INSTRUCTION MANUAL

HFT-70 / 80 Series

HIGH FUNCTION THERMOMETER

ANRITSU METER CO.,LTD.

HIGH FUNCTION THERMOMETER

HFT-70/80 Series

HFT-70 · 80 · 81 · 82 · 83 · 88

INSTRUCTION MANUAL

3rd edition
1 October, 1997

ANRITSU METER CO., LTD.


HFT-80
K -200~1200°C
CONT
HOLD
ON
OFF
LIGHT
CONT
HOLD
HOLD
Zero
AVG
ANRITSU
DIGITAL SURFACE THERMOMETER


HFT-70
K -200+1000°C
23.2 °C
ON
OFF
HOLD
1/0.1
°C/°F
RS
THERMOMETRE DE CONTACT

CONTENTS

1. General

This is a hand-held high-function thermometer developed by the latest microcomputer technology.

A microprocessor is used for constant calibration of zero-point and full scale, as well as for 16-bit equivalent A/D conversion, thus ensuring extremely stable, high-precision measurement.

2. Unpacking

2.1 Unpacking

Open the case and check that the following are provided. If any of them is missing or out of order, or if any item is missing in the warranty, please contact the place of purchase or our service counter.

Item	Qty
• Main unit	1 pc
• AA-size alkaline batteries	4 pcs
• Instruction manual	1 pc
• Warranty	1 pc
• Analog output cable (for analog output model only)	1 pc
• Alarm output cable (for alarm function model only)	1 pc

※ When all accessories are in good order, check the operation in accordance with item 4. Preparation for Operation (P.3).

2.2 Repacking

Use the original case of the instrument for its transportation (by mail or by car). If the original case is not available, carefully wrap the instrument in shock-absorbing material (polystyrene foam and the like). Wrapping material should be dry and free of dust generation, otherwise the instrument may be damaged.

3. Table of HFT Series

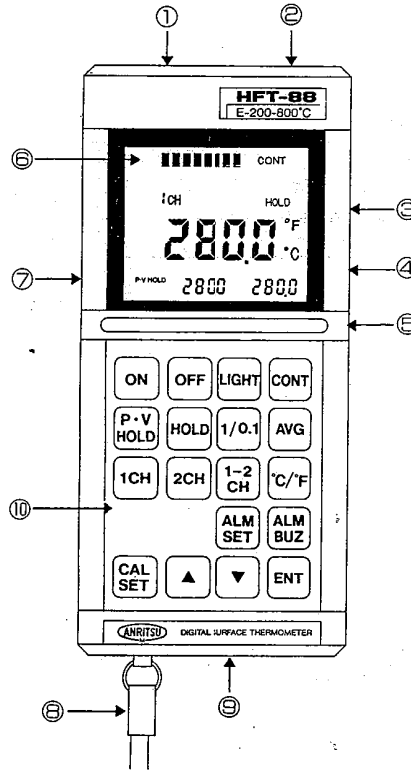
HFT-70/80 series come in a variety of models shown below.

Function \ Model	HFT-70	HFT-80	HFT-81	HFT-82	HFT-83	HFT-88
Display	LCD					
Hold/resolution change	○					
Average/backlight Continuous power supply mode (Auto power OFF); P/V hold	—	○				
Alarm/calibration function	—	—	—	○	○	○
Analog output		—	○	—	○	—
2CH sensor input	—	—	—	—	—	○

4. Preparation for Operation

4.1 Names of Components

4.1.1 HFT-88 (full function model)



① Sensor input connector 1CH
② Sensor input connector 2CH
③ Analog output connector
④ Alarm output connector
⑤ AC adaptor jack
⑥ Liquid crystal display (LCD)
⑦ Calibration interface connector
⑧ Hand strap
⑨ Battery housing
⑩ Key switch pannel

Keys

[ON] Power ON key

[OFF] Power OFF key

[LIGHT] Backlight key

[CONT] Continue key (continuous power supply)

[P·V HOLD] P/V hold key

[HOLD] Hold key

[1/0.1] Resolution change key

[°C/°F] °C/°F change key

[AVG] Average key

[1CH] 1CH display key

[2CH] 2CH display key

[1–2 CH] Temperature difference key

[ALM SET] Alarm set key

[ALM BUZ] Alarm ON/OFF change key

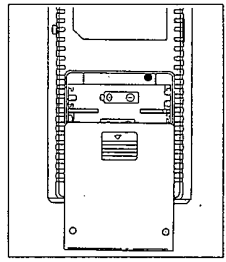
[CAL SET] Calibration set key

[▲] Numeral change key (up)

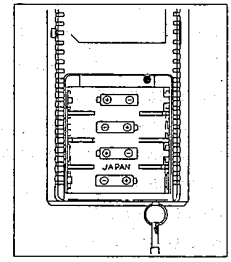
[▼] Numeral change key (down)

[ENT] Entry key

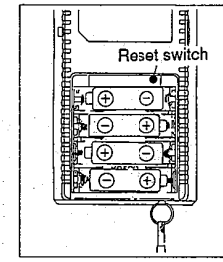
4.2 Battery Installation



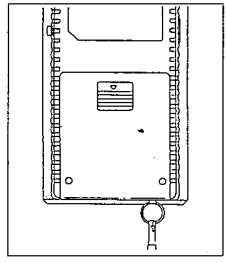
(1) Open the battery housing cover.



(2) Set batteries correctly.



(3) After setting four batteries, press the reset switch once.



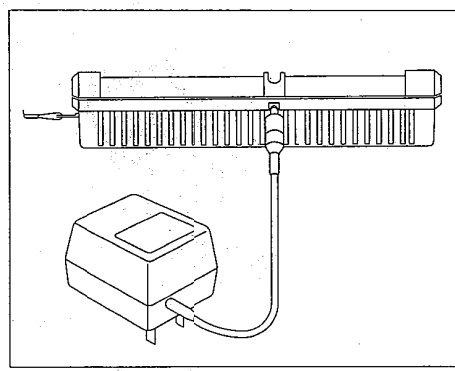
(4) Completely close the battery housing cover.

※ Be sure to keep the power OFF during battery change.

- The reset swith is a small push button in the upper section of the battery housing. Use a thin stick (a match, etc.) to lightly press it.
- When the reset button is pressed, operation begins in the same way as power is turned ON, and the instrument will be ready for measurement. When measurement is not intended after battery change, turn power OFF (P. 9). Even if power is not turned OFF, the automatic stop mode (P.19) automatically turns power off in about 5 minutes. [HFT-80 series]

4.3 AC Power Supply

(1) After turning power OFF, connect the AC adaptor connection plug to the main unit as shown.



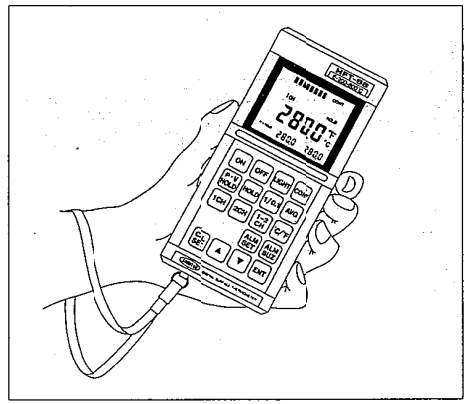
(2) Connect the power plug of the AC adaptor to commercial power (100VAC).

※ When the AC adaptor is connected, the internal battery circuit will be cut off. The instrument can operate only when the AC adaptor is under operating conditions.

Be sure to use the specified AC adaptor. An AC adaptor for HFT series is available as an option.

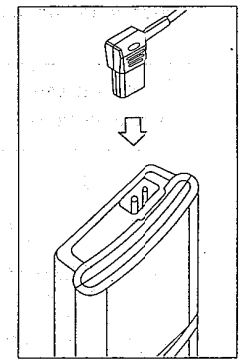
4.4 How to Use Hand Strap

Hang the hand strap around the hand as shown to prevent inadvertent drop of the instrument.



4.5 Sensor Setting

Set the sensor as shown on the right. The plug is so designed that it will not be set when the polarity is reversed. Forcible insertion will damage the instrument. Be sure to check the polarity.



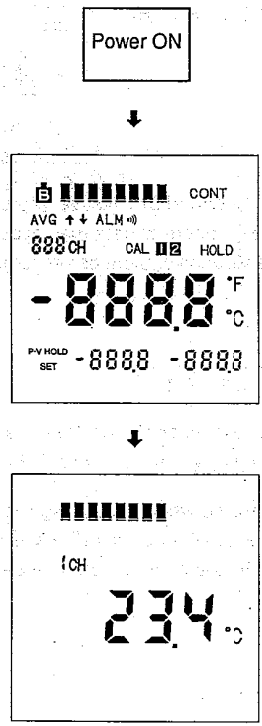
Use the specified connector plug, otherwise a substantial measurement error will result. Our connection plug is made of thermocouple materials, and any error due to the plug joint will not occur.

4.6 Operation Check

When batteries have been set, check the instrument for normal operation.

(1) Turn power ON. For details, refer to item 5.1 Power ON/OFF (P. 9).

(2) When power is turned ON, all segments appear on the display for about 1 second, and the instrument enters the measurement mode.



Display of all segments

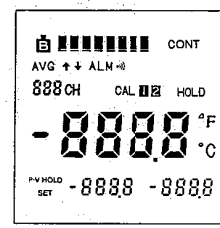
- Measurement mode
  When the sensor is not set, "bcur (burnout)" appears.

5. Operation

5.1 Power ON/OFF

Press [ON] key to turn power ON. Press [OFF] key to turn power OFF.

When power is turned ON and the initial test is completed, all segments appear on the display for about 1 second, as shown on the right, and the instrument is ready for measurement.



※ When power is turned ON right after it is turned OFF (within 1 second), abnormal operation may result or meaningless, abnormal data may appear. If so, turn power OFF immediately. Wait for 3 seconds or more before turning power ON.

5.2 Backlight

Applicable model	All mocels of HFT-30

Press [LIGHT] key to turn the backlight ON, and the display on the screen will be visible even in the dark. Press [LIGHT] key again to turn the backlight OFF.

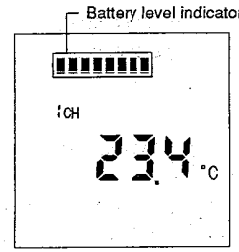
※ The battery comsumption will be doubled when the backlight is used, and the battery life will be shortened. Do not turn the backlightCN when it is unnecessary. When power is turned ON/OFF, the backlight automatically goes out.

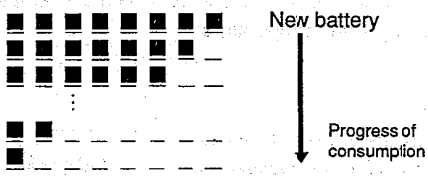
5.3 Error Message

5.3.1 Indication of battery voltage drop

- The battery level indicator

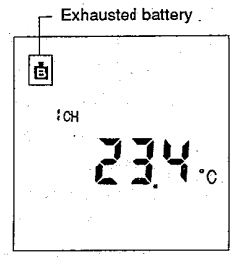
  The battery level is indicated in the upper section of the display. In accordance with operation hours, the indicator lights go out as shown below.





- Indication of voltage drop

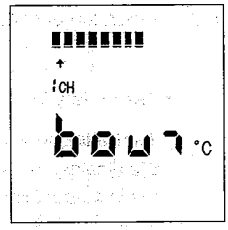
  When batteries are running down, appears on the display. Then replace the old batteries with new ones.



※ The instrument can work for about 5 hours after the voltage drop display appears. However, change batteries in good time, otherwise satisfactory function will not be available.

5.3.2 Indication of sensor burnout

When the sensor has burned out or is not coupled, the indication of burnout, shown on the right, appears on the dispay. When it appears, change or connect the sensor.

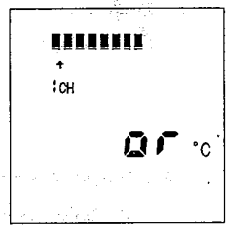


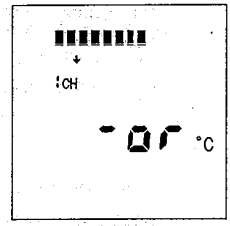
※ While such an indication is shown on the display, [P-V HOLD], [CAL SET], and [ALM SET] keys are invalid. If the sensor burns out while the instrument is in the P/V HOLD mode, the burnout indication appears for the measured maximum temperature, minimum temperature, and present temperature.

5.3.3 Indication of overrange

When the measured temperature exceeds the measurable range, the indication of overrange, shown on the right, appears.

- The indication of overrange appears when the sensor is about to burn out, as well. Check the sensor when the measured temperature is obviously within the measurable range.
- Even if the indication of overrange appears, the instrument will not be damaged. However, in consideration of the heat-resistance of the sensor, it is recommended to immediately shift the sensor to a place where the temperature is below the heat-resisting temperature.





※ When a voltage exceeding 500 mV is applied to the input terminal of the sensor, the internal amplifier circuit may be damaged. Do not connect anything other than a thermocouple.

5.4 Key Operation

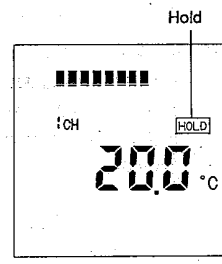
Whenever a key on the instrument is pressed, a peep sound is issued to ensure correct key operation.

5.4.1 HOLD Hold key

Press this key to stop temperature measurement and show the measured temperature on the display.

When the instrument is in the hold mode, **HOLD** appears on the display.

Press the key again to return to the normal display and operation.

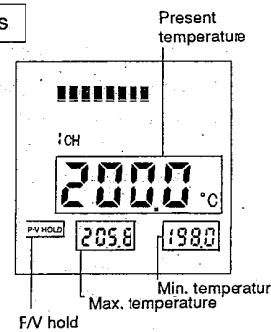


5.4.2 P/V HOLD P/V hold key

Applicable model	All models of HFT-80 series

Press this key to enter the P/V hold mode, and three data - maximum temperature, minimum temperature, and present temperature - are displayed simultaneously. **P·V HOLD** is displayed while the instrument is in the P/V hold mode.

Press the key again to return to the normal display and operation.

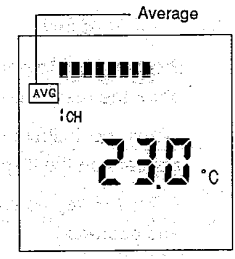


5.4.3 [AVG] Average key

Appicable model	All models of HFT-80 series

Press this key to average all temperature data. The average of sampled temperatures is displayed every 16th measurement.

This mode is effective for stable display of unstable temperature fluctuation. **AVG** appears on the display when the instrument is in the average mode. Press the key again to return to the normal display and operation.

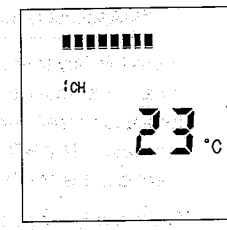


Values measured during P/V HOLD are also averaged and displayed.

5.4.4 [1/0.1] Resolution change key

Press this key to change the resolution of the displayed temperature.

The automatic resolution change function usually displays temperatures from -99.9°C to +499.9°C at every 0.1°C. When temperatures exceed this range, the resolution automatically changes to 1°C.



When the resolution is set at 1°C, data with 0.1°C resolution are rounded off, and all temperatures within the measureable range are shown at every 1°C. Press the key again to return to the normal resolution.

This key is also valid when calibration or alarm is being set. Select the 1°C resolution to quickly set numerals with [▲] and [▼] keys.

5.4.5 [CAL] Calibration set key

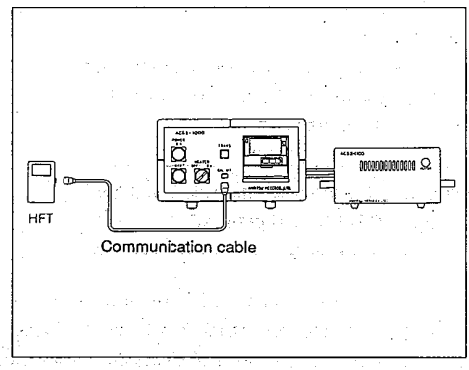
Applicable model	HFT-82, 83, 88

This key permits calibration of data, that are displayed in accordance with the characterisitics of sensors, in order to materialize extremely high-precision temperature measurement.

Our temperature calibration system (ACS II) permits higher-precision temperature calibration.

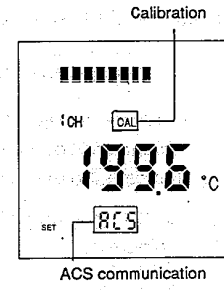
(1) ACS II system

Check that the power for the instrument is OFF, and insert the plug of the ACS II communication cable into the calibration interface connector. Then turn power for the instrument ON.



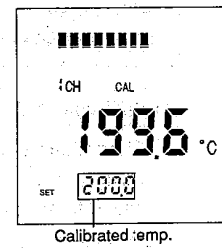
Touch the sensor to the calibration block and wait unti the display stabilizes.

Press [CAL SET] key on the instrument to enter the calibration mode. Then **CAL** and **ACS** appear on the display. If **ACS** does not appear, check the cable and press [CAL SE] key to return to the ordinary mode. Then press [CAL SET] key again to repeat this operation.

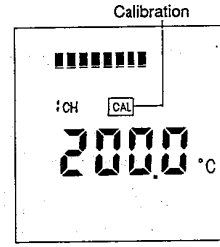


Check the indication of **ACS** on the display, and press the TRANS key on ACS II, and the calibrated temperature data are transferred to the instrument.

Check the data and press [ENT] key.



When measured data have been calibrated, **CAL** appears as shown on the right during ordinary measurement, as well.



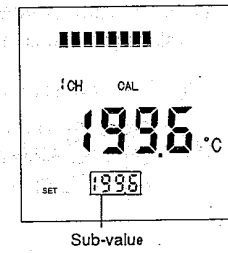
Keep touching the calibration block with the sensor until [ENT] key is pressed.

※ Automatic calibration with ACS II presupposes correct measurement of the temperature of the calibration block by the instruemnt and sensor. A deformed sensor that cannot touch the calibration block correctly or dust on the calibration block causes ncorrect temperature indication. Since calibration communication is established as it is, calibrated temperature may be wrong. Check the conditions of the sensor and the surface of the calibration block before calibration.

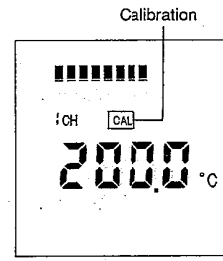
(2) Manual calibration

In the absence of the ACS II system, a reference temperature generator will permit manual calibration.

Touch the sensor to the reference temperature generator, and press [CAL SET] key to enter the calibration set mode. Set the sub-value to the desired calibrated temperature with [▲] and [▼] keys, and then press [ENT] key.



When measured data have been calibrated, **CAL** appears as shown on the right during ordinary measurement, as well.



Input temperatures for manual calibration are limited to ±10°C.

When [▲] or [▼] key is kept pressed while the calibrated value reaches the limit, the value will not change any more and a buzzer sound is issued to signify invalid key operation.

Such a function is provided to prevent incorrect calibration by a defective sensor with a deformed cortact point.

Check that the sensor is normal before calibration.

- Cancelling calibration

  Cancel the calibrated data and press [CAL SET] key to return to the ordinary display. Then press [ENT] key, and **CAL** disappears from the display. Now, ordinary data are shown on the display.

※ Remove the communication cable from the ACS II system before cancelling calibration.

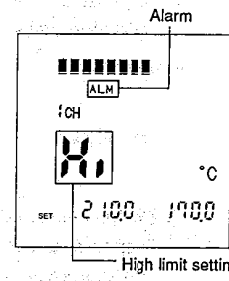
5.4.6 High/low limit alarm

Appicable model	HFT-82, 83, 88

This function presets high and low limits and sounds buzzer when measured values go beyond the measurable range.

(1) High/low limit setting

Press [ALM SET] key, and the high limit setting screen appears. While **Hi** is displayed, set the high limit with [▲] and [▼] keys.



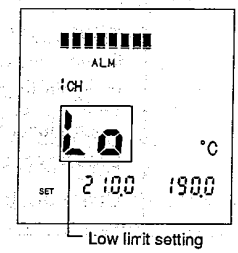
For setting lower limit also

For setting high limit alone

Press [ENT] key to end setting.

Press [ALM SET] key, and the low limit setting screen appears.

While **Lo** is displayed, set the low limit with [▲] and [▼] keys.



Press [ENT] key to end setting.

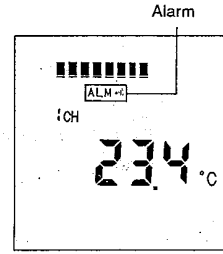
※ To set only the low limit, press [ALM SET] key twice before starting to set.

- Initial high/low limit setting: Before shipment, the high and low limits are set at the maximum and minimum, respectively, within the measurable range, respectively.
- Be sure to maitain the condition of [High limit > Low limit]. Otherwise, input will be invalid.
- When [ALM SET] key alone is pressed without input by [▲], [▼] and [ENT] keys, data will not be renewed. Confirmation of set values only is possible.

(2) Alarm ON/OFF

Press [ALM BUZ] key to turn the alarmbuzzer ON/OFF.

When the alarm is set in the ON position, **ALM** appears on the display.



Models with the alarm function can output preset high/low limits by means of digital signals. (For details, see 5.5 Alarm Output (P.21).)

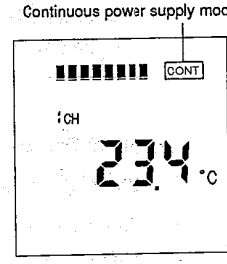
Digital signals are output when the buzzer sound is turned OFF by [ALM BUZ] key, as well.

5.4.7 CONT Continuous power supply mode

Applicable model	All mocels of HFT-30 series

An automatic power OFF mode is provided to automatically turn power OFF when there is no key operation for a certain period of time (about 5 min) after power is turned ON. Thus omission of turning power OFF can be prevented.

Press CONT key to enter the continuous power supply mode for measurement for an extended period of time. **CONT** appears on the display in this mode.



※ Every time power is turned ON, the instrument enters the automatic power OFF mode.

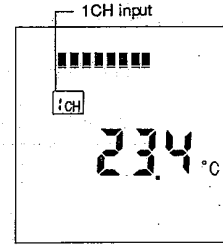
HFT-40 s not equipped with the automatic stop mode.

5.4.8 Input channel set key

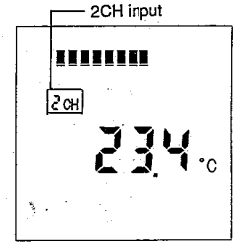
Applicable model	HFT-88

Press [1CH], [2CH], or [1-2 CH] key to set a desired channel.

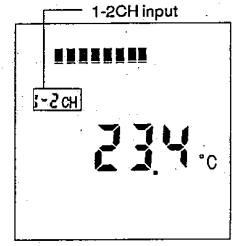
Press [1CH] key to display the temperature measured by the sensor connected to the sensor input connector 1CH.



Press [2CH] key to display the temperature measured by the sensor connected to the sensor input connector 2CH.



Press [1-2 CH] key to display the temperature difference between 1CH and 2CH. At that time, the datum is 1CH.



※ When channels are changed while the hold, P/V hold, or average function is in operation, the function will be cancelled.

Calibration is possible for 1CH and 2CH independently.

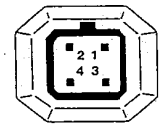
5.5 Alarm Output

Applicable model	HFT-82 83, 88

Models equipped with the alarm function can output the high/low limits by means of digital signals.

(1) Signal names and connector pin arrangement

Pin No.	Signal name
1	ALM1 (Hi)
2	ALM2 (Lo)
3	V1 (Power 1)
4	V2 (Power 2)

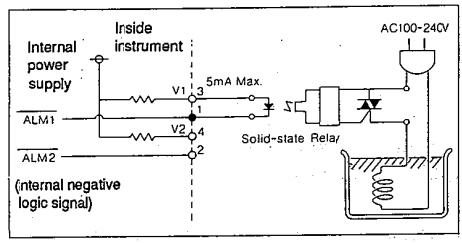


Applicable connector: E4-150 series made by Chuo Musen

	ALM1 (Hi)	ALM2 (Lo)
Over Hi	"L"	"H"
Between Hi and Lo	"H"	"H"
Below Lo	"H"	"L"

ALM1 and ALM2 are directly coupled with C-MOSIC.

(2) Signal takeout and example of use



- An example of simple temperature measurement (ON/OFF control) with the high limit alarm.
- Signal current of up to 5 mA can be taken out. Examine the junction circuit (driver, etc.) in accordance with the driving load.
- Be sure to turn the power OFF before connecting to or separating from other equipment.

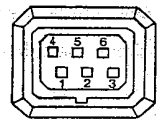
5.6 Calibration interface

Applicable model	HFT-82, 83, 88

This is a special interface for communication with the ACS II system.

- Signal names and connector pin arrangement

Pin No.	Signal name
1	GND
2	SCK
3	SI
4	SO
5	N.C.
6	N.C.



Be sure to turn the power switch OFF before connecting to other equipment.

5.7 Analog Output

Applicable model	HFT-81, 83

There are two analog output rates. The instrument is equipped with the rate specified by you.

1 mV/°C output model ..... Ertire measurable range at the rate of 1°C resolution.

10 mV/°C output model ..... Within the range from -100°C to +500°C at the rate of 0.1°C resolution.

Output accuracy: ± (0.15% of full scale + 1 mV)

In the instrument, all temperature data are digital-processed, and a highly stable D/A converter is used for analog output. Unlike the existing analog output, the output voltage changes step by step. The accuracy and stability are far superior in comparison with existing models.

● Connection with recorder

(1) Turn OFF the power for the recorder and the instrument.

(2) Connect the red terminal of the attached cable to the positive (+) side of the recorder terminal and the black terminal to the negative (–) side of the recorder terminal.

(3) Adjust the recorder input range to the measuring range of the instrument.

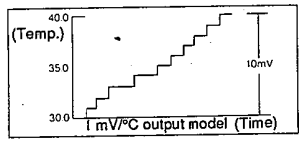
(4) Turn ON the power for the recorder and the instrument.

(5) Press CONT key to enter the continuous power supply mode (P.19).

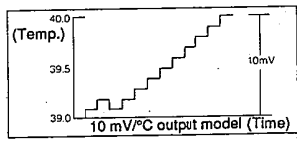
※ Never short-circuit the cable terminals or cable itself, otherwise failure will result.

● Example of recording

1 mV/°C output model



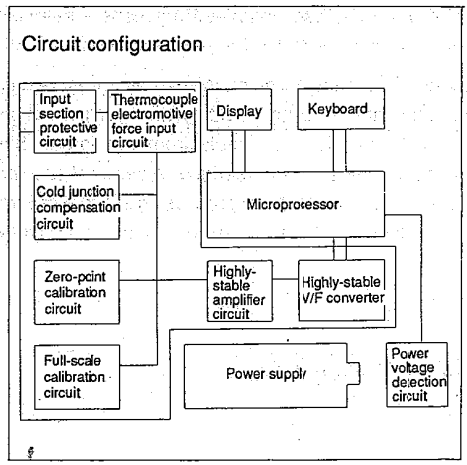
10 mV/°C output model



6. Principle of Operation

6.1 Circuit Configuration

The instrument equipped with a high-precision V/F converter and C-MOS microprocessor permits extremely high-precision temperature measurement.



6.2 From Temperature Input to Display

6.2.1 Temperature input

When temperature change occurs in the thermocouple sensor connected to the sensor input connector, thermoelectromotive force is generated accordingly. The thermoelectromotive force is sent to the input circuit via the input protector circuit. A noise filtering circuit that cuts noise is incorporated in front of the amplifier section for stable temperature input. The thermoelectromotive force taken into the input circuit is amplified in the highly stable amplifier circuit.

6.2.2 Data exchange

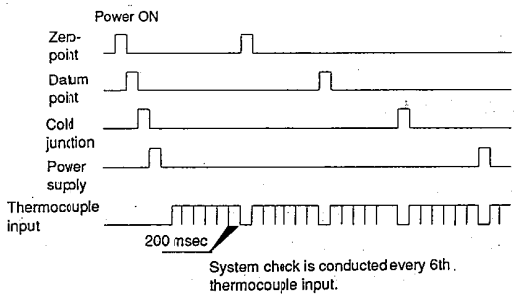
The amplified thermoelectromotive force is immediately converted into digital data by the high-resolution V/F converter. To obtain higher-precision data, the microprocessor conducts zero-point and full-scale calibration.

Unlike the existing instruments, this instrument is not equipped with a zero-point or full-scale control. We call these two combined functions a self-calibration function, which materializes extremely stable temperature measurement.

The thermoelectromotive force itself cannot be handled as temperature data. Cold junction temperature data are input through a cold junction compensation circuit to convert the data into 0°C-equivalent thermoelectromotive force. Since the thermoelectromotive force is non-linear, it is linearized. A series of such processing is done by the microprocessor that conducts processing at a rate of 5 times per second. Thus the thermoelectromotive force of the sensor is converted into temperature data.

6.3 Scan Timing

The scan timing for data input is shown below.

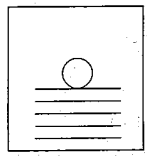


7. For More Accurate Temperature Measurement

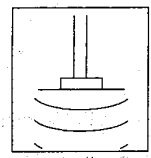
7.1 Surface Temperature Measurement

7.1.1 Sensor contact method

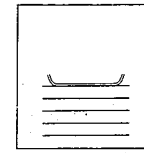
The total area of a sensor for measuring surface temperature must be small enough in comparison with the area of the portion of the sensor that is in contact with the object surface. In other words, a sensor must ensure sufficient thermal contact with the object surface, and it must be shaped so that it will not absorb heat excessively from the object surface or discharge heat to the surface. Correct measurement cannot be expected when the sensor is in a shape that changes the surface conditions.



The contact area is a point, which is not suited for surface temperature measurement.



The heat capacity of the sensor is to large, and the error is extremely large accordingly.

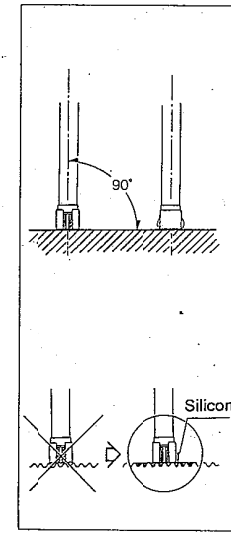


The heat capacity is smal and the contact area is large. Measurement is very accurate.

7.1.2 How to use sensor

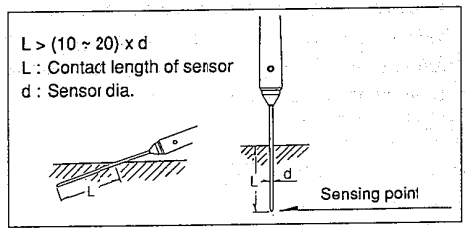
Most of our sensors are designed so that the sensor head will touch the object surface perpendicularly. Slight inclination will not cause an error, but extreme inclination prevents sufficient contact with the object surface. Touch the sensor head as perpendicularly as possible.

Apply the sensor to a flat surface without irregularity. Apply silicone grease, etc. to an extremely rough surface to ensure sufficient thermal contact.



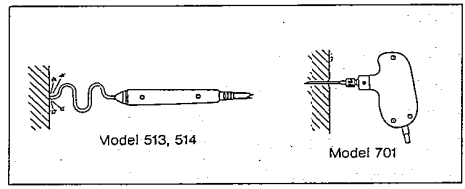
7.2 Liquid/Internal Temperature Measurement

For measuring liquid or internal temperature, a thin bar-shaped or needle-shaped sensor is used in general. For correct measurement with such a sensor, sufficient contact with an object must be ensured. It is said that a thin bar-shaped or needle-shaped sensor must have a contact portion the length of which is 10 ~ 20 times the diameter of the sensor.



● Measurement of the temperature of the inside of a solid

When an ordinary internal temperature sensor is used to measure the temperature of the inside of a solid, such as hard rubber or frozen food, the life of the sensor may be shortened substantially. Select a durable sensor (especially a sensor with a durable end).



7.3 Gas (Air) Temperature Measurement

Sensors similar to those used for measuring liquid or internal temperature are frequently used for measuring gas (air) temperature. However, most of such sensors seem to have quicker response than those for liquid/internal temperature measurement. Sensors in such shapes must be in close contact with the object surface for correct measurement.

8. Maintenance

8.1 Storage

Avoid places subject to the following when storing the instrument.

- Direct sunlight
- Strong vibration
- High humidity (80% RH or more)
- Hot atmosphere (60°C or more)
- Dust, corrosive gas, or salt
- Strong electromagnetic field

It is recommended to put the instrument in the original case when storing it for a long time.

8.2 Case cleaning

When the case is dirty, lightly wipe it with a cloth slightly impregnated with water or petroleum.

Do not use thinner or benzene, otherwise the case or keyboard may discolor or deform.

8.3 Boiling Point Check

It is recommended to purchase a boiling point checking sersor (Our models: 509, 522, 523) for checking boiling poins in order to roughly judge whether or not the input characteristics is normal. Prepare the following equipment before checking boiling poirts.

- Electric pot, or other water boiling equipment
- Boiling point checking sensor
- Pure water

Apply the end of the checking sensor to the steam coming out of a boiling pot to measure the steam temperature. The instrument is in good order when the reading is about 100°C.

> This is a rough checking method because the boiling poirt of water is subject to the atmospheric pressure.

★ If the data shown by the instrument do not satisfy the specification, please contact the place of purchase or our service counter.

8.4 Calibration

Our temperature calibration system (ACS II) ensures comprehensive calibration of measured data including instrument and sensor error.

- Set the ACS II system at the specified temperature and place a sensor on the calibration block. Read the temperature in each channel. (Limited to models with a calibration function)

★ If the data shown by the instrument do not satisfy the specification, please contact the place of purchase or our service counter.

※ The instrument is to be calibrated and adjusted by our company, so please return it to the place of purchase.

> In general, our sensors display higher surface temperatures than those made by other companies, because the thermal contact of our sensors are superior. Temperatures shown by our sensors are nearer to actual temperatures.