MN-0420-EL60-E

0420-EL60
EDDY CURRENT CONDUCTIVITY TESTER

OPERATION MANUAL

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VIDEO

INSIZE

1. APPLICATION FIELDS

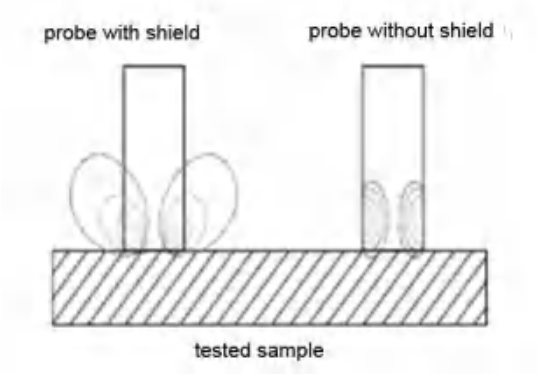
0420-EL60 Eddy Current Conductivity Tester is a compact handheld instrument for measuring conductivity or resistivity of non-ferromagnetic metals or alloys. With special temperature coefficient setting and auto calibrating mode, it's convenient and reliable for user to operate. Excellent design of lift-off compensation and temperature compensation of the instrument ensure the precision of measurement. It's commonly used in industries of machinery, electric power, aviation, aerospace, nuke, military, etc.

- Measure the conductivity of metal or alloy
- Examine heat-treating state during manufacturing, as well as inspect over-heated damage during service (such as airplane).
- Detect grades of materials
- Metal classification

2. CHARACTERISTICS OF THE INSTRUMENT

- Measure conductivity (MS/m, %IACS) and resistivity (Ω·mm²/m) of non-ferromagnetic metals or alloys with eddy current phase detection with temperature compensation, even when the temperature of the calibration block and the material are different, test results can be automatically compensated.
- Lift-off compensation function ensures accurate results when there are non-conductive layers such as coatings, dust, rough surfaces, etc., and reduces measurement error caused by operation as well
- Measure with high speed and efficiency, results show on screen after probe touch with the material in 1 second
- Data can be saved manually or automatically and exported to Excel with computer software
- Wear-resistant and heat-resistant probe
- Unit switch
- Display with backlight
- Language: English, Chinese, Japanese

3. TEST PRINCIPLE



1. The eddy current probes equips with electromagnetic shielding technology, which is significantly different from other probes. When the measured part has a surface diameter more than or equal to 14mm, it can be

completely contacted with the probe. The φ14mm probe can measure the smallest area with a diameter of about ≥ φ 14mm.

2. The least required thickness of the tested material: pure copper needs 0.85mm, aluminum needs 1.15mm, the lower the conductive properties of the material require the thicker thickness. If thickness is not enough, materials can be stacked to test, less than three layers stacked is recommended.

3. It's recommended to keep the tested material and the standard block at the same temperature (temperature difference at most 3°C). Large temperature differences can also be compensated by manual temperature compensation mode, please refer to the detailed operation manual.

4. OPERATION INSTRUCTIONS

4.1 Keyboard Instructions

4.1.1 "MEAS": key for measurement

4.1.2 "STORE": key for storing data (effective for manual storing)

4.1.3 "CAL": key for calibration

4.1.4 "SET": key for setting

4.1.5 "OK": key for confirmation

4.1.6 "DEL/UNIT": UNIT key for unit selection (effective for measurement interface)/ DEL key for deleting (effective for query interface)

4.1.7 "a_0": key for temperature coefficient selection

4.1.8 "☼": key for back-light

4.1.9 "ON/OFF": key for turn on/ turn off

4.1.10 " ↑ ": key for increasing or moving upwards

4.1.11 " ↓ ": key for decreasing or moving downwards

4.2 Operation Methods

4.2.1 Turn on/Turn off

4.2.1.1 In turning off condition, press key "ON/OFF" for 2 seconds, the instrument is turned on and welcome interface appears on the screen.

4.2.1.2 If you don't test for a long time or restart the machine after a short time power-off state, you can directly press the MEAS key to enter the measurement interface without waiting for the warm-up bar to finish; if you are going to test for a long time or start up after a long time power-off state, it is recommended to wait for the warm-up to finish and then automatically enter the measurement interface (about 5 minutes).

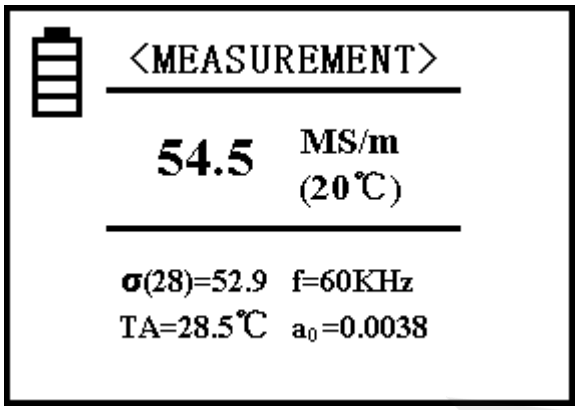
4.2.1.3 Please calibrate with the calibration block before measurement.

4.2.1.4 In turning on condition, press key "ON/OFF" for about 2 seconds, this instrument is turned off and

current setting information is stored.

4.2.2 Measurement

4.2.2.1 The measuring interface will show on the screen by pressing "MEAS" key directly under the welcome, calibration or setting interface.



Remarks:

a. The word (measurement) at the upper side on the screen indicates the function of the current interface. " " indicates the current residual energy of the battery.

b. The big typeface digits in the middle row indicates the conductivity value of the tested sample at +20℃. MS/m or %IACS is the unit of the conductivity.

c. At the lower part on the screen, σ(28)=□□□□ indicates the measured conductivity value at current temperature, the measurement unit is the same as that in the middle row. The value inside the bracket of σ(28) indicates the compensation temperature value TC.

d. TA=□□□□℃ indicates the current environmental temperature value. The value is measured by the temperature sensor on the host.

e. F=□□□KHz means the working frequency of the probe.

f. a_0=□□□□□ indicates the current temperature coefficient of the tested sample material. The temperature coefficient is invalid when the compensation temperature value TC is set to 20℃。

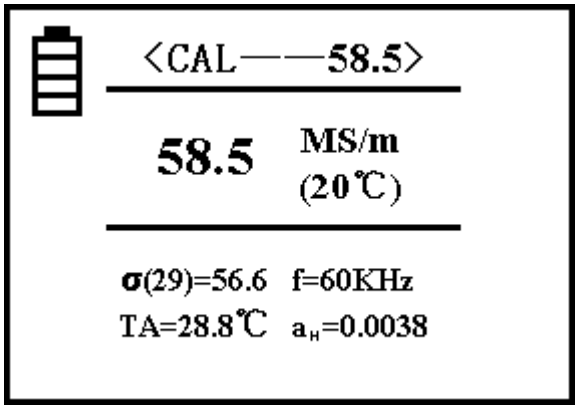
4.2.2.2 In the test interface, put the probe on the surface of the test piece vertically from 5cm higher above the sample, the instrument drops a beep to complete the measurement and automatically hold the measured value till the next measurement and then updated.

4.2.2.3 In the test interface, press key "DEL/UNIT" to switch the unit of MS/m, %IACS, Ω-mm²/m. The unit will be restored to the original set unit after returning to the measurement interface from other interfaces or restarting the device.

4.2.2.4 When the temperature of the tested material and the calibration block is different, please select correct temperature coefficient and compensation temperature TC of the tested material to guarantee the accuracy.

4.2.3 Calibration

4.2.3.1 Press the calibration key “CAL” in test interface or setting interface to enter calibration interface, shown as the following figure.



Remarks:

a. At the upper part on the screen, “CAL” means the function of the current interface. The digits nearby——□□□□ indicate the conductivity value of the calibrated block at +20℃. This value must be the same as the the conductivity of the current calibration block.

b. In the middle part on the screen, it shows the conductivity value of the tested calibration block.

c. At the lower part on the screen, the a_H or a_L is is the temperature coefficient of the high or low calibration block.

4.2.3.2 After entering the calibration interface, the instrument is set to perform high value calibration first. (At the upper part on the screen, the digits nearby “CAL” show the set value $a_H(20)$ of the high-value block; and at the lower part, a_H means the temperature coefficient value of this block. Put the probe flatly onto the surface of the high-value block vertically to measure the conductivity value.

a. When the measured value is equal to the set value $a_H(20)$, you don’t need to calibrate the high value. Put the probe back to the air, and press key “OK”. This instrument is ready for low-value block calibration.

b. When the measured value is not equal to the set value, keep the probe touching the block, press key “OK”. The instrument completes calibration automatically with a beep sound.

c. Then measure the calibration block once more. If the error is more than 0.3%, calibrate again, till the measured value meets the requirement. Put the probe back to the air and press key “OK” to get ready for calibrating the low-value block.

4.2.3.3 Calibrating the low-value block (at the upper part on the screen, the digits nearby “CAL” show the set value $a_L(20)$ of the low-value block, and at the lower part on the screen, a_L indicates the temperature coefficient value of this block).

a. Keep the probe touching the block, press key “OK”. The instrument completes calibration automatically with a beep sound.

b. Measure the calibration block once more. If the error is more than 0.3%, calibrate again till the

measured value meets the requirement. Put the probe back to the air and press key “OK”, the instrument quits the calibration interface.

4.2.3.4 If you press the measuring key “MEAS” or the setting key “SET” during the calibration, the instrument quits the current calibration interface and the calibrated data become invalid.

4.2.3.5 Additional remarks to instrument calibration.

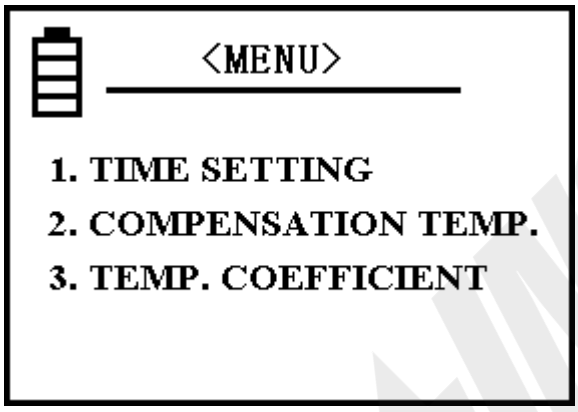
a. Calibration principles: This instrument calibration with two points, high-value block σ_H and low value block σ_L.

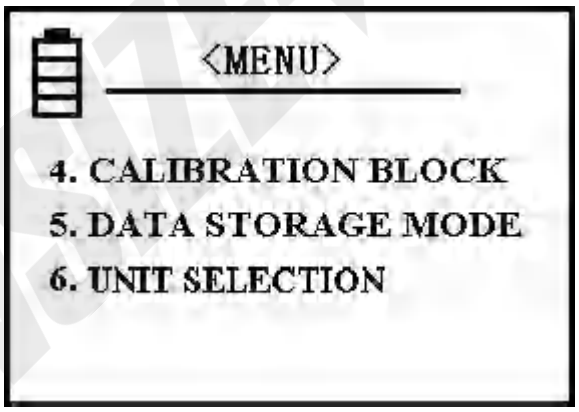
b. The regulation for calibration blocks: The value $\sigma_H(20)$ of the high–value block is commonly selected higher than the conductivity value of the tested material. The value $\sigma_L(20)$ of the low–value block is commonly selected lowerr than the conductivity value of the tested material.

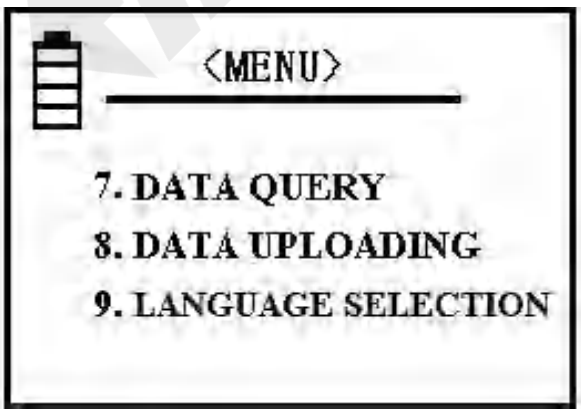
4.2.4 Function Selecting

4.2.4.1 Menu

Press the setting key “SET” directly at any interface to enter the setting main interface, shown as below.







Remarks:

a. There are 9 setting options on the screen. The user may press the upward key “ ↑ ” or the downward key “ ↓ ” to select the item, and press key “OK” to enter.

b. While the item setting, press setting key “SET” or press measuring key “MEAS”, the instrument returns to the relevant interface.

c. When the setting main interface, press measuring key “MEAS” or calibrating key “CAL”, the

instrument quits and returns to the relevant main interface.

4.2.4.2 Time Setting

Remarks:

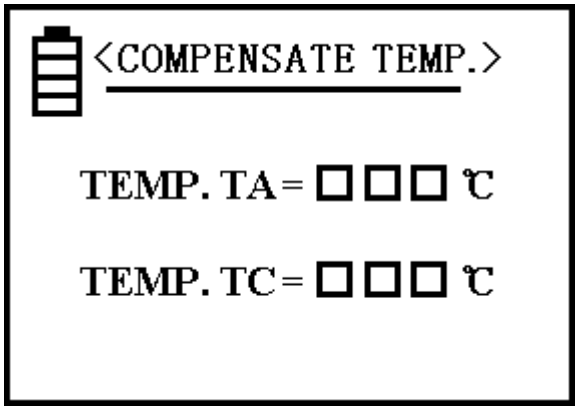
a. Press the upward key " ↑ " or the downward key " ↓ " to move the cursor to the selected item DATE or TIME. For the first item DATE, press the confirmation key "OK". Move the cursor to the first group of digits of the selected item, then use the upward key " ↑ " or the downward key " ↓ " to revise the number, then press key "OK" to store the first location digits. Move the cursor to the second group of digits, the rest may be deduced by analogy, till completing the revision of the third group of digits, then press key "OK" to store the third group of digits and the instrument quits from this item. Move the cursor to the next item TIME. If the instrument quits from TIME item, it will return to the setting main interface.

b. Digits in the first group of DATE may be set as "00-99" for year. Digits in the second group may be set as "00-12" for month. Digits in the third group may be set as "00-31" for day.

c. Digits in the first group of TIME may be set as "00-24" for hour. Digits in the second group and the third group may be set as "00-60" for minute and second.

d. While the cursor points on digits, and if you press the upward key " ↑ " or the downward key " ↓ ", you can revise the digits quickly.

4.2.4.3 Compensation Temperature Setting



Remarks:

a. The current temperature TA indicates the environment temperature value measured with the built-in temp. sensor.

b. While the cursor staying on compensation temp. TC, press the confirmation key “OK” and move the cursor to the digital part and press the upward key “↑” or the downward key “↓” to revise numerical value. Press the confirmation key “OK” to store data and return to the setting main interface.

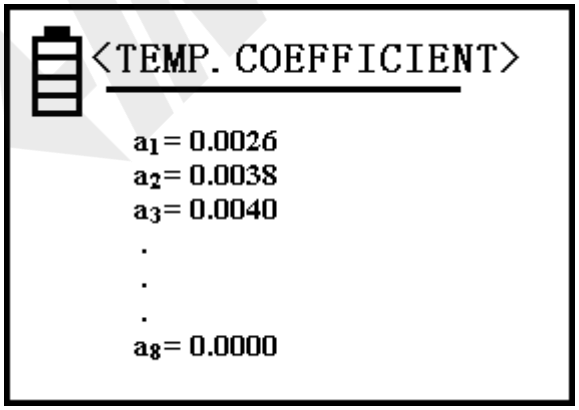
c. During setting numerical value, if you press the upward key “↑” or the downward key “↓” continuously, you can change numerical value quickly.

d. Regulations for compensation temperature value:

(1) When the calibration block and the test piece are used at the same ambient temperature (or the calibration block and the test piece have essentially the same temperature), it is not necessary to consider the compensation temperature TC and temperature coefficient of the test piece. You can set the compensation temperature TC at 20 before measurement. And the instrument is ready to measure after performing calibration for the following time.

(2) When the temperature of standard block is different from the testing material, you can input the temperature compensation TC for measuring: first input the temperature of standard block into TC and perform the calibration. Then input temperature of testing material into TC before measuring and set temperature coefficient a0 at measuring interface for measurement.

4.2.4.4 Temperature Coefficient Setting



Remarks:

a. There are 8 numerical values of the temperature coefficient setting for the tested material.

b. The values of a_1 and a_2 are commonly used temperature coefficient values. a_1 is the average value of the temperature coefficient. a_2 is the temperature coefficient of copper product or aluminum product. These are set by the factory and cannot be replaced. The user can change temperature coefficient value a_3~ a_8 for different material.

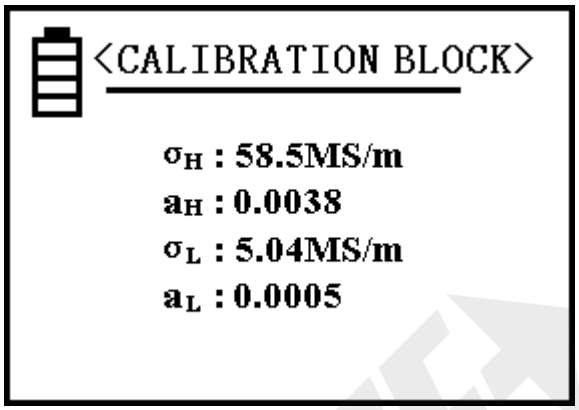
c. Press the upward key “↑” or the downward key “↓” to move the cursor to select an. Press the confirmation key “OK” to get into numerical value an, press the upward key “↑” or the downward

key " ↓ ", to revise the value. After completing, press the confirmation key "OK", the cursor moves downward to an-1 automatically and the set value an is stored.

d. The setting range for a_n value is "0.0000—0.0300".

e. During setting the numerical value, you can press the upward key " ↑ " or the downward key " ↓ " continuously to change numerical value quickly.

4.2.4.5 Calibration Block Setting



Remarks:

a. The numerical values of σ_H , σ_L can be set as conductivity value of high-value block and low-value block at 20℃ for calibration of this instrument. a_H or a_L can be set as the temperature coefficient value of the relevant block. The unit MS/m or %IACS can be selected by unit setting

b. Press the upward key " ↑ " or the downward key " ↓ " and move the cursor to the item to be revised. Press the confirmation key "OK" and move the cursor into the numerical value location, then move the upward key " ↑ " or the downward key " ↓ " to revise the numerical value. After completing, press the confirmation key "OK" to store data and the cursor moves to the next item automatically. The rest may be deduced by analogy, till the value a_L appears. Then, press the confirmation key "OK", the instrument quits and returns to the setting main interface.

c. The setting range for σ_H and σ_L is "0.45—64.0 MS/m or 0.77—111.0%IACS".

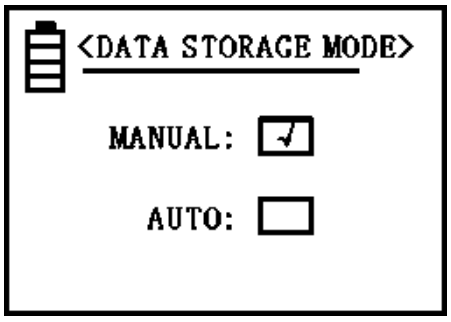
d. The setting value σ_H of the high-value block should be higher than value σL of the low-value block.

e. The setting range of a_H, a_L is "0.0000—0.0300".

f. When the cursor points to the numerical value row, and if you press the upward key " ↑ " or the downward key " ↓ ", you can revise numerical value quickly.

Note: To prevent unexpected modification of the calibration block setting, , you must firstly input the password to enter calibration block setting, press key "STORE" 4 times continuously (filling 4 black dots into the password boxes "□"). Then press the confirmation key "OK" to enter the setting interface. While verifying the password, if you press other key wrongly, it is invalid at all.

4.2.4.6 Data Storage Mode



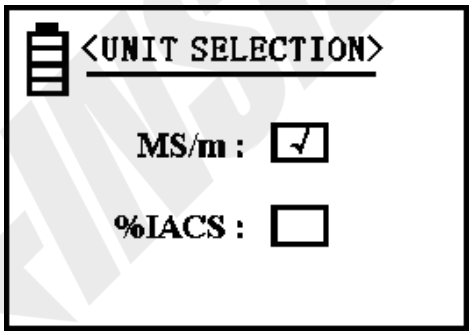
Remarks:

a. The data storage mode is set with this interface.

b. Press the upward key " ↑ " or the downward key " ↓ ", move the cursor to the selected item (input a √ inside the box). Then, press the confirmation key "OK", the instrument quits and returns to the setting main interface.

c. Turning on the instrument each time after it was turned off, this instrument tacitly approves the Manual Storage Mode..

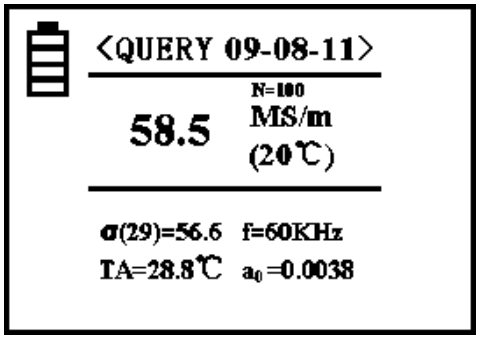
4.2.4.7 Unit Selection:



Remarks:

After you select the unit, the conductivity values are all in this unit. And the conductivity value can be conversed according to the conversion formula.

4.2.4.8 Data Query



Remarks:

a. You can check the measured data stored in this instrument (up to 16000 groups).

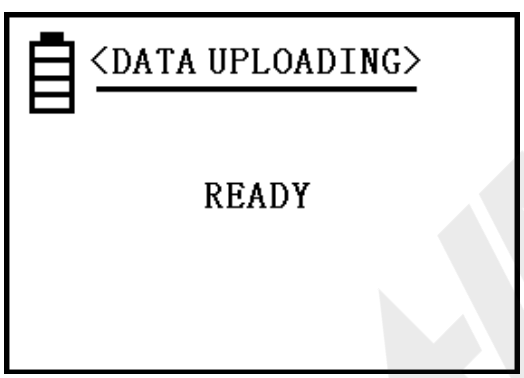
b. At the upper part on the screen, the digits indicate the measured date of the data on this page.

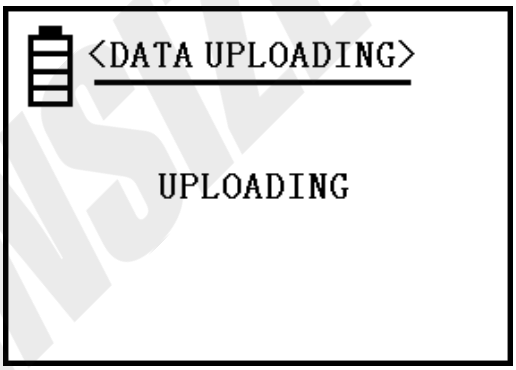
c. In the middle on the screen, the English letter N indicates the storage number of the data on this page. The currently measured data will be saved as the first group and the data measured last time will be numbered as the second group automatically. The storage capacity is up to 16000 groups.

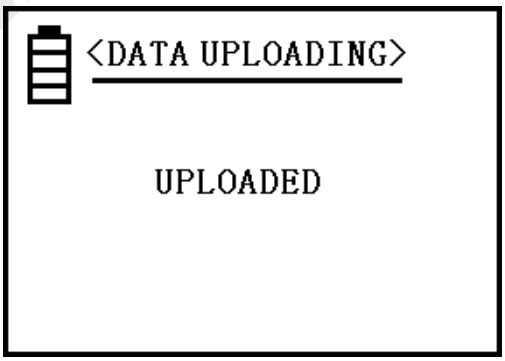
d. After getting into Query interface, the first page shows the number 1 saved data. Press the upward key " ↑ " or the downward key " ↓ ", you can query the former group or the later group of those stored data. After querying, press the confirmation key "OK", this instrument quits and returns to the setting interface.

e. Delete storage data: On data query page, press the deleting key "DEL" once, the current data will be deleted, press the "DEL" key for about 3 seconds to delete all stored data. After deleting all stored data, there appears the prompt term "Empty". Press the confirmation key "OK", the instrument quits and returns to the setting interface.

4.2.4.9 Data Uploading







Remarks:

a. This function is for uploading measured data to PC software.

b. Uploading begins from page 1 of stored data to the last page.

c. Please connect to PC via the USB cable before uploading. Enter uploading interface, "READY" shows on the screen. When the confirmation key "OK" is pressed, "UPLOADING" shows on the screen and the data will be uploaded.

d. After uploading, "UPLOADED" shows on the screen. Press the confirmation key "OK", the

instrument quits and returns to the setting main interface.

e. Please refer to the U- disk for the driver and software of this instrument.

4.2.4.10 Language Selection

Remarks:

Press the upward key " ↑ " or the downward key " ↓ " to move the cursor to the selected item (input a tick √ inside the box). Press the confirmation key "OK" (the instrument keeps on this selected item till the next selection). the instrument quits and returns to the setting main interface.

4.2.5 How to Store Measured Data

4.2.5.1 There are two methods for storing data: Manual storing and Auto storing. The two modes are valid for the main measurement interface. The stored information includes the current measured data, "σ(20), σ(TC), unit, temp. TA, measuring freq. f, value a_0, date, etc", you can store up to 16000 groups of measured data.

4.2.5.2 Manual storing: On the main interface, after measuring the conductivity value of the sample, keep the probe touching the sample, press the storing key "STORE", symbols N=XXX on the screen flash quickly. It means the measured data on this page have been stored.

4.2.5.3 Auto storing: Each time the instrument gets effective measured data, symbols N=xxx flash quickly. It means that the measured data on this page have been stored automatically.

Remarks:

a. Manual storing is set by default after power on.

b. During the data storing procedure, the numerical value of N=XXX shows the data group stored currently in the internal memory. When the data group number comes up to 16000, the prompt term "FULL" appears. The user should delete all data groups in the internal memory. Then the instrument is able to store new data.

c. The conductivity unit of the stored data is the same as the unit selected in the setting menu. It's not relevant with the unit selected with key "DEL/UNIT" while measuring.

4.2.6 How to Select Temperature Coefficient

4.2.6.1 When you need to input the temperature compensation TC manually, you should select a_0 value according to the temperature coefficient of the tested material.

Press the temperature coefficient key "a_0" on the measurement main interface. There appears a box cursor on the temperature coefficient a_0. Press the confirmation key "OK", the cursor moves to the digits. Then press the upward key " ↑ " or the downward key " ↓ " to select the temperature coefficient among stored values "a_1 to a_8". Press the confirmation key "OK" to confirm. The instrument quits and revises the default value a_0 to the selected value automatically and keeps it till the next selection. If you don't press the confirmation key "OK", the instrument go back to the original a_0 value automatically after 5 seconds.

4.2.6.2 For measuring unknown material, you can select the average value of temperature coefficient a=0.0026 for reference.

4.2.6.3 There are 6 groups of values (a_3 to a_8) adjustable for inputting temperature coefficient value manually.

4.2.7 How to Recharge Batteries

4.2.7.1 The instrument is equipped with a lithium-ion battery of 2200mAh.

4.2.7.2 When the battery indicator shows the residual energy lower than 1/3, the instrument may give out two successive prompt sounds of each 30 seconds to remind the user to recharge batteries timely and power off automatically.

4.2.7.3 Recharging battery: Plug the adapter into the AC 220v or 110v socket. The red light indicates the battery is being charged and green light indicates the battery is fully recharged.

5. ATTENTION AND MAINTENANCE

Before the instrument and probe are taken out from the packing box, they should be stationary for about 1 minute, or wipe the shell of the main unit with a slightly wet cotton cloth, and then turn on for use.

5.1 Please perform calibration using the proper standard blocks which have similar conductivity value with the material to be measured before measurement.

5.2 Please prevent the instrument and the probe from shaking, collision. The surface of the block is strictly forbidden to be scratched. Keep away from heaters, fans, fireplaces and avoid direct sunlight.

5.3 The main unit, calibration blocks should be used and stored in an environment free of corrosion, vibration and electromagnetic field interference. Before test, it is recommended to place the main unit, calibration block and workpiece to be tested in a stable environment at a constant temperature, keep the temperature stable during the test.

5.4 It is strictly forbidden to touch the end of the probe, the block, the tested part of the sample with fingers. Holding the probe for a long time while measurement, the temperature may increase and affect the

measurement precision.

5.5 Please keep the probe touching the sample surface vertically and smoothly, putting down or picking up gently, handling with even strength.

5.6 Please avoid pulling the probe wire, strong twist the connection part of aviation jack and probe wire. Regularly dispose of residues on the probe with alcohol in a timely manner. Avoid abrasion of the probe during testing.

5.7 If the end of the probe is worn seriously, it's recommended to buy a new probe to ensure precision. Main unit information is required for ordering a replacement probe, no need to return the main unit to factory.

5.8 Avoid long-time charging, the general charging time is about 3 hours. Try to avoid testing while charging and testing when the battery is low, the unstable voltage may cause the instrument measurement error.

5.9 Components not included warranty: such as the probe, rechargeable batteries, the shell, keyboard, USB cable etc.

6. SPECIFICATION

SPECIFICATION

Conductivity	range	0.3MS/m~65MS/m or 0.51%IACS~112%IACS
	unit	MS/m, %IACS
	resolution	0.01 (<30MS/m or <30%IACS) 0.1 (30MS/m~65MS/m or 30%IACS~112%IACS)
	accuracy*	20°C: ±0.5%: 4.00MS/m~65.0MS/m or 6.90%IACS~112.0%IACS 0°C~40°C: ±(1.0%+1d): 0.30MS/m~4.00MS/m ±(1.0%+2d): 0.51%IACS~6.90%IACS ±1.0%: 4.00MS/m~65.0MS/m or 6.90%IACS~112.0%IACS
Resistivity	range	0.01538Ω·mm²/m~3.3333Ω·mm²/m
	unit	Ω·mm²/m
	resolution	0.00001 (<1.0000Ω·mm²/m) 0.0001 (1.0000~3.3333Ω·mm²/m)
Temperature	range	0°C~50°C
	resolution	0.1°C
	accuracy	±1.0°C
Test frequency		60kHz sinewave
Probe diameter		Ø14mm
Lift-off compensation		maximum 500μm
Storage capacity		16000 groups
Interface		USB, RS232 protocol
Calibration block		about 0.60MS/m, 4.10MS/m, 58.0MS/m refer to values marked on the supplied blocks
Operation environment		temperature: 5°C~45°C humidity: <95%RH, no condensation
Power supply		3.7V rechargeable Li-ion battery
Dimension		230×97×60mm
Weight		370g

*d is resolution

Please refer to **0421-CBxx** series standard calibration blocks for more conductivity values.

APPEDIX 1:

Table of Conductivity Value for Common Material and Temperature Coefficient

Metal	Conductivity (20℃)		Temp. Coefficient (20℃)
	%IACS	MS/m	
Copper	100	58	0.0038
Aluminum	29～61	17～35.4	0.0040
Gold	70.7	41	0.0034
Silver	108	62.5	0.0038
Brass（H90）	43.10	25	0.0018
Aluminum bronze	9	5.2	～0.0008
Titanium	3.6	2.08	0.0040
Lead	7.8	4.5	0.0039
Zinc	30	17.4	0.0037
Nickel	22	12.8	0.0060
Magnesium	38	22	0.0040
Nickel silver	8.6	5	0.00068
Titanium alloy	1.02	0.59	0.0002
Tungsten	31.46	18.25	0.0052
Platinum	17.24	10	0.000374
Constantan	3.92	2.27	0.000005
Manganin copper	4.1	2.38	0.000005

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