

DUAL THERMO
Non-Contact and Contact Thermometer

AR-6500Series

User's Manual

ANRITSU METER CO., LTD.

Introduction

Thank you for purchasing this Anritsu Meter Co., Ltd. product.

This instruction manual was written to ensure safe and correct use of the instrument. Do not attempt to operate the instrument until you have carefully read this manual and gained a good understanding of its various functions.

Warranty and After-Sales Service

Warranty

This product was rigorously tested by Anritsu before shipping. However, in the event of any damage arising from product defect or accident during operation, please contact your dealer or the Anritsu Customer Service Counter listed below. The term of warranty is one year from the date of purchase. During this period, any damage which is clearly the responsibility of Anritsu will be repaired free of charge.

Please note that trouble caused by the following is not covered by the warranty:

- Fire, earthquake or other acts of God
- Improper use or handling, or alteration of the product (including opening of the case, loosening of the screws etc.).

The Anritsu thermocouple sensor is a consumable, and is not covered by warranty.

After-Sales Service

If the product does not appear to be working properly, please use this manual to investigate the problem. If the problem still cannot be solved, please contact your dealer or the Anritsu Customer Service Counter listed below. Repairs during the warranty period will be performed free of charge according to the provisions of the warranty. Repairs after the warranty period, or improvements or alterations to the product made at the customer's request, may also be performed for a fee.

When shipping the product for repair or calibration, please ship the product in its original container. If the case is no longer available, pack the product in a cushioning material to avoid damage during shipment.

Customer Service Counter :

*Anritsu Headquarters
Fax : +81-3-3493-6729*

Technical FAX-back Service:

As an added service to our customers, Anritsu Meter Company offers a FAX-back service to help users of its instruments achieve optimal temperature measurement. Anritsu's specialists in temperature measurement are ready to provide technical assistance in order to help you obtain maximum performance from your measurement.

When requesting technical assistance by FAX-back, be sure to include figures, diagrams and photographs to supplement your explanation of the problem. Please describe the problem in as much detail as possible. Use A4-size paper, write "Technical Service Request" at the top, and then fax your request to the number below. Please do not forget to include contact information such as your name, company name and address, telephone number, and FAX number.

Anritsu's Technical Service FAX-back Number is:

Dialing from Japan: 03-3493-6729
Dialing from overseas: +81-3-3493-6729

Caution :

- Reproduction of any part of this manual, in any form, without written permission from Anritsu Meter Company is prohibited.
- Every effort has been made to provide a clear and complete description of the operation of this product. In the event that you are uncertain about operation of any aspect of this instrument, contact Anritsu Meter Company or your nearest sales representative.
- The contents of this manual and the specifications of this product are subject to change without notice.
- This equipment uses semiconductor red lasers. Be sure to follow the Cautions on Laser Handling when using the laser.

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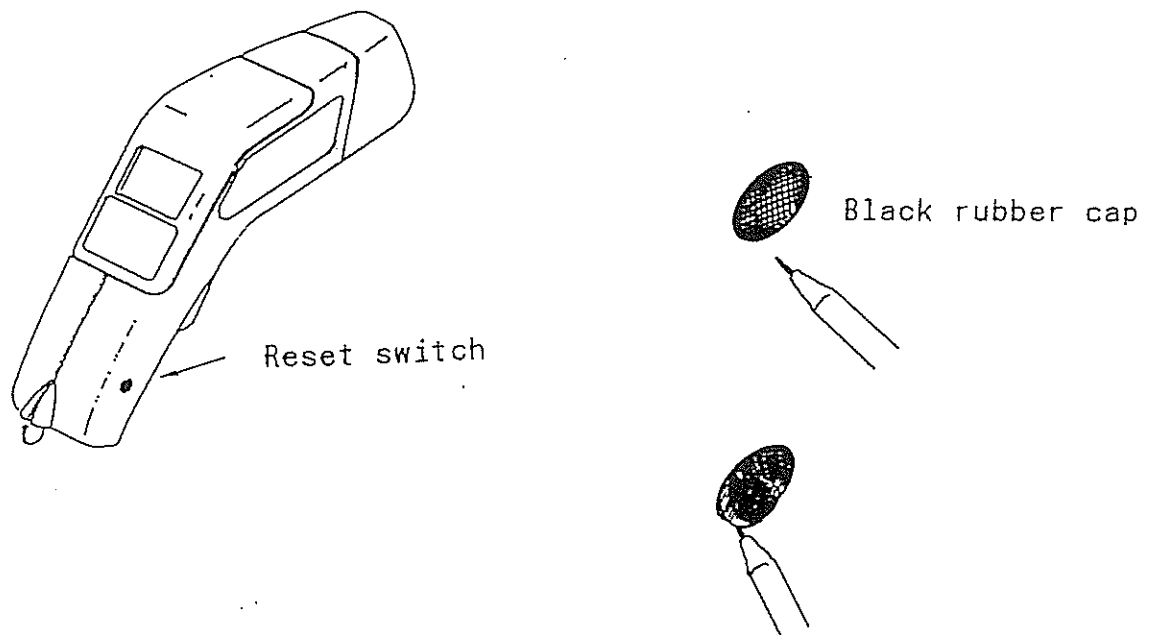
■ How to operate the reset switch

When your unit was in trouble such as the abnormal value on the display, carry out initialization of the unit by the reset switch.

- (1) Remove the black rubber cap on the right side of the body.
- (2) Push the internal white switch by something small stick.
- (3) After sound a signal, all segments on the display will be lighted and the initialization of the unit is finished.

[NOTE]

- ※ After carry out the initialization, A constant will turn back to "1.00".
- ※ If your unit does not return to the normal condition mode, please contact to Anritsu Meter Co. or your nearest sales representative.



1. Overview

1.1 Overview

The Dual Thermo AR-6500 is a new type of instrument for temperature measurement, which combines a non-contact thermometer with a contact thermometer. In dual-mode temperature measurement, the fast response and stable performance of the contact (thermocouple) sensor is used to determine the A Constant, based on which the non-contact component obtains easy, accurate measurements.

This unit can be used in a wide range of applications. The combination of non-contact and contact measurement methods enables the operator to respond flexibly to the requirements of various subjects and environments by selecting the most appropriate method. Moreover, its compact size and superb measurement performance deliver high mobility for handy field use.

The A Constant

The non-contact thermometer obtains its temperature reading from the level of infrared energy radiated by the subject body. This infrared radiation varies from the ideal value according to factors such as composition of the subject body, surface properties and the measurement environment. To measure the body's temperature accurately, a correction value is needed. This value is the A Constant.

To obtain accurate measurements with the non-contact thermometer, the Dual Thermo combines it with a contact thermometer, which is employed to obtain the A constant (correction value).

The temperature measurement process is as follows:

- 1) An accurate temperature reading is obtained by the contact method to serve as the criterion
- 2) Temperature measurements are made using the non-contact thermometer
- 3) The A Constant is calculated from these two data

The A Constant thus determined corrects not only for the actual emissivity of the subject body itself, but for external interference effects as well. This method is effective in rendering accurate correction of the non-contact temperature measurement according to the actual measurement conditions.

Dual Mode

When calibration to obtain the A Constant is complete, the Dual Thermo automatically switches to dual mode. By switching the temperature measurement method to Dual mode following A Constant calibration, the Dual Thermo provides a convenient means of obtaining accurate non-contact temperature measurements.

1.2 Features

■ Easy-to-Use Calibration System

By performing a single temperature measurement with the contact and non-contact thermometers, the Dual Thermo can be calibrated to determine the A Constant. The error in the A Constant can thus be used to prevent error in the measurement value.

■ Laser Display Function

When using the non-contact thermometer, it is important to be certain of the exact area being measured. The dual Thermo indicates the center of the measurement point with a laser marker, ensuring accurate measurement.

■ Built-in Analog Output Function (for use with the AR-6501)

When used in combination with the high-stability Digital/Analog (D/A) Converter, a 1 mV/°C analog signal can be output. This function can be connected to a wide range of recording instruments, including the Anritsu Voltage Data Collector (AM-7101).

2. Opening the Package

2.1 Opening the Package

When opening the package which contains the Dual Thermo, please verify that the following items are contained inside. Anritsu makes every effort to ensure that every package is complete; however, in the event that the contents are incomplete or damaged or the enclosed warranty appears unsatisfactory, contact your dealer or the Anritsu Service Counter.

■ Names of Items (basic set)

Dual Thermo (main unit)	1
Dedicated recharger	1
User's manual (this manual)	1
Warranty	1
Analog output cable (1.5 m) *AR-6501 only	1

When you have determined that the included items are in order, perform a check of operations.

*Contact Sensor is sold separately.

2.2 Repacking

When moving this unit (by mail, by car, etc.), use the original case in which the unit was packed. If the case is no longer available, carefully protect the unit by packing it in a shock-absorbent material such as styrofoam. Since the unit may be damaged if the packing material is moldy or wet, be sure to use dry material which is free of mold and dust.

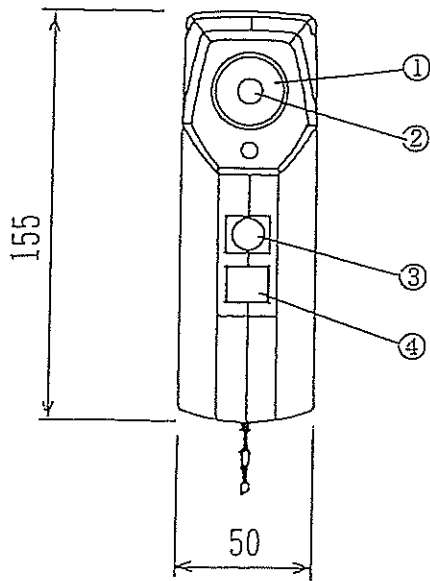
This unit contains a lens and other optical components. If the lens, etc. are scratched or otherwise damaged, problems such as incorrect measurement values may occur.

When repacking the unit, it is recommended that the lens and other optical components be wrapped in a cloth or similar material for protection.

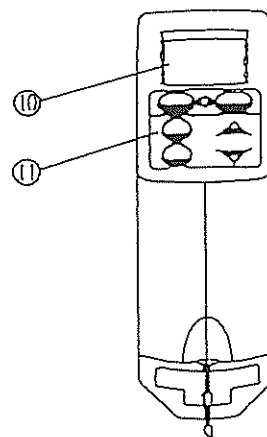
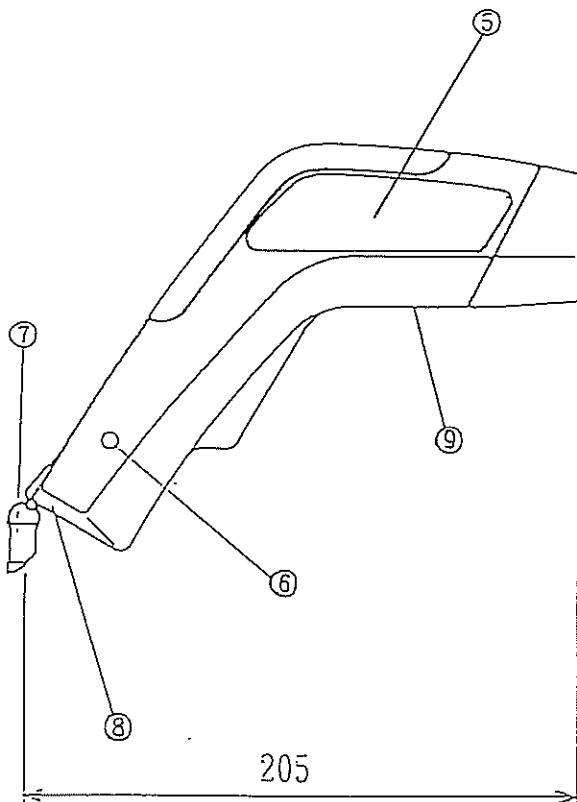
3. Basic Operation

3.1 Names of the Parts and their Functions

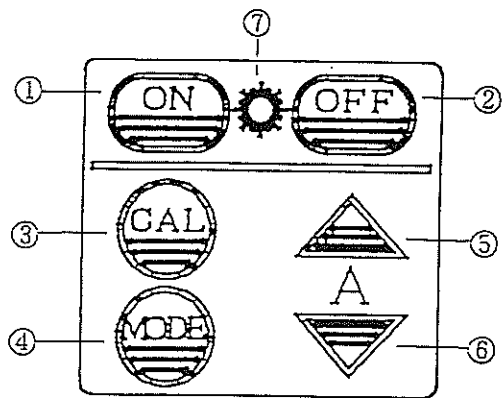
■ External View



- ① Convex lens for infrared rays
- ② Prism(laser emission component)
- ③ HOLD key
- ④ LASER key
- ⑤ F.O.V label
- ⑥ RESET switch
- ⑦ Handstrap
- ⑧ DC connector for recharger
- ⑨ Tripod screw groove
- ⑩ LCD
- ⑪ Membrane switches

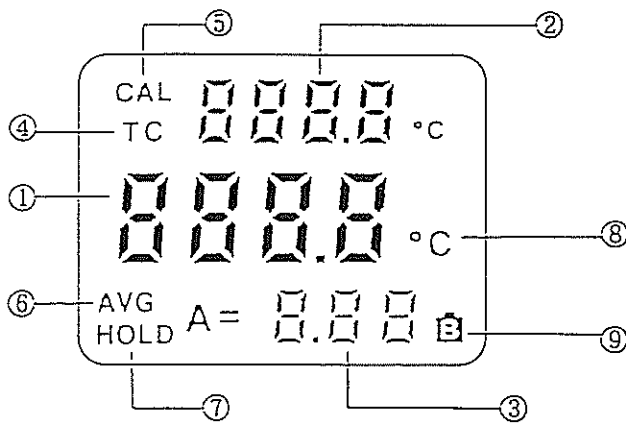


■ Membrane Switch



- ① ON key
- ② OFF key
- ③ CAL (calibration) key
- ④ MODE (mode-switching) key
- ⑤ ▲ key
- ⑥ ▼ key
- ⑦ Laser lamp

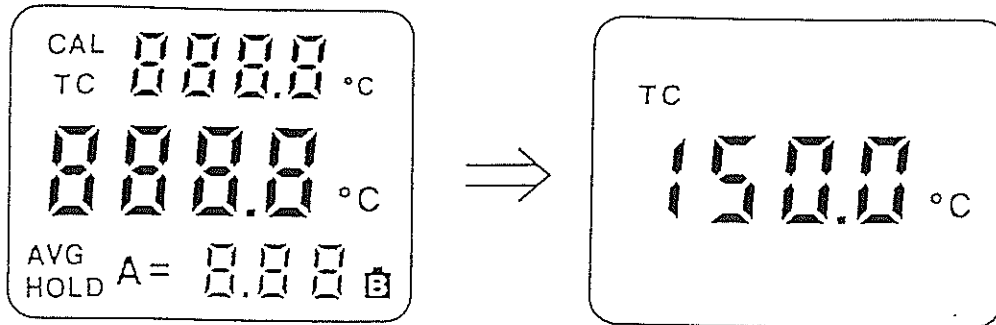
■ LCD



- ① Main switch
- ② Sub-display
- ③ A Constant display
- ④ TC segment
- ⑤ CAL segment
- ⑥ AVG segment
- ⑦ HOLD segment
- ⑧ °C segment
- ⑨ BL segment

- ON key

Press the ON key to turn the power ON. All segments appear on the screen for approximately 1 second, then the temperature measurement mode appears.



Note: The temperature measurement mode that appears at this time is the temperature measurement mode that was set when the power was last turned OFF.

- OFF Key

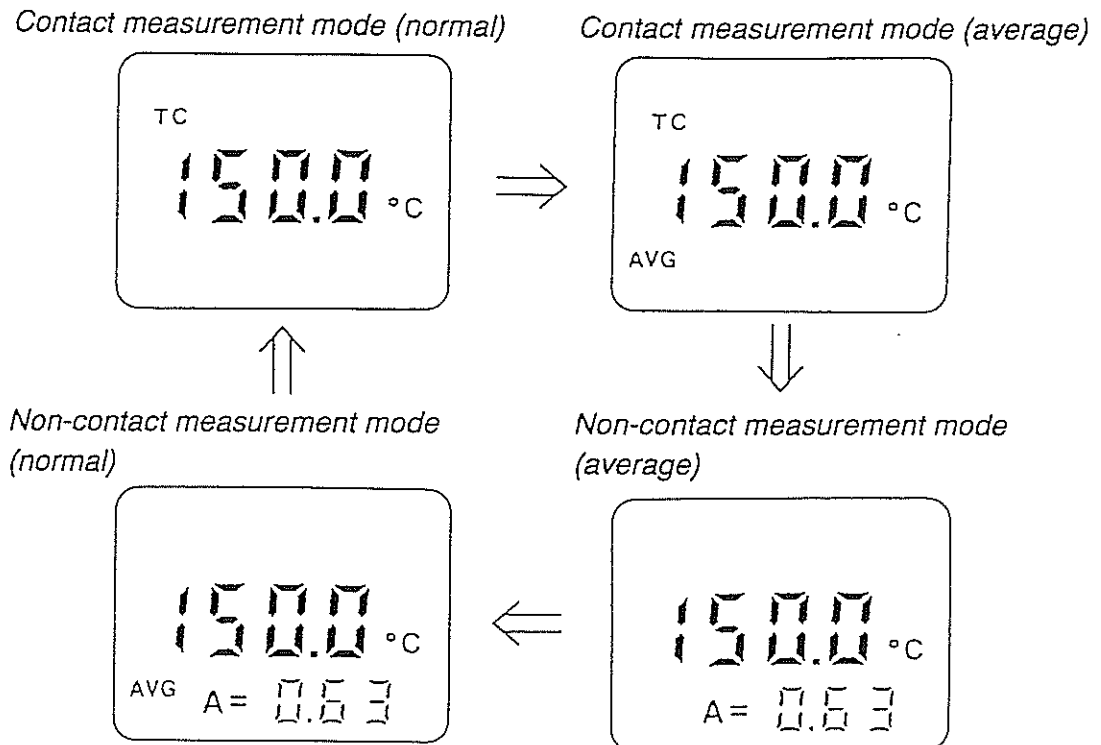
Press this key to turn the power OFF.

- CAL Key

Press this key to switch to calibration mode. Note that this switch can only be used when the screen is in non-contact temperature measurement mode. For a detailed explanation see "5. Determining the A Constant."

■ **MODE Key**

Each time the MODE key is pressed, the measurement mode screen changes.



■ **▲, ▼ Keys**

- Change the A Constant.
(See "4.2 Non-Contact Temperature Measurement Mode")
- Change the Hold function.
(See "6.2 Maximum and Minimum Value Display Function")

■ **Hold Key**

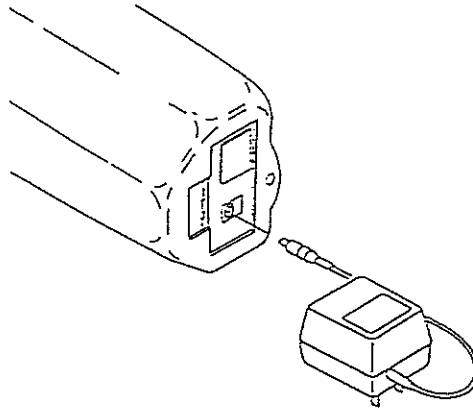
- Sets the measurement value.
(See "6.1 Hold Function")
- Is used to set the value obtained during calibration.
(See "5. Determining the A Constant")

■ **LASER Key**

Is used to indicate the center of the measurement point using the laser marker. (See "6.3 Laser Marker Function")

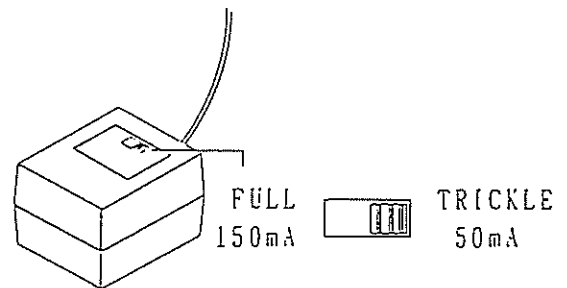
3.2 Recharging the Battery

This unit contains a built-in NiCd rechargeable 4AA battery. Use the voltage selection switch of the dedicated recharger to match its voltage with that of the main unit. Next, connect the power cord to the DC jack on the main unit and the recharger to the power lamp. This begins recharging.



Caution:

- When recharging the main unit, use the dedicated recharger only.
- Before recharging, check the voltage and use the voltage selection switch of the dedicated recharger to match its voltage with that of the main unit.
- When the battery is drained and the BL segment appears in the display, recharge the battery. Recharging takes approximately 10 hours when the main unit power is OFF. Be careful not to overcharge the battery, as this reduces its working life.



Attention:

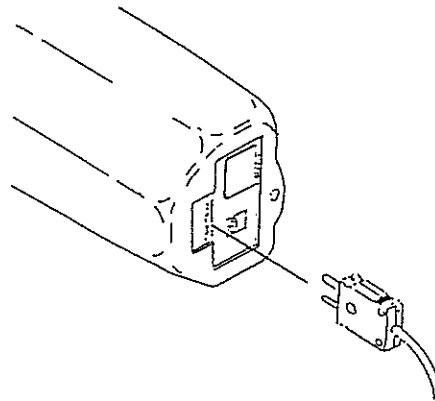
The battery that you have purchased is recyclable. At the end of its useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream. Check with your local solid waste officials for details in your area for recycling options or proper disposal.

3.3 Using the Handstrap

You can avoid inadvertently dropping the unit by using the handstrap to attach the Dual Thermo to your wrist.

3.4 Connecting the contact Sensor Plug

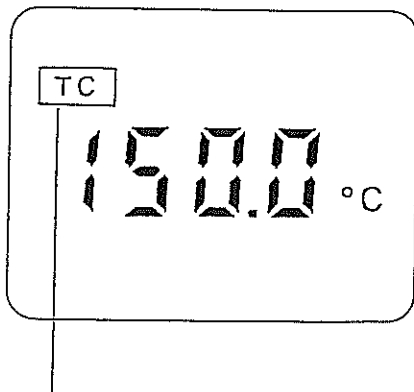
Connect the thermocouple sensor to the main unit as shown in the diagram on the left. The plug is designed so that it can only be inserted if the polarity is correct, so do not use excessive force to insert the plug. Be sure to verify that the polarity is correct.



4. Operation

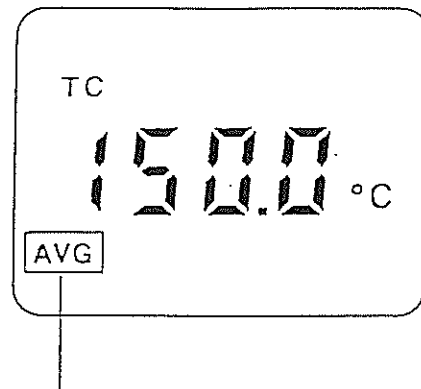
4.1 Contact Temperature Measurement Mode

Display Example 1 (Normal)



Contact (TC) mode display

Display Example 2 (Average)



Average (AVG) display

Press the MODE key to switch the screen display as shown above and perform temperature measurement using the contact sensor.

Display 1

Normal measurement using the contact mode (Normal)

The measurement value is displayed directly.

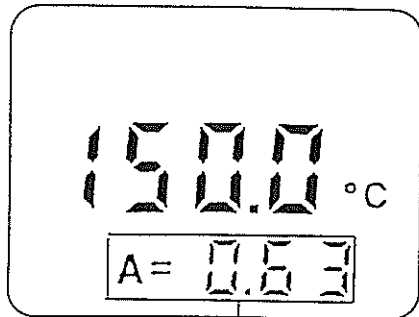
Display 2

Average measurement using the contact mode (Average)

The average value of 16 data samples is calculated and displayed continuously.

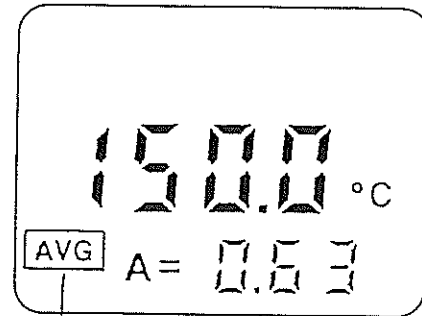
4.2 Non-Contact Temperature Measurement Mode

Display Example 3 (Normal)



A Constant display

Display Example 4 (Average)



Average (AVG) display

Press the MODE key to switch the screen display as shown above and perform non-contact temperature measurement.

The A Constant can be set freely using the ▲, ▼ keys.

Display 3

Normal measurement using the non-contact mode (Normal)

The measurement value is displayed directly.

Display 4

Average measurement using the non-contact mode (Average)

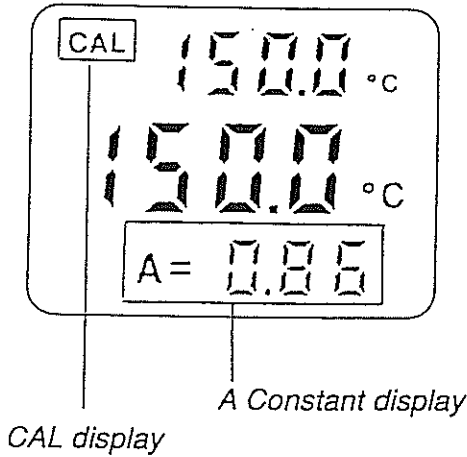
The average value of 16 data samples is calculated and displayed continuously.

Note: *This screen cannot be selected while calibration is in process. To switch to this screen, cancel calibration (see page 13, "Canceling Calibration").*

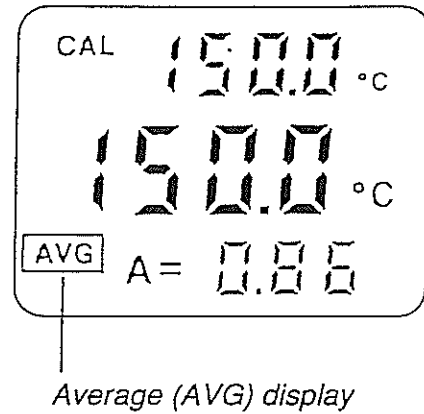
Note: *It is recommended that calibration be used to set the A Constant.*

4.3 Dual Mode

Display Example 5 (Normal)



Display Example 6 (Average)



When the A Constant is set in Calibration mode, the unit switches to the Dual mode screen. (see "5.1 Calibration Mode")

Display 5

Normal measurement using the Dual mode (Normal)

The measurement value is displayed directly.

Display 6

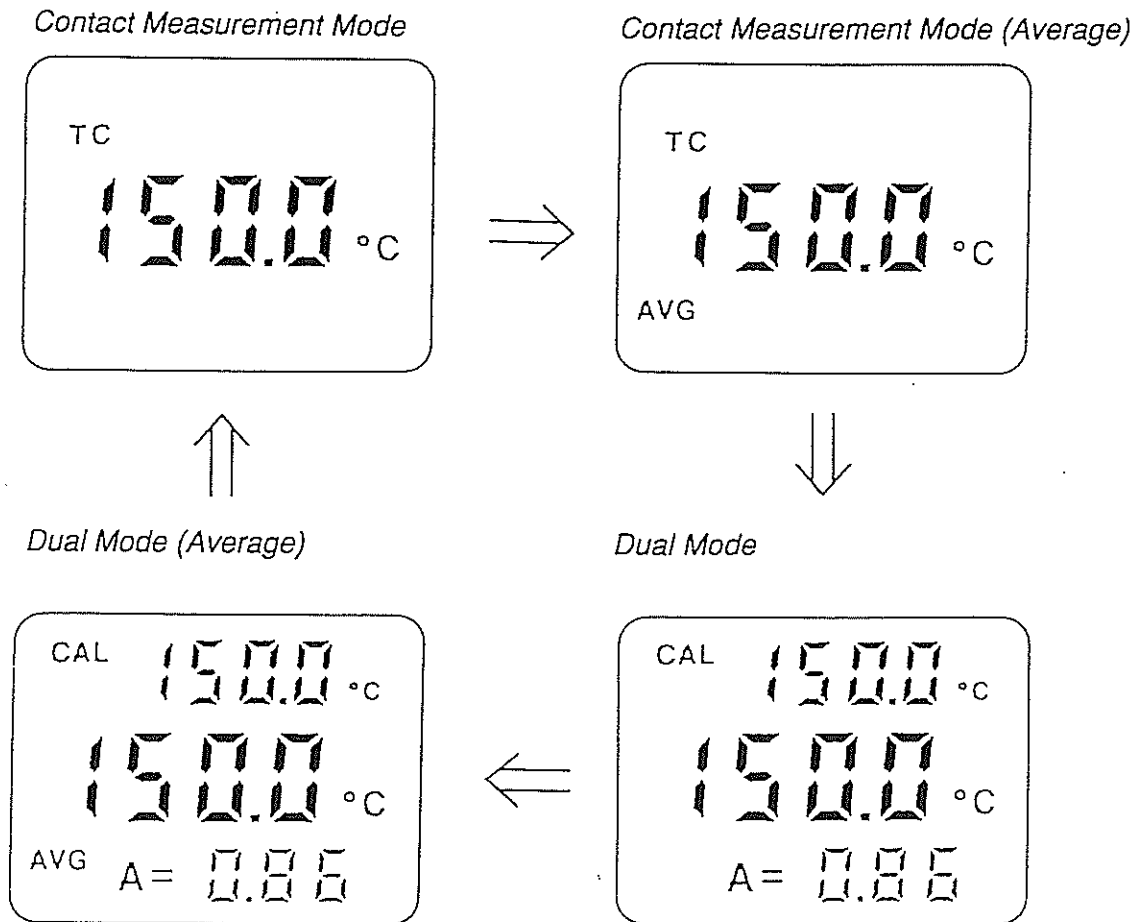
Average measurement using the Dual mode (Average)

The average value of 16 data samples is calculated and displayed continuously.

■ **What is Dual Mode?**

When the A Constant has been set through calibration, the Dual Thermo automatically switches into Dual mode. This mode is recommended for accurate non-contact temperature measurement after A Constant calibration has been performed.

Caution: During calibration, pressing the MODE key switches the screen as shown below.



■ **Canceling Calibration**

When the CAL key is pressed during Dual mode, calibration is canceled and the unit switches to non-contact temperature measurement mode.

5. Determining the A Constant

5.1 Calibration Mode (A Simple Way to Determine the A Constant)

Using the value obtained by the contact sensor as the criterion, determine the A Constant for the subject body whose temperature is to be measured in Dual mode. After calibration the unit switches automatically into Dual mode.

Operating Procedure

- 1) With the unit in Non-Contact Temperature Measurement mode, press the CAL key.
- 2) Using the contact sensor, measure the surface temperature of the subject body (the measurement value blinks in the sub-display. See figure 1).

After the value in the sub-display stabilizes, press the HOLD key to hold it.

- 3) Using non-contact temperature measurement, measure the surface temperature of the subject body (the measurement value blinks in the main display. See figure 2).

After the value in the main display stabilizes, press the HOLD key to hold it.

- 4) The A Constant has been determined and Dual mode measurement can now be performed (see figure 3).

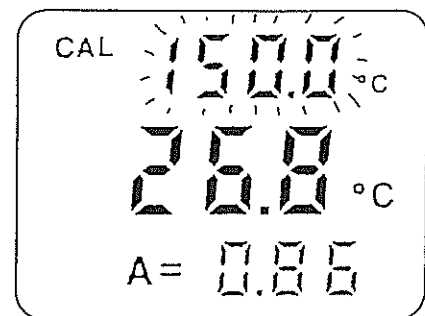


Figure 1

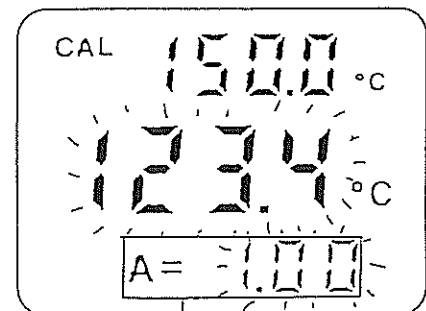


Figure 2

A is set at 1.00

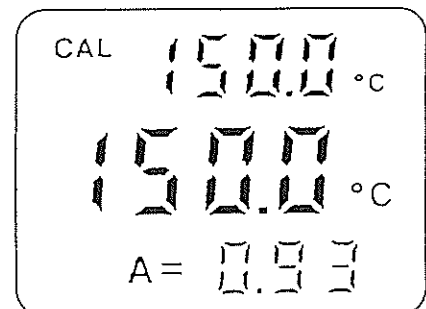


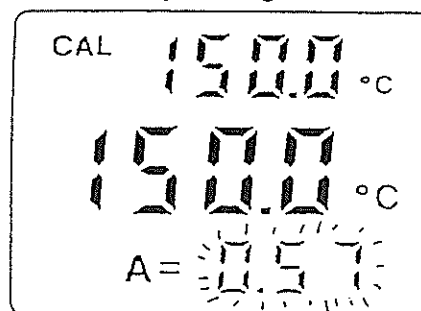
Figure 3

Cautions: *Measurement values cannot be held in the following cases (the unit will not proceed to the next step when the HOLD key is pressed):*

1. The contact measurement value (in the sub-display) does not hold. (Pressing hold key is not helpful to go to next step.)
 - If the difference in temperature between the main unit and the subject body is 10°C or less, the A Constant cannot be set and the value does not hold.
2. The non-contact measurement value (in the main display) does not hold.
 - If the A Constant you are trying to hold is outside the unit's range, the unit will be unable to hold it (the unit can set an A constant within the range of 0.10 to 2.00).
 - Depending on the emissivity and temperature of the subject body, sufficient infrared radiation to fix the A Constant may not be obtained, and the value will not hold.

Generally, if the subject body's emissivity is low (as in the case of shiny metals), the level of infrared energy will be low. The body will need to be measured at a higher temperature.

If the A Constant is held when it is blinking, as shown below, infrared energy is low. In this case, note that the measurement value may change.

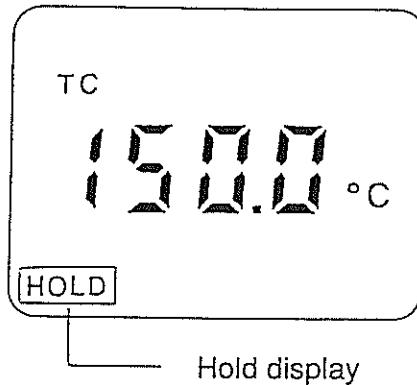


If there is a great difference between the measurement temperature (in the main display) and the calibration temperature (in the sub-display), repeat calibration and then repeat measurement.

If the A Constant does not hold, repeat calibration or perform measurement in a different mode.

6. Other Functions

6.1 Hold Function



Pressing the HOLD key holds the current measurement in the display. Pressing the HOLD button again cancels this function.

6.2 Maximum/ Minimum Value Display Function

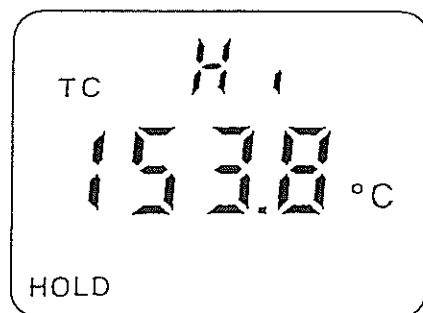
This function displays (holds) the maximum or minimum value obtained by contact, non-contact or dual mode measurement. Also, by using the maximum/minimum background function, the field of application can be widened.

Procedure

In HOLD mode, press the ▲, ▼ keys to switch to the following 3 screens.

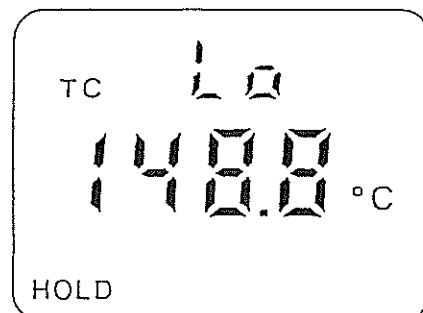
1) Hi (High) Display

This displays the maximum value currently measured. It also displays the memorised maximum value held in background.



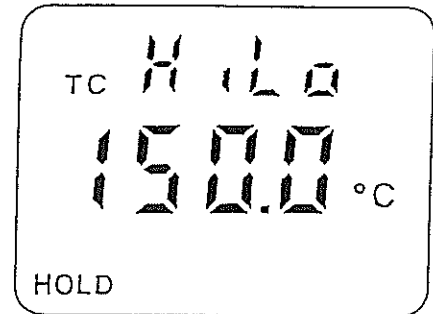
2) Lo (Low) Display

This displays the minimum value currently measured. It also displays the minimum value held in background memory.

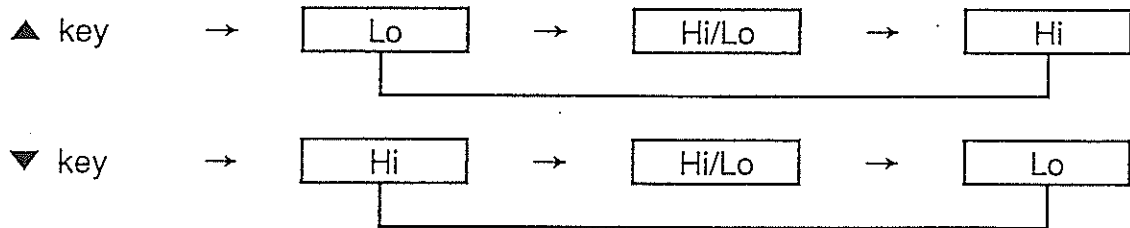


3) Hi/Lo Display

This function holds the maximum and minimum values in background memory while displaying the normal measurement values.



The displays rotate as follows:



Notes:

- When Hold is canceled, the display returns to the original display.
- When the power is turned OFF or mode is changed, the Hold function is canceled.
- If the Hold function is entered when in Average mode, the average value is displayed in memory.

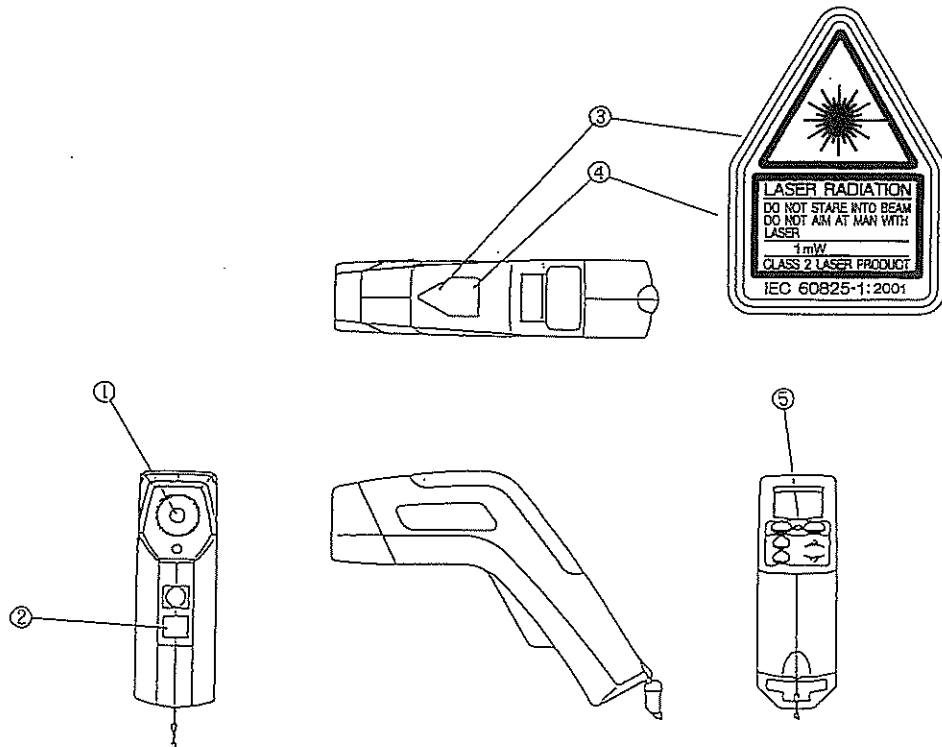
6.3 Laser Marker Function

In non-contact temperature measurement, this function indicates the center of the temperature measurement area using a semiconductor infrared laser.

The Dual Thermo uses a semiconductor infrared laser. When the laser output key 2) in the diagram below is pressed, laser radiation is emitted from the laser prism 1). Please be sure to follow the cautions on laser handling given below.

Cautions On Laser Handling:

- Do not look directly into the laser radiation.
- Do not look directly at the laser radiation with optical instruments.
- Depending on the measurement environment, the laser radiation may be reflected. Be careful of reflected laser radiation.
- Do not emit laser radiation at a position higher than shoulder (especially head, or face) height.



- ① Laser prism
- ② Laser key
- ③ Laser warning label

- ④ Laser explanation label
- ⑤ Laser lamp

6.4 Celsius (°C) / Fahrenheit (°F) Switching Function

When the power of the unit is ON, pressing the ▲ and ▼ keys simultaneously while pressing the ON key switches the temperature measurement unit between Celsius (°C) and Fahrenheit (°F).

7. Analog Output (For Use with the AR-6501 Only)

Analog output is possible using the AR-6501.

Output rate: 1 mV/°C 1°C resolution throughout the entire measurement range (-50 to 500°C)

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

This unit digitally processes all temperature data and performs analog output using a high-stability digital/analog (D/A) converter. This output is therefore different from conventional analog output in that the output voltage varies in steps. However, this output method provides high accuracy and stability.

7.1 Relation between the Modes and Analog Output

In analog output, a voltage is output which is equal to the measurement value in the main display in each mode. In calibration mode, however, due to the nature of this mode the analog output value is fixed at 0 mV. Also, analog output of Hi and Lo display is not available.

When the measurement range is exceeded, the analog output is as follows:

500°C or over	Approx. 1 V
-50°C or below	Approx. 0.06 V

If the contact sensor is burned out, the analog output will be 0 V.

7.2 Advantages and Disadvantages of the D/A Converter

Advantages: Using digital processing, high resolution can be achieved, and zero correction, full-scale correction, etc. are available. This enables highly precise and highly stable output.

Disadvantages: During smooth and continuous temperature changes, since the output voltage changes in steps, there appears to be a loss of precision.

7.3 Connecting to the Recorder

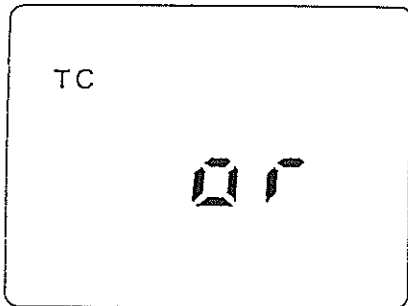
- 1) Turn the power of the main unit and the recorder OFF.
- 2) Connect the red terminal of the included cable to the (+) terminal of the recorder, and connect the black terminal to the (-) terminal of the recorder. Connect the analog output terminal of the main unit to the analog output terminal of the cable.
- 3) Match the input range of the recorder to the measurement range of the main unit.
- 4) Turn the power of the main unit and the recorder ON.

Note: *Absolutely do not cause a short circuit in the cable terminals or cable body. A short circuit can damage the cable.*

8. Error Messages

8.1 Over Range display

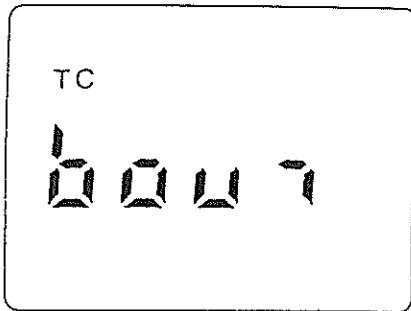
(Contact temperature measurement mode, non-contact temperature measurement mode, calibration mode)



If the temperature exceeds the measurement range during measurement, the Over Range display appears as shown on the left.

8.2 Contact Sensor Burnout display

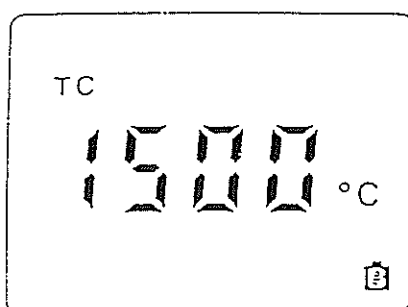
(Contact temperature measurement mode, calibration mode)



If the contact sensor burns out or is not connected, the Contact Sensor Burnout display appears as shown on the left (in calibration mode, it appears in the sub-display). Connect the sensor or check the sensor for burnout.

8.3 Low Voltage display

(Contact temperature measurement mode, non-contact temperature measurement mode, calibration mode)



If the remaining power in the unit's built-in NiCd battery becomes low, the Low Voltage display appears in the bottom right side of the screen. Recharge the battery using the dedicated battery recharger as soon as possible.

9. Troubleshooting

If anything unusual happens during operation of the Dual Thermo, or if it cannot be operated, do not conclude that the unit is broken before checking the following items.

9.1 Basic Items

- The power does not turn ON.
 - The battery is exhausted.
 - Recharge the battery using the dedicated recharger.

9.2 Contact Measurement Mode

- The display is unstable.
 - The contact sensor may be interrupted or deformed.
 - Perform a visual external check of the contact sensor.
 - The contact sensor's plug may not be plugged in firmly.
 - Plug in the contact sensor's plug again.
 - The contact sensor is not sufficiently in contact with the subject body.
 - Apply the contact sensor to the subject body in a different way.
 - Use a contact sensor which is appropriate to the subject body.
 - The contact sensor is not an Anritsu contact sensor.
 - Use an Anritsu contact sensor.

- The unit is making large measurement errors.
 - The contact sensor may not be a Type K sensor.
 - Verify that the contact sensor is a Type K sensor (the plug should be yellow).
 - The sensor head may be deformed.
 - Replace with a new sensor.

- The keys do not respond.
 - Check whether the burnout display appears.
 - Connect the sensor or check the sensor for burnout.
 - You may have pressed the CAL key.
 - Calibration mode cannot be entered from contact mode.

9.3 Non-contact Temperature Measurement, Normal Mode

- Displayed value is unstable.
 - The measurement environment may be changing.
 - Isolate the unit from any external interference.
 - The measurement position may be changing.
 - Use the laser to verify the measurement area.
 - The temperature of the subject body itself may be unstable.
 - Use AVG to display the average value.

- The unit is making large measurement errors.
 - The A Constant for the subject body may not be appropriate.
 - Perform calibration or set an appropriate A Constant.
 - The measurement environment may be changing.
 - Isolate the unit from any external interference.

9.4 Non-Contact Measurement in Dual Mode

- Displayed value is unstable.
 - The measurement environment may be changing.
 - Isolate the unit from any external interference.
 - The measurement position may be changing.
 - Use the laser to verify the measurement area.
 - The temperature of the subject body itself may be unstable.
 - Use AVG to display the average value.
- The unit is making large measurement errors.
 - The A Constant for the subject body may not be appropriate.
 - Perform calibration again or reset the A Constant.
 - The measurement environment may be changing.
 - Isolate the unit from any external interference.

- The keys do not respond.

- You may be pressing the ▲ or ▼ key.
 - During non-contact measurement in dual mode, the A Constant cannot be changed. Press the CAL key to enter Normal mode, or perform calibration again to find an appropriate A constant.

9.5 Calibration Mode

- The keys do not respond.

- The unit does not enter Hold mode when the HOLD key is pressed.
 - The Hold function cannot be used in Calibration mode.
- The unit does not hold the displayed values when the HOLD key is pressed.
 - Calibration cannot be performed because the environmental conditions for determining the A Constant are not met. Refer to the ***Cautions*** on page 15 and improve the measurement environment.

10. Specifications

AR 6500 Series Specifications

Model		AR-6500	AR-6501
Measurement range		- 50.0 ~ 500.0°C	
Resolution		0.1°C	
Measurement precision	Non-contact mode	250 ~ 500°C	0.8% of reading (°C) + 1 digit
		0 ~ 250°C	±2°C + 1 digit
		0°C or lower	±3°C + 1 digit
	Contact Mode	- 50 ~ 500°C	±(0.05% of reading + 0.2°C)
Cold junction		0.2°C at 25°C ±10°C	
Temperature coefficient		±(0.01%/1°C) of measurement range	
Power supply		Rechargeable NiCd battery (4AA)	
Operating time		30 hours continuously (with no condensation)	
Operating conditions		Within 0 ~ 40°C, 0 ~ 80% relative humidity (with no condensation)	
Storage conditions		Within 20 ~ 50°C, 0 ~ 85% relative humidity (with no condensation)	
Analog output rate		—	1 mV/°C
External dimensions		See External View (p. 4)	
Weight		Approx. 400 g	
Accessories		Recharger	
		—	Analog output cable

Non-contact Mode Specifications

Detector	Thermopile
Spectral response	8 ~ 14 μ m
Repeatability	\pm (0.4% of reading + 1 digit) °C
Response speed	500 msec (95% response)
Field of view	See diagram below
A Constant correction range	0.10 ~ 2.00 (in steps of 0.01)
Collimation	Laser marker (Class 2)

Contact Mode Specifications

Input	Thermocouple Type: K (available separately)
Sampling time	200 msec

Measurement range

