CONTENT

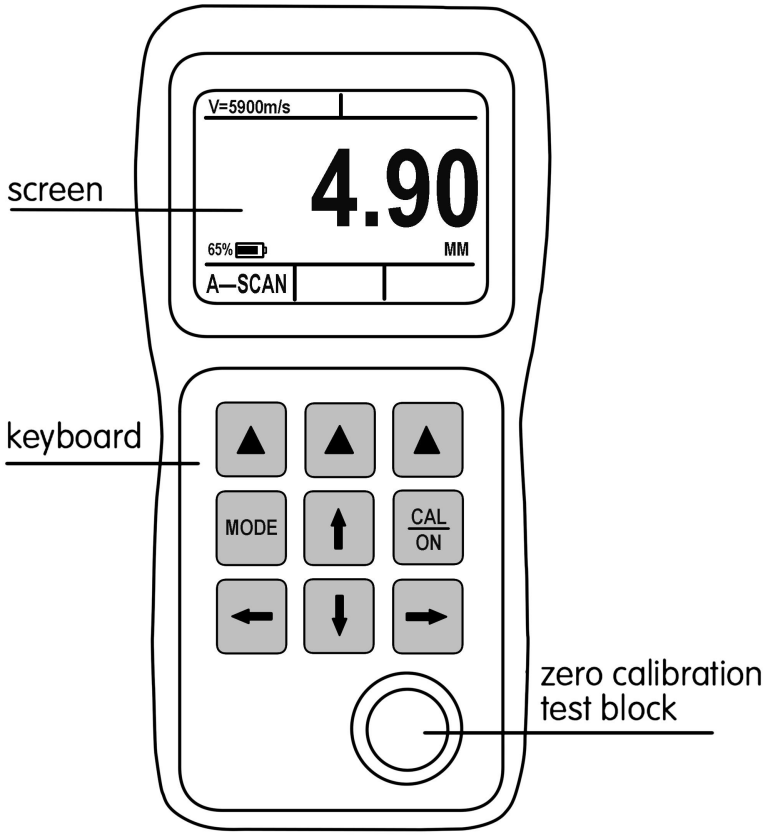
1. GENERAL INTRODUCTION

UM-4 series ultrasonic thickness gauge made by our factory with OLED true color, built-in A-SCAN snapshot, great capacity data storage and through coating thickness function is a kind of high precision, new-type, and portable industrial nondestructive testing instruments according to ultrasonic measuring principle.

As the essential NDT instrument, UM-4 series can be widely applied in the detecting fields like manufacturing, metal processing, chemical industry, commodity inspection industry and so on. It can not only measures various kinds of panels and processing components precisely, but also monitor the thickness minus of tubes and pressure vessels in the manufacturing instruments after corrosion.

All models of this series' gauges are standard with A-scan snapshot; it can help users better control measurement and avoid the inaccurate measurement value caused by the factor of material itself. And the UM-4DL with great capacity data storage function can save a total of 100,000 sets of data, and can be output to the personal computer via USB to archive and data analysis. UM-4D and UM-4DL have through coating function: when there is coating layer on the surface of the object, the net thickness of the material can be directly measured without removal of the coating layer.

1.1 CONSTRUCTION OF THE GAUGE



1.2 STANDARD CONFIGURATIONS

NAME	NUMBER
THICKNESS GAUGE	1
PROBE	1
ALKALINE BATTERY	2
COUPLANT	1
CARRYING CASE	1
OPERATING MANUAL	1
USB CABLE	1(ONLY UM-4DL)
SOFTWARE CD	1(ONLY UM-4DL)

1.3 OPTIONAL CONFIGURATIONS

HIGH-TEMPERATURE PROBE	CAST IRON PROBE
SMALL PROBE	MINI PROBE
PROBE CABLE	STEPPED CALIBRATION BLOCK
RUBBER SHEATH	STORAGE OPTION(ONLY UM-4)

1.4 SPECIFICATIONS

Display Type	2.4" color OLED, 320 X 240 pixels, contrast 10,000:1
Operating Principle	Pulse echo with dual element transducers
Measuring Range	0.60mm to 508mm(0.025" to 20.00"), depending on material, probe and surface condition
Measuring Resolution	Selectable 0.01mm, 0.1mm(selectable 0.001", 0.01")
Units	Inch or Millimeter
Gain	Low, Medium or High for varying test conditions
Display Mode	Normal, Minimum / Maximum capture, DIFF/RR%
V-Path Correction	Automatic
Update Rate	Selectable 4Hz, 8Hz, 16Hz
Material Velocity Range	500 to 9999m/s (0.0197 to 0.3937in/us)
Languages	Selectable Chinese, English, Japanese
Alarm Settings	Minimum and Maximum alarms. Range of 0.25 mm to 508 mm (0.010" to 20.00"). Dynamic waveform color change on alarm

Power Requirements	2 AA size batteries
Operating Time	Approximately 40 hours
Instrument Shut-off	Selectable ALWAYS ON or AUTO OFF after 5, 10, 20 minutes of inactivity
Operating Temperature	-10°C to +50°C (+10°F to +120°F)
Size	153mm × 76mm × 37mm(H × W × D)
Weight	280g including batteries

1.5 MAIN FUNCTIONS

1.Parameter configuration interface is simple and easy to operate.

2.A-scan snapshot, users can see ultrasonic signal waveform on the screen directly, for verify the thickness value is correct, analyses the cause of problem, and help users to find the solution.

3.Coupling condition is different with different color digital to display the thickness.

4.Alarm Mode: Programmable Hi-Low alarm set point with Dynamic change thickness value's color.

5. Limit value mode: catching the minimum and maximum value when measuring.

6. Difference mode: getting the difference between the actual value and the normal value as well as the percentage of difference value and normal value.

7. Selectable units of mm and inch.

8. Great capacity data storage function: Stores 100,000 thickness values. (only UM-4DL).

9. Measure the net thickness of the workpiece through the coating layer. (only UM-4D&UM-4DL)

10. Optional resolution: X.XX mm /X.X mm; X.XXX inch / X.XX inch.

11. Multi-languages Available: Chinese, English, German and Spanish, ahead of agreeing with the company.

12. Approx. battery life: 35hours.

2.KEYBOARD FUNCTIONS

There are 9 keys on the keyboard totally, including 3 virtual function keys (▲), four direction keys (▲ ▼ ◀ ▶), two specialized function keys (CAL ON MODE). See the following illustration (2.1)

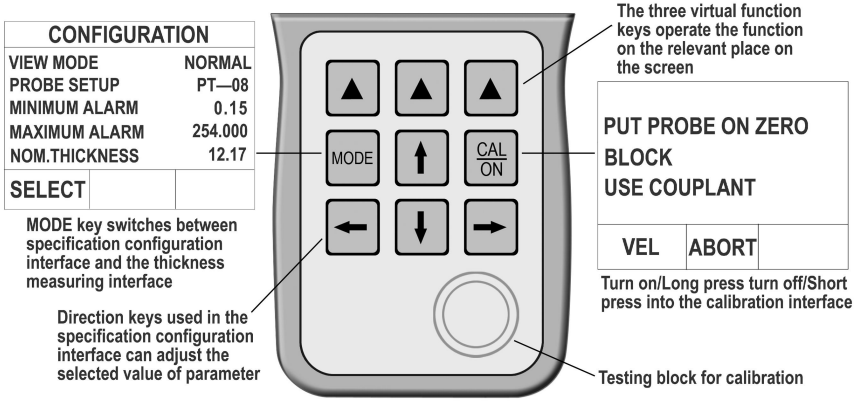


Figure 2.1 KEYPAD FUNCTION ILLUSTRATIONS

3. MEASURING THICKNESS

3.1 INSTRUMENT CALIBRATION

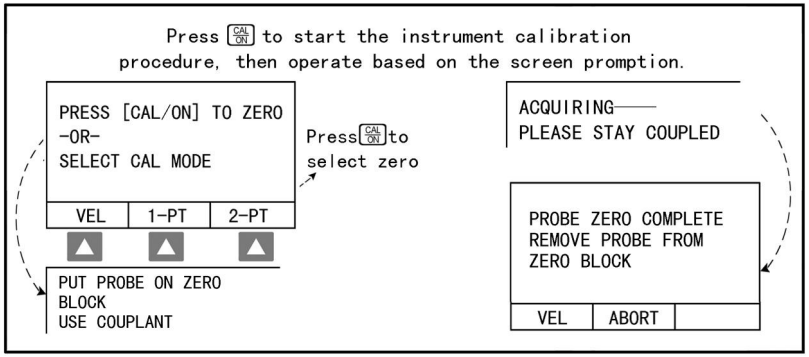
Before using UM-4 series, the instrument and probe must be calibration. Purpose of calibration is performing probe zero procedure and obtain the sound velocity of the material being tested. And it's important to set up the correct probe model firstly before the calibrating process. UM-4 series' calibration divided in to the following:

1. Probe zero procedure：Use the zero block on the instrument to set up the probe zero procedure.
2. One point calibration：Use the zero block on the instrument to set up the probe zero procedure first, and then obtain the velocity from the test block of known thickness.
3. Two point calibrations：Calibrate the probe zero and the velocity of test

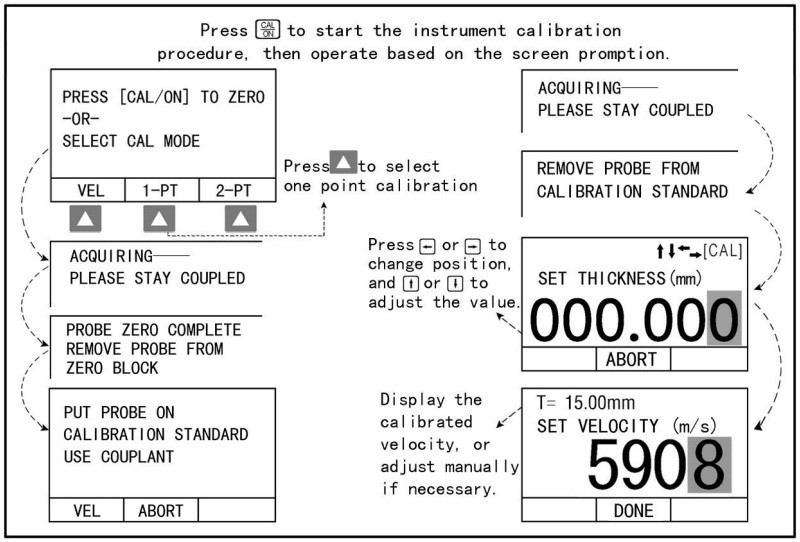
block from two known thickness and same material standard blocks.

4. Dual Echo calibration： Calibrate the velocity from the test block of known thickness.
5. Setting the velocity manually： If the material velocity is known, for example the velocity of steel is 5900m/s. The sound velocity can be setting manually.

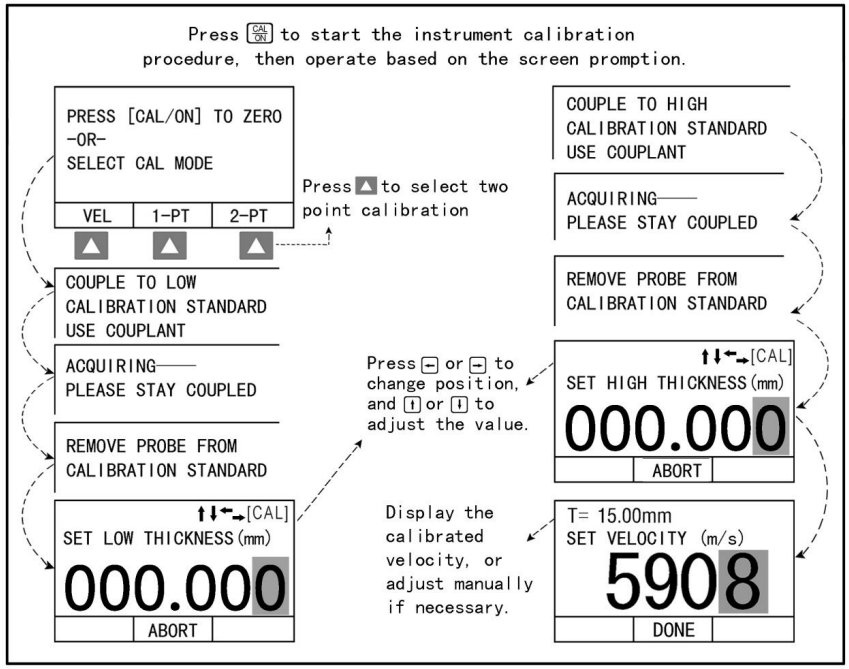
3.1.1 Probe zero procedure



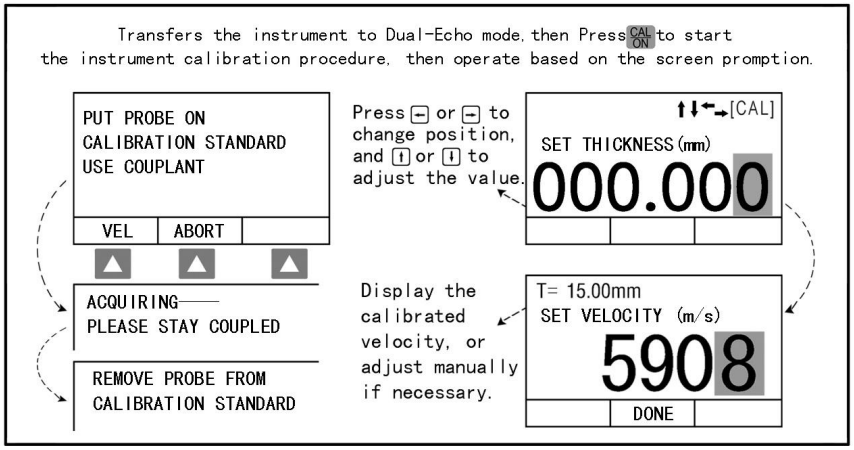
3.1.2 One point calibration



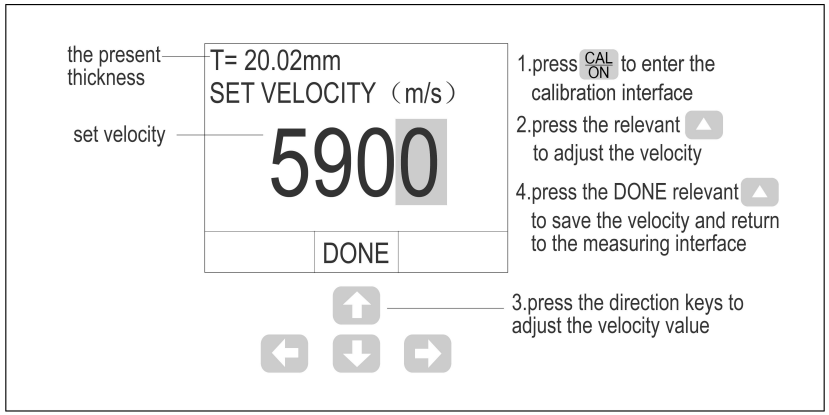
3.1.3 Two point calibrations



3.1.4 Dual Echo calibration



3.1.5 Velocity adjusting steps



Attention 1: Measure the standard block before the calibration, to ensure that the current setting of instrument parameters can measure the standard test block correctly.

Attention 2: probe zero procedure, one point calibration and two point calibrations is suitable for single echo mode, dual echo calibration is suitable for dual echo mode.

3.2 PRESET OTHER SPECIFICATIONS

Press MODE to enter the specification configuration interface, which including many specification adjusting options like FILE NUMBER, MEASURING MODE,VIEW MODE,PROBE SETUP, MINIMUM ALARM, MAXIMUM ALARM, NORMAL THICKNESS, GAIN, ESOLUTION, PDATE RATE, ANGUAGE, NITS, UTO POWER-OFF, ELETE ALL FILES AND DEFAULT SETUP. See the following figure:

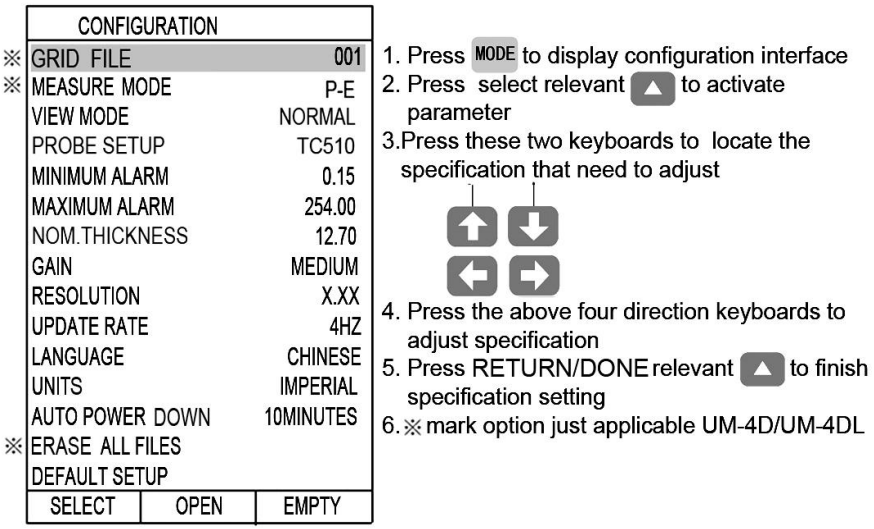


Figure 3.2 SPECIFICATION ADJUSTING STEPS

FILE NUMBER – Select the current file. Total 400 files and each file could save 252 thickness values.

MEASUREMENT MODE - Single echo and dual-echo mode, single-echo mode is used for common measurement, dual-echo mode is used for through coating function.

VIEW MODE: Normal mode, differential mode and limit scanning mode.

PROBE SETUP: Many probe models available including TC510 (Dedicated probe for through coating, UM-4D&UM-4DL standard), PT-08(normal probe, UM-4 standard), PT-06(small probe), PT-04(mini probe), GT-12(high-temperature probe), and ZT-12 (casting iron probe).

MINIMUM ALARM: Set the minimum thickness alarm value, range of 0.15-635mm. The result will be displayed in red if the actual thickness is less than the minimum value preset.

MAXIMUM ALARM: Set the maximum thickness alarm value, range of 0.15-635mm. The result will be displayed in red if the actual thickness is more than the maximum value preset. NORMAL THICKNESS: Set the

normal thickness, range of 0.15-635mm.The real concrete application will be introduced in the DIFFERENCE MODE.

RESOLUTION: Set the decimal of the measurement result. Metric of X.X and X.XX and imperial of X.XX and X.XXX.

UNIT: Selectable units of mm and inch.

DEFAULT SETUP: Default settings out of the factory.

AUTO POWER-OFF: The device will be automatic shut off if no key presses or measurements occur for set 5m', 10m' or 20m'. If set to OFF, the instrument is only powered off when press and hold CAL ON .

GAIN: Select the default value or reduction rate corresponding with the current setup, that is to say, adjust voltage magnification with high, middle and low three settings choices.

3.3 DISPLAY MODES

UM-4 series have three measuring interface display modes: normal mode, difference mode, limits value mode, and A-scan snapshot could be recalled on each mode. Select in "VIEW MODE" of CONFIGURATION.

ATTENTION: When the probe and the object are not completely coupled, the letters in the various interfaces are in GREEN, when properly coupled, they are displayed in WHITE color and when the either the upper or lower limited are exceeded, the letters are displayed in RED color.

3.3.1 NORMAL MODE/THICKNESS VALUE MODE

NORMAL MODE/THICKNESS VALUE MODE: The acquiescent opening interface. This interface mainly shows the present thickness value with big font.

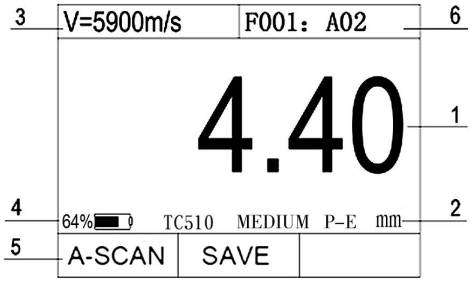
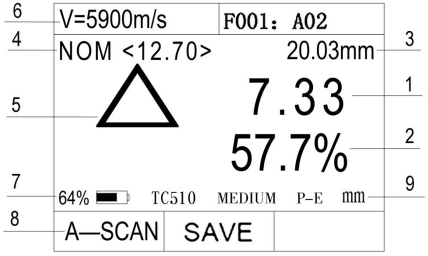


Figure 3.4 NORMAL MODE INTERFACE

1—the present thickness value 2—probe types, gain degree, single echo, measuring units 3—material velocity 4—battery power display 5—A-scan snapshot interface 6—storage file

3.3.2 DIFFERNCE MODE

This interface shows the normal thickness value, the present thickness value, the difference between the normal value and the present value and the ratio between the difference and the normal value. Before using this mode, presetting the normal thickness is needed. The method can be taken according to chapter 3.5.



3.5 DIFFERENCE MODE INTERFACE

1—the difference between the normal value and the present value. 2—the ratio between the difference and the normal value. 3—the present hickness

value. 4—the normal value. 5—difference signal. 6—material velocity. 7—battery power. 8—A—scan snapshot interface

3.3.3 LIMITS VALUE SCANING MODE

Limits value scanning mode: This mode allows the customer to test thickness of material continuously and to show the upper/lower limits after the tests. It shows the minimum and maximum values during testing as well as the present thickness. Press the RESET relevant ▲ to get the limits when measuring the thickness.

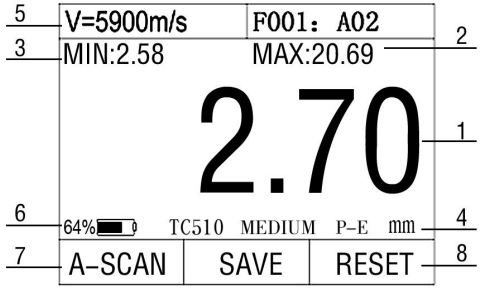


Figure 3.6 LIMITS VALUE MODE INTERFACE

1—the present thickness value 2—the maximum value 3—the minimum value 4—unit 5—material velocity 6—battery power 7—A—scan snapshot interface 8—reset

3.3.4 A-SCAN SNAPSHOT MODE

A-scan snapshot model: in this mode, user could view the thickness values and A-scanning waveform snapshot.

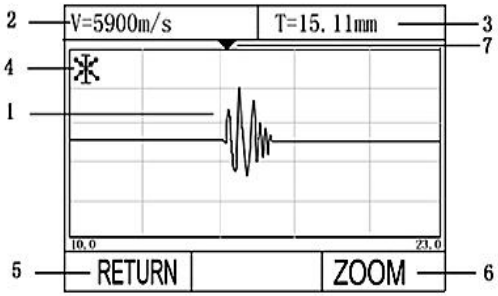


Figure 3.7 A-SCAN SNAPSHOT INTERFACE INTRODUCTION

1—waveform snapshot display area 2—material velocity 3—present thickness value 4—A-scan snapshot state identification 5—bact to the state of thickness value 6—magnify the current waveform 7— the triangle mark the location of the thickness value

3.3.5 A-SCAN SNAPSHOT AMPLIIFICATION MODE

Enter A-scan snapshot amplification interface, at the same time, in the bottom left of the screen appears amplification identification, in this mode, you can see the A-scanning snapshot wave amplification figure of the current thickness value, which is continent for the user to analysis and measure.

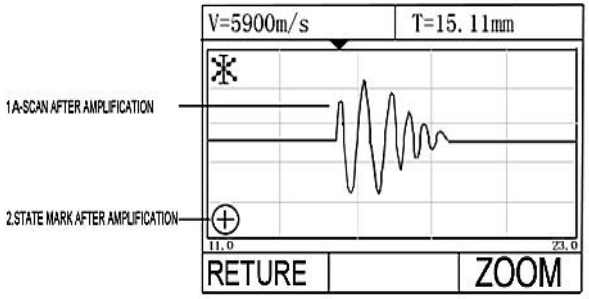


Figure 3.8 A-SCAN SNAPSHOT AMPLIFICATION MODE

3.4 THROUGH COATING MEASURING FUNCTION

When measure the thickness of the workpiece covered with coatings with the common thickness gauge, there will be some errors. UM-4D and UM-4DL could accurate measure the net thickness of the workpiece with double echo measurement principle without having to remove the coatings or destroy the surface process. This function is achieved by measure the two consecutive bottom echo of base material.

Press MODE into parameter interface, according to Figure 3.2,set the measurement mode to double echo and press MODE again back to thickness measurement interface. And then we can measure the thickness through coating, as the following 3.9.

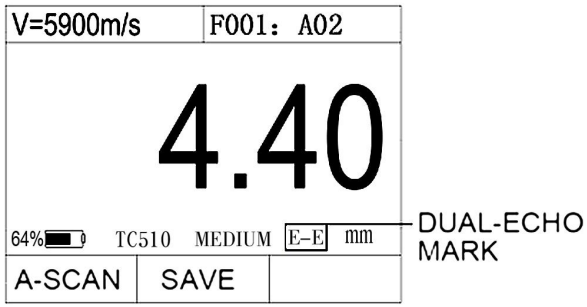


Figure3.9 THICKNESS MEASUREMENT INTERFACE WITH THROUGH COATING MODE

Note: UM-4 is the basic model without through coating function, UM-4D and UM-4DL have the function.

4. DATA STORAGE FUNCTION

The UM-4DL have a powerful storage function, for save one hundred thousand thickness values, it adopt the storage mode of micro grid (the follow Figure3.11). This is convenient for viewing and selecting the location of storage via adjusting  . And the measurement data files can be transferred from the instrument to a PC via USB communication generate EXCEL or TXT format files. Using our powerful DataView software to statistical and analyze measurement, report via connect printer.

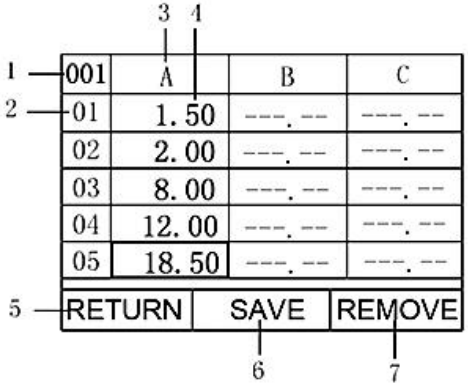


Figure 3.10 GRID STORAGE MODE

1—storage file number 2—line mark 3—row mark 4—the location of thickness value or waveform 5—back to the state of thickness value 6—save thickness value or waveform 7—delete the selected data

Note: only UM-4DL has the function of storage and output.

5. MEASUREMENT APPLYING SKILLS

5.1MEASURING ERROR PREVENTION

1. MATERIAL INFLUENCE

In many materials like nonmetal or plastic, the change of velocity is obvious, thus, the accuracy of measuring is influenced. If the material of the object is not isotropic, the velocity varies in different directions. In this condition, the preset velocity should be the average value among the testing range, which can be acquired through testing a block with the same velocity as the object average velocity value.

2. ULTRA-THIN MATERIAL

When the thickness of the testing object is below the minimum value of the probe limit, the result may be incorrect, and the thickness can be acquired by contracting the blocks when necessary.

When testing ultra-thin materials, sometimes DUAL-ECHO happens, which is a kind of incorrect result and the result is twice of the real one. Another incorrect result called PULSE ENVELOPE AND CIRCULATORY JUMPING, which means that the testing result is higher than the real one. In order to prevent this kind of error, when testing the object with the appropriate thickness as the minimum limit and judgment is available, customer should pay attention to the waveform displayed and adjust the gain or use blank function.

3.SURFACE CLEANING INFLUENCE

Before measuring, all the dust, dirt and corrosion should be cleaned and the cover like paint should be removed.

4. ROUGHNESS INFLUENCE

The extremely rough surface may arouse measuring error or even reading lost, therefore, the surface of the material should be smooth before measuring through polishing, filing, grinding or using high-viscosity couplant.

5. SURFACE OF THE ROUGH MACHINE PROCESSING

The regular slugs after rough machine processing (such as lathing or planning) on the surface of the work-piece may also arouse measuring errors. Except for the compensation methods mentioned above in 4, adjusting the angle between and sound insulating wall (the metal film through the center of the probe bottom) of the probe and the slugs of the material and making them perpendicular or parallel with each other to get the minimum reading as the thickness value is also efficient.

5.2 MEASURING METHODS

1. SINGLE-POINT MEASUREMENT

Using the probe to measure a random point on the surface of the object, the reading displayed is the thickness value.

2. DOUBLE-POINT MEASUREMENT

Measuring twice at the same spot on the object, and making the probe inclines 90°in the second measurement, the thinner reading is the thickness value.

3. MULTIPLE-POINT MEASUREMENT

When the reading is unstable, measuring several times within a circle with a certain point as center and 30mm as diameter, the thinnest reading is the thickness value.

4. CONTINUOUS MEASUREMENT

Taking continuous measurements along a specified path at intervals of 5mm or less according to the single measurement method, the thinnest reading is the thickness value.

5.3 PIPE WALL MEASUREMENT

When measuring a piece of pipe to determine the thickness of the pipe wall, orientation of the transducers is important. If the diameter of the pipe is larger than approximately 4 inches, measurements should be made with the transducer oriented so that the gap in the wearface is perpendicular (at right angle) to the long axis of the pipe. For smaller pipe diameters, two measurements should be performed, one with the wearface gap perpendicular, another with the gap parallel to the long axis of the pipe. The smaller of the two displayed values should then be taken as the thickness at that point.

Perpendicular Parallel

5.4 CAST MEASUREMENT

It’s difficult to measure cast work-piece because there are some special features of the cast measurement: the rough grain of cast material, the loose structure, and the rough surface measuring status. So there are some tips to follow:

1. Use low frequency probe like ZT-12 in our company.

2. When measuring the non-processing surface of some cast work-piece, high viscosity couplant such as machine oil, grease or water glass is needed.

3. Calibrate the sound velocity with the standard block which shares the same material and same measuring direction with the testing object.

6. CARE AND MAINTENANCES

6.1 POWER SOURCE INSPECTION

During the usage of the gauge, the current battery power will be shown on the display, when the battery power is low, the customer should change the batteries promptly so that the measuring accuracy won't be influenced.

The steps of changing batteries are as follow:

1. Turn off the gauge.

2. Loosen the screws on the back of the units and remove the battery cover.

3. Take out the batteries and replaces with new ones. Pay careful attention to polarity.

Attention: When not using the gauge for extended periods of time, please remove batteries to prevent any leakage or corrosion.

6.2 CONSIDERATIONS

1. Please be cautious of the zero block's getting rust as couplant will be spread on the surface of it when calibrating the gauge. After using, clean the zero block. Avoid dripping sweat on the gauge in high temperature. Some grease spreading on the surface of zero block is useful to avoid rusting if the gauge will be spared for long. Wipe the grease out when reusing.

2. Be sure to avoid any caustic liquid such as alcohol or viscous fluids to prevent corrosion to the cover and the display window, clean with water only.

3. Avoid scratching the surface of the probe. A worn probe will cause unstable readings.

6.3 MAINTENANCES

Contact with the maintaining department of our company if the following problems appears:

1. Components damage and the gauge fail to measure.

2. The display of the screen is disordered.

3. The measuring error is abnormally big in normal situation.

4. Keyboard operating is disordered or keyboard doesn't work.

As the UM-4 series ultrasonic thickness gauge is high-tech product, the maintaining work should be made by professional operator and please avoid self-acting operations.

SOUND VELOCITY MEASUREMENT CHART

Material	Sound Velocity	
	Inch/µS	M/s
Air	0.013	330
Aluminum	0.250	6300
Alumina Oxide	0.390	9900
Beryllium	0.510	12900
Boron Carbide	0.430	11000
Brass	0.170	4300
Cadmium	0.110	2800
Copper	0.180	4700
Glass(crown)	0.210	5300
Glycerin	0.075	1900
Gold	0.130	3200
Ice	0.160	4000
Inconel	0.220	5700
Iron	0.230	5900
Iron (cast)	0.180	4600
Lead	0.085	2200
Magnesium	0.230	5800
Mercury	0.057	1400
Molybdenum	0.250	6300
Monel	0.210	5400
Neoprene	0.063	1600
Nickel	0.220	5600
Nylon, 6.6	0.100	2600
Oil (SAE 30)	0.067	1700
Platinum	0.130	3300
Plexiglass	0.110	1700
Polyethylene	0.070	1900
Polystyrene	0.0930	2400
Polyurethane	0.0700	1900
Quartz	0.230	5800
Rubber, Butyl	0.070	1800
Silver	0.140	3600
Steel, Mild	0.233	5900
Steel, Stainless	0.230	5800
Teflon	0.060	1400
Tin	0.130	3300
Titanium	0.240	6100
Tungsten	0.200	5200
Uranium	0.130	3400
Water	0.584	1480
Zinc	0.170	4200

All velocities are approximations