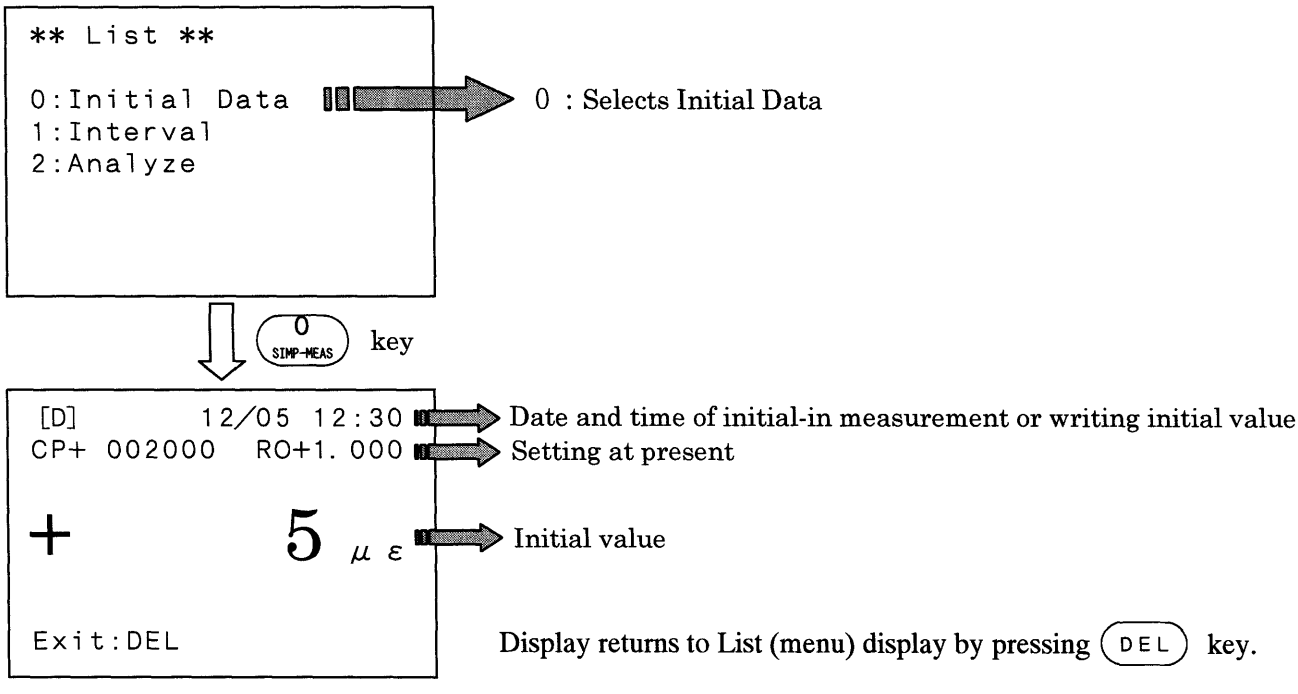
8.2 LISTING

This is a function to indicate initial data, set content of interval timer or time trend graph of stored data in data memory. Press (9 LIST) key to call List (menu) display and operate as follows.

8. 2. 1 INITIAL DATA

Initial unbalance value of connected sensor at the time of initial-in measurement is indicated.

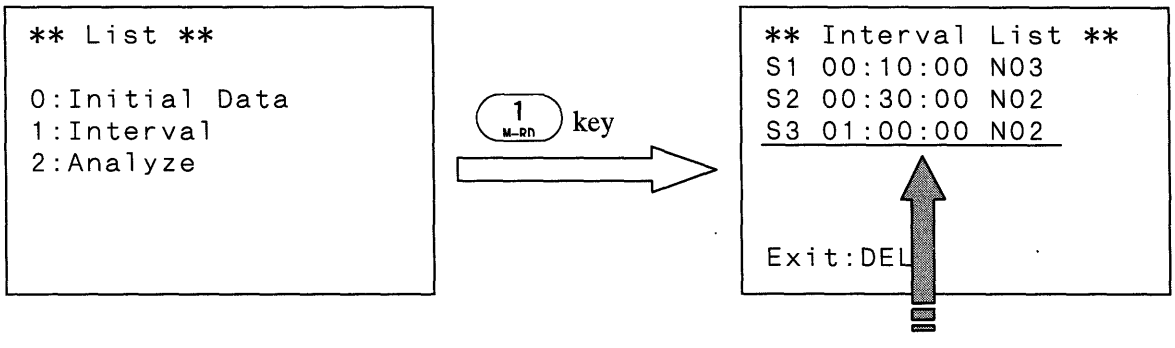
Press (0 SIMP-MEAS) key in List (menu) display to select Initial Data.



8. 2. 2 SET CONTENT OF INTERVAL TIMER

Setting of interval timer measurement is indicated.

Press (1 M-RD) key in List (menu) display to select Interval.



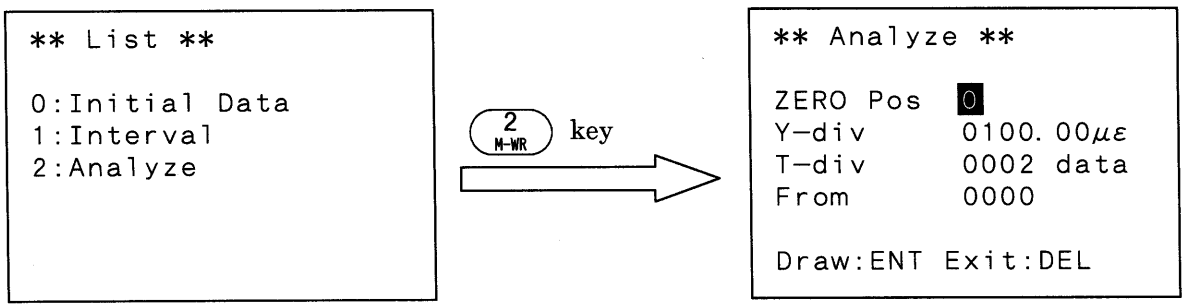
If end of interval timer (00 : 00 : 00 N00) or infinite repeats (N00) is set, following steps are not indicated.

Display returns to List (menu) display by pressing (DEL) key.

8．2．3 INDICATING GRAPH

Data stored in data memory are indicated in time trend graph.

Press (2 M-WR) key in List (menu) display to select Analyze.



ZERO Pos : Position of zero
Select among 0, 1, 2, 3, 4 and 5.

Y-div : Value for 1 division of Y-axis. (Coefficient, decimal point and physical unit are reflected.)
Select among 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000 and 20000.

T-div : Number of data for 1 division of X-axis.
Select among 1, 2, 5, 10, 20, 50, 100, 200, 500 and 1000 data.

From : Data memory number to start drawing graph.

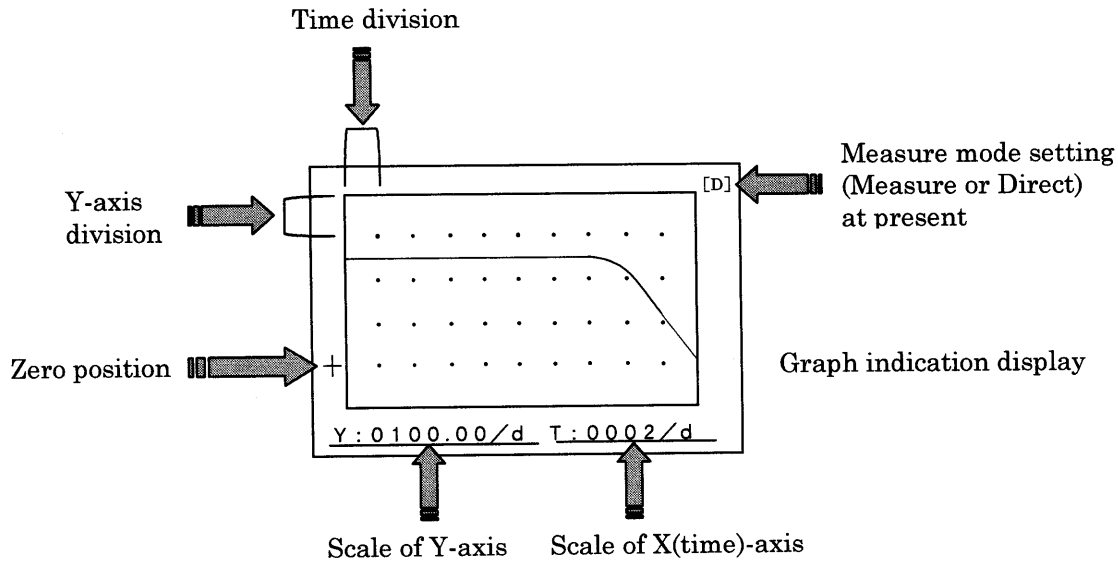
Move cursor by ▼ ▲ keys.

Change value by ◀ ▶ keys. (Use numerical keys for From)

Start drawing graph by (ENT) key.

Graph is not drawn and display returns to List (menu) display by (DEL) key.

Value of Y-axis reflects coefficients, decimal point and physical unit set by display form. However, if simple measurement is selected, it is fixed to coefficient 1.000, decimal point 0 and physical unit 00 ($\mu\varepsilon$).



Display returns to Analyze display by pressing (DEL) key.

9. SPECIFICATIONS

【Measurement】

Applicable transducer	Strain gauge based transducer (Full bridge with resistance 120 - 1000 Ω)
Number of measuring point	1 point
Measurement mode	Initial, Direct, Measure
Measuring range	$\pm 30000 \times 10^{-6}$ strain
Initial value storing range	$\pm 16000 \times 10^{-6}$ strain
Sampling speed	200msec
Bridge excitation	2.47V constant voltage method
Measuring accuracy	±(0.08%rdg+2digit) (at25±5℃)
Thermal effect	±0.0045%rdg/℃
Aging effect	±0.04%rdg/year
Allowable input range	±5V

【Indication】

Display	128×64 dot Reflection type liquid crystal display
Content of indication	Measured data, Time, Data memory number, Physical unit
Coefficient	Setting available in the range of ±(0.001 - 9.999)
Physical unit	36 kinds including $\mu\varepsilon$, N, Pa
Decimal point	Available at arbitrary point

【Timer】

Clock setting	Year, Month, Day, Hour, Minute, Second
Clock accuracy	±2 sec/day (at 25±5℃)
Number of step	Programming available in 5 steps at maximum
Setting content of timer	Time interval and number of measurement times
Time interval	Setting available in 1 second step among 1 second and 99 hours 59 minutes 59 seconds
Timer operation	Automatically starts measurement according to timer setting and stores measured data and time in data memory. Turns the power off automatically except measurement period

【Data memory】

Capacity	10000 data at maximum
Method of storing	Data entry key (manual), Interval timer
Method of reproduction	Indicates on display by manual operation, or read by personal computer after saving into memory card

【Memory card】

Card standard	Conforms to PC Card Standard (Type II)
Card capacity	8 - 128Mbyte
Function	Storing and reproducing the content of data memory of TC-31M
Maximum number of files	512 files

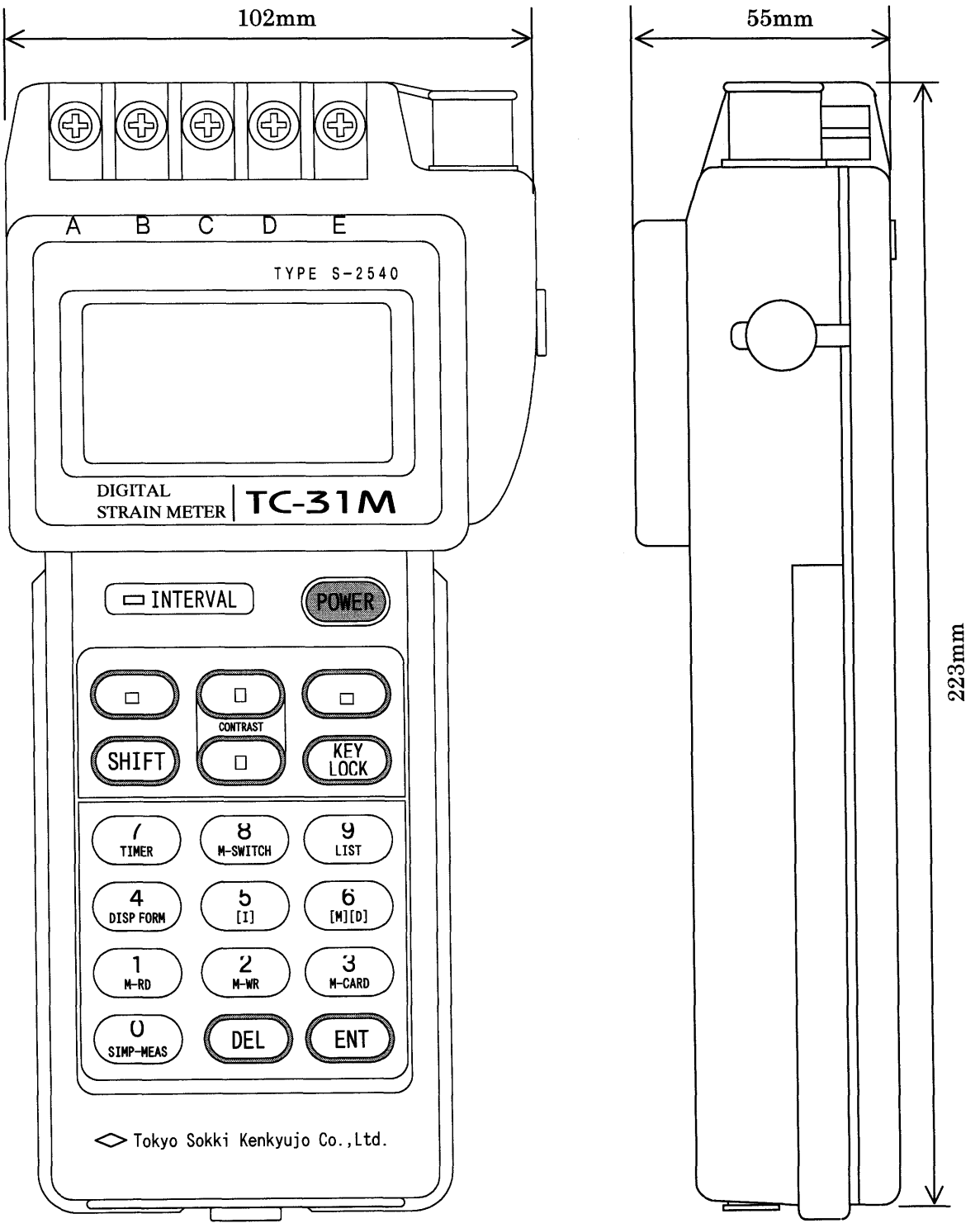
【Power source】

Power source	LR6 (AA size alkaline dry battery) × 4 or Exclusive AC adapter (option)
Continuous operation	Approx. 8 hours (using alkaline dry batteries and connecting 350 Ω transducer)
Operating time by interval timer measurement	60 hours with 1 minute interval 500 hours with 10 minutes interval 2800 hours with 1 hour interval (all using alkaline dry batteries and at temperature 25 ± 5℃, sleep interval function is activated)
Auto power off	Automatically turns off power if no key is pressed for 10 minutes when powered by internal batteries(Available to deactivate this function)

【Other specifications】

Vibration tolerance	29.4m/s^2 (50Hz 0.6mm$_{P-P}$) , Shock 49m/s^2	
Drip-proof	IP-54 (with connector cap installed)	
Environment	0～+50℃ 85%RH or less (No condensation)	
Dimensions	102(W) × 55(H) × 223(D)mm (Excluding projected parts)	
Weight	Approx. 800 g	
Standard accessories	Operation manual	1 copy
	Alkaline dry battery LR6	4 pcs.
	Strap	1 pc.
	Accessory box	1 pc.
	Certificate of guarantee	1 copy
	Inspection sheet	1 copy

1 0. OUTER VIEW



Before Requesting for Maintenance and Service (repair)

If there should be any failure or malfunction of TC-31M, please contact TML head office or your local representatives.

When you send us the device for repair and maintenance service:

○ For quick and precise repair and delivery service, please let us know the conditions of trouble or likely cause of such trouble.

○ When packing the device to return it to us, use the packing material employed upon delivery of the device from us or the equivalent.

○If the device must be adjusted with accessory parts or element attached, make sure to deliver them to us at the same time.

Tokyo Sokki Kenkyujo Co., Ltd.

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