PCE Americas Inc.
711 Commerce Way
Suite 8
Jupiter
FL-33458
USA
From outside US: +1
Tel: (561) 320-9162
Fax: (561) 320-9176
info@pce-americas.com

PCE Instruments UK Ltd.
Units 12/13
Southpoint Business Park
Ensign way
Hampshire / Southampton
United Kingdom, SO31 4RF
From outside UK: +44
Tel: (0) 2380 98703 0
Fax: (0) 2380 98703 9
info@pce-instruments.com

www.pce-instruments.com/english
www.pce-instruments.com

PCE-USC 20

Thickness Gauge

Operating Manual

Chapter 1   Overview

When ultrasonic waves transmit in test materials, acoustics properties will be effected due to flaws existing in the material, thus these properties can be used to demonstrate flaws within the material. According to this theory, by use of ultrasonic waves can detect flaws like crack, cavity, inclusion when test various media such as metal, non-metallic materials and composite materials.

Digital ultrasonic flaw detector ÚÔÒËẀÙÔÁŒ is a portable industrial non-destructive flaw detector, which can quickly and easily, without damage, accurate to a variety of work piece defects (cracks, inclusions, cavity, etc) of the detection, location, assessment and diagnosis. Both can be used in laboratories and project site.

PCE-USC 20 is widely operated in the field of flaw detection and quality control, such as manufacturing industry, metallurgy of iron steel , metal processing industry, chemical lines , as well as operated in in-service safe inspection and life appraisal, such as aerospace, railway transportation, boiler and pressure vessel safety check in service and life assessment.

ÚÔÒËẀÙÔÁŒ is a high-tech instrument which launched by PCE Instruments.
Full consideration of ergonomic
made for instrument's appearance, its structure is strong and light, easy and comfort to take, as well as shockproof. Scientific and rational setting of keystroke and menu, common features can be simply operated for more efficiency and less labor intensity. Instrument complies with European standard EN12668-1, has more advantages like high performance, stability, functional and practical, reliable quality, anti-interference ability and so on, also in full compliance with most industry standards, high praise for it both from domestic and abroad, after the software version upgrade to Ver1.10 it become more convenient for operation.

ÚÔÒËẀÙÔÁŒ is equipped with imported lithium batteries, no memory effect, with high capacity, batteries service time can up to more than 8 hours, it is priority choice for testing operations especially for field work.

Chapter 2   Parameters and Features

2.1   Basic Performance Parameters

- Horizontal Linearity Error ≤0.1%
- Vertical Linearity Error ≤3%
- Surplus Sensitivity ≥62dB
- Dynamic Range ≥40dB
- Electronic Noise Level ≤20%
- Far-field Resolution ≥30dB
- working Mode   Single-probe or Dual-probes
- Transmit Pulse   400V negative spikes
- Operating Frequency Range   0.5MHz~20MHz, frequency subsection option, match probes well
- Detection Range   0.5mm~9999mm (steel; longitudinal wave), adjustable continuously, switchable steps
- PRF   range≤125mm: 1KHz;
  125mm<range≤1400mm: 250Hz;
  1400mm<range≤9999mm: 40Hz
- Sampling Rate   400MHz hardware real-time sampling
- Velocity   1000m/s~15000m/s, adjustable continuously, switchable steps
- Display Delay   -10mm~1000mm, adjustable continuously, switchable steps
- Probe Delay   0μs~199.9μs
- Damping   50Ω, 100Ω, 200Ω, 500Ω
- Gain Adjustment   0dB~110dB, step by 0.0/0.1/0.5/1.0/2.0/6.0dB
- Rectification Mode   Full wave / Positive half-wave / Negative half-wave / RF
- Display Screen   5.7" high brightness TFT color LCD screen, 640×480

	pixels
● Measurement Mode	flank or peak
● Store	store commonly-used detection parameters and test result data
● Alarm	Hardware alarm, sound and light two methods, alarm models including positive mode, negative mode and DAC mode
● Communication Interfaces	USB, Ethernet
● Operating Temperature	-10~+50℃
● Battery	Lithium battery (10.8V⎓5200mAh), supplying power continuously for more than 6 hours
● Power Supply	AC: 100-240V; DC: 15V/4A
● Weight	about 1.4Kg (including battery)
● Language	Chinese / English
● Waterproof Level	IP54 standards

2.2 Features and Functions

2.2.1 Features

(1) Leading technical target, abundant applied assistant function

(2) Intelligible setting of keys and menu, easy to operate

(3) 400 MHz real-time hardware sampling, high-fidelity echo pulse

(4) Broadband and amplifying circuit with low noise, selectable damping, excellent matching with low or high frequency probe

(5) Excellent EMI design，good EMC performance

(6) 5.7″ high resolution color LCD display

2.2.2 Main Functions

(1) DAC Making, Storing and Recalling Function

    (a) Making easily

        When sampling dots one by one, it will automatically draw four lines such

as "Assess Line", "RATINE Line", "GENERATRIX Line" and "Void Line".

(b) Compiling conveniently

It can automatically modify each sampling dot and adjust the curve offset(to fit all kinds of standards).

(2) AVG Making, Storing and Recalling Function

(a) Making easily

It can draw curve by sampling one dot in ">3N" area automatically, or by sampling dots one by one in "<3N" area, which ensures the practicality.

(b) Applying conveniently

It can automatically adjust the curve equivalent and calculate the flaw equivalent size Φ automatically.

(3) RF Displaying Function

It can display the real original waveform, which is convenient for the user to analyze the details of the echo and help to analyze the flaw qualitatively.

(4) Curve Surface Amending Function

It can amend the test result of the arc surface automatically.

(5) Peak Holding Function

Assist to record the maximum echo.

(6) Envelope Function

Record the changing profile of the echo.

(7) Automatically Testing Echo Spectrum Function

It is used to test the center frequency and its spectral characteristics of the probe echo.

(8) Auto Gain Adjusting Function

The adjustable Auto Gain can be used to set echo amplitude conveniently.

(9) Weld Graph Displaying Function

The graph displaying is intuitional, which makes the flaw position legible. The graphs can be stored in the flaw detection report, which is convenient to be replayed and printed.

(10) Intelligent Calibrating Procedures

It is used to calibrate the material sound velocity rapidly, measure the probe delay automatically, calibrate the refraction angle β automatically, and calibrate the probe easily.

(11) Setting Quick Channels Function

It has 30 quick channels which can store 30 groups of detect parameters in all, which makes the storing and recalling easily.

(12) Automatically Generating Reports Function

It generates detection reports based on detecting parameters and data automatically. The detection reports contain detailed detecting parameters, waveform graphs and detailed echo data, which can be directly printed by the connected printer or stored in the computer.

(13) Continuously Storing and Replaying Function

It can record the dynamic waveform while detecting, which makes the recorded data more detailed. The menu settings are analogous to the video function, which is easy to be understood and operated. The stored documents can be re-stored to the U disk or other storage devices directly at any time.

(14) Waveform Display Area Zoom Function

The waveform display area can be zoomed in to full screen, which can efficiently prevent misuse in field testing.

(15) Gate Area Zoom-in Function

The Gate area can be zoomed in to the whole display area, which is convenient to observe the waveform details.

Chapter 3　Structure

This chapter focuses on three aspects, including "Overall Structure", "Interfaces" and "Waveform and Data Display".

3.1　Overall Structure

It mainly contains three aspects, including "Panel Keys", "Main Menus" and "Submenus". Refer to Figure 3-1.
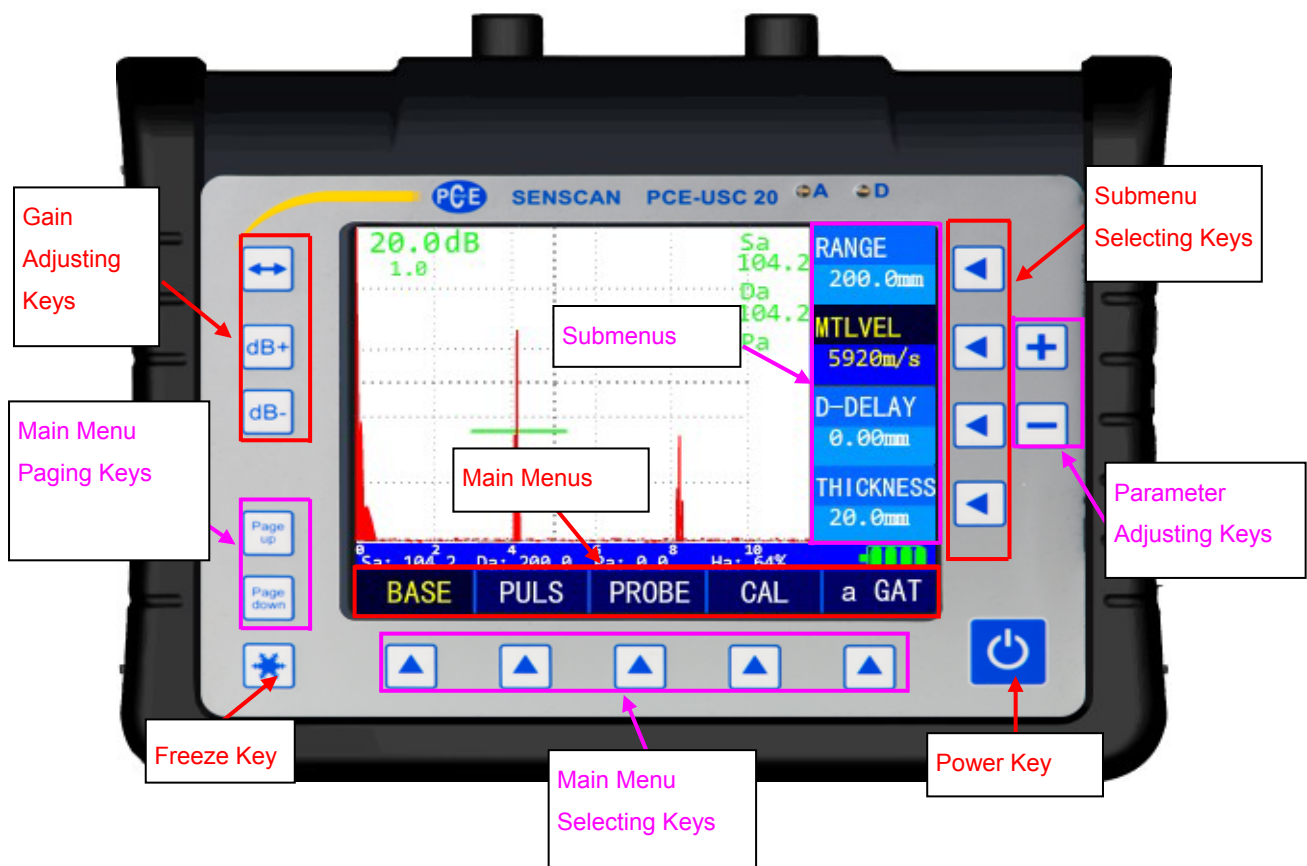

Figure 3-1　Overall Structure

3.1.1　Panel Keys

(1) Power Key

: it is used to turn on/off the power supply by long press for about 2s. (Represented by [Power] below.)

(2) Gain Adjusting Keys

It displays the gain value and the gain-step value in the upper left corner of the

6

screen. Refer to Figure 3-1.

⬌ : gain-step adjusting key. Press it for switching gain-step value cyclically by one of the step values in the array of 0.0/0.1/0.5/2.0/6.0dB. (Represented by [↔] below.)

(dB+) : gain increasing key. Press it each time for increasing gain value, by which the increment is the current step value. (Represented by [dB+] below.)

(dB-) : gain decreasing key. Press it each time for decreasing gain value, by which the decrement is the current step value. (Represented by [dB-] below.)

Note: when the step value is "0.0dB", it means that the gain is unadjustable, which is convenient for the user to prevent misoperation in detecting.

(3) Main Menu Paging Keys

(PgUp) : main menu page-up key. Press it for entering the up-page of the main menu. (Represented by [PgUp] below.)

(PgDn) : main menu page-down key. Press it for entering the down-page of the main menu. (Represented by [PgDn] below.)

(4) Submenu Selecting Keys

◀ : it has two functions as follows. (Represented by [◀] below.)
(a) Select submenus (first press for the submenu being selected).
(b) Switch parameter step value or submenu optional selections (need to press for the submenu being selected first).

(5) Parameter Adjusting Keys

⊕ : parameter increasing key. Press it to increase the parameter value of the selected submenu or switch submenu optional selections. (Represented by [+] below.)

⊖ : parameter decreasing key. Press it to decrease the parameter value of the selected submenu or switch submenu optional selections. (Represented by [−] below.)

(6) Freeze Key

: press it to freeze the screen waveform and data, and then press again to
    unfreeze. (Represented by [Freeze] below.)

3.1.2 Main Menus

Each page of the main menus has five selections and each selection has its
relative selecting key ▲ (Represented by [▲] below.). The words of the current
selected main menu are yellow and the background is deep blue, while the words
of the un-selected menu are white and the background is light blue. Refer to
Figure 3-2.

Figure 3-2   Main Menu

3.1.3 Submenus

The displaying group of the submenus is subordinated to the current selected
main menu. The function of the submenus is either parameter adjusting (for
setting parameters) or function controlling. Each page of the submenus has four
selections and each selection has its relative selecting key [◄]. The words of the
current selected submenu are yellow and the background is deep blue, while the
words of the un-selected menu are white and the background is light blue.

3.2 Interfaces

The instruction of the instrument interfaces is as follows. Refer to Figure 3-3.
①: two standard Lemo-01 probe sockets. The left one (T) means "Transmitter"
    and the right one (R) means "Receiver".
②: Ethernet interface. It is used for long-distance controlling and data
    transmitting.
③, ④: one USB-B interface (③) and two USB-A interfaces (④). They are used for
        the computer communicating, which can directly copy and store data to
        the U disk or any other storing devices.
⑤: standard LEMO DC power socket. It is used for DC power supplying and

8

battery charging.

⑥: buckle. There are four buckles distributed in the two sides of instrument.

⑦: battery cover. There are two quick screws which are used for quickly locking and opening the battery cover.

⑧: instrument back bracket. It is used for supporting the instrument in a sloping way, which is available in opening and closing.
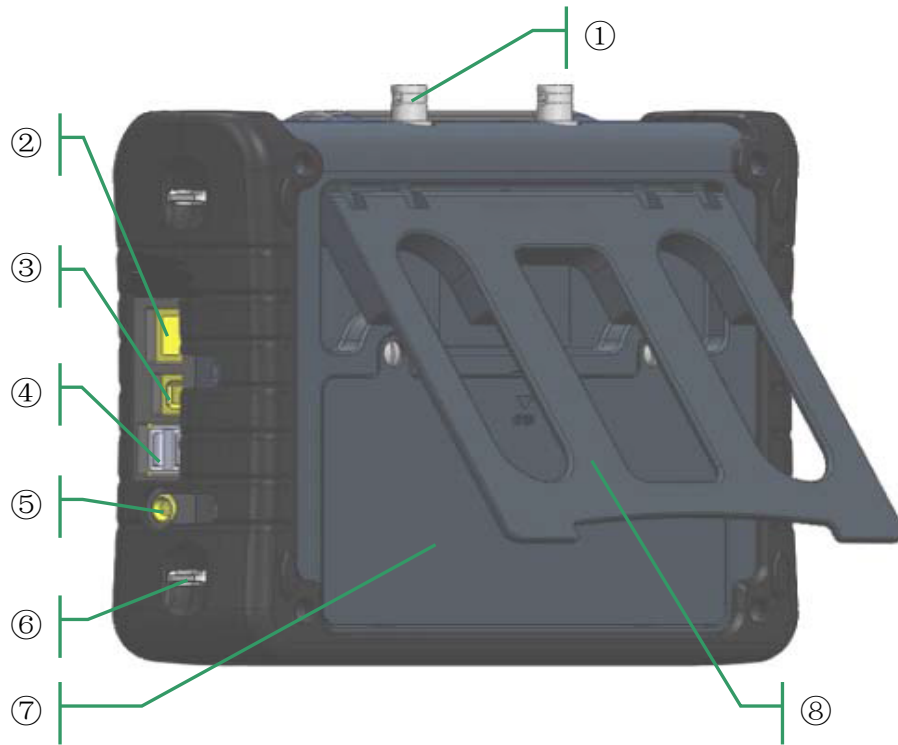
Figure 3-3   Interfaces

3.3   **Waveform and Data Display**

The instruction of the waveform and data display is as follows. Refer to Figure 3-4.
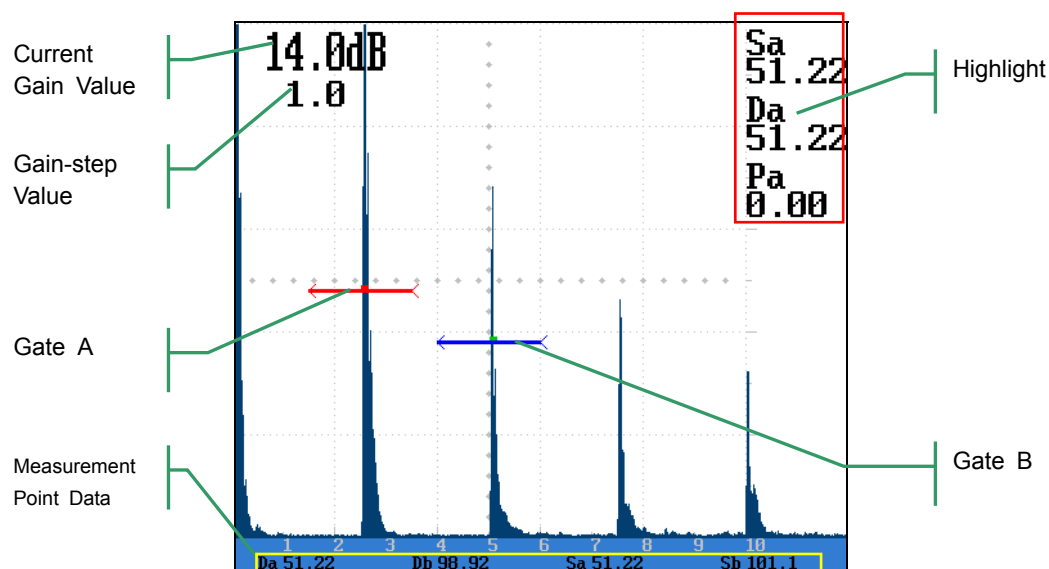
Figure 3-4　Echo and Data Display

(1) Current gain value. It means the current signal magnified grade.

(2) Gain-step value. It has six values in the array of 0.0/0.1/0.5/2.0/6.0dB.

(3) Measurement point data. It is displayed the measurement data, including "Sa", "Ha", "Sb" and "Hb" etc.. The four data can be set if necessary. Please refer to appendix Ⅳ for their detailed definition.

(4) Gate

　　(a) There are two gates which are Gate A and Gate B. It is only one gate used in the common testing task and usually the default gate is Gate A.

　　(b) The function of the gates is to test the selected echo signal or alarm. In the testing task, there may appear many echo signals in the instrument screen at the same time. You can move Gate A to select the echo signal you required.

10

Chapter 4   Operating Instruction

4.1   Power Supply

Digital ultrasonic flaw detector ÚÔÒËÙÔÂ can be operated by use plug-in unit (AC adapter) or batteries. Put battery into instrument, connect the instrument to adapter for power supply also charge battery.

4.2   Operating Instruction of the AC Power Supply

The instrument can use the AC power to supply power by being connected to the special AC adapter.

Note: in the condition of the instrument using the AC adapter for power supply without loading the battery, if shut it off forcibly, the instrument is under abnormal shutdown state and the parameter previous settings may not be saved. The correct way to shutdown is to long press the power key for about 2s.

4.3   Battery Power Supply

Using battery for power supply, please use batteries manufactured for matching instrument from factory.

(1) **Insert battery:** battery compartment is in the back side of instrument, use screwdriver to loosen the cover of battery compartment, put battery into compartment, close the battery compartment then screw down bolts.

(2) **Battery power indicator:** there are five grids at lower right corner of display screen to show power supply condition, if these grids are less then two, stop flaw detection immediately, save test parameters and data, replace battery or charge battery promptly.

(3) **Charge battery:** please use power adapter manufactured for matching instrument from factory. Before use adapter, please read instruction carefully. 5 hours required for battery continual charging.

Note: if long-time detecting is needed on site, please bring the reserve battery with you. You should pay more attention to it especially in winter when the temperature is low outside and the efficiency of battery discharging decreases.

4.4   Probe Connecting

Connectors of Instrument are standard Lemo-01. Operating in single element method, both sockets of connector are applicable (parallel connection inside). When connecting the double elements probes or two probes for receive-transmit work, please make sure to connect the transmitter probe to the right socket ("⬜" mark on the instrument crust), and the receiver probe to the left one ("⬜" mark on the instrument crust). Wrong connection may cause unsatisfied test effects.

4.5   Power On/Off

The basic operation for powering on/off is as follows.

(1) **Powering on:** long press [Power] key to start up the instrument.

(2) **Self-checking after Start-up:** the instrument will complete the Self-checking automatically after start-up, then it will enter the previous state with the same parameters keeping when normally powered off.

(3) **Checking battery voltage:** please check the power monitor icon in the lower right corner of the screen at times. If the power is insufficient, the instrument will power off automatically after alarming for one minute.

(4) **Working:** set the instrument parameters or do the testing.

(5) **Powering off:** press [Power] key for some time to shutdown the instrument normally, the current settings are saved.

Note: it is in the abnormal shutdown state when the power is cut off suddenly while testing, the current settings may be not saved.

4.6   Software Update and Return to Factory Default Settings

The instrument has many updating methods as follows, which are convenient for on site detection.

(1) **Software update**: in the condition of start-up, long time press [PgUp] and [PgDn] keys at the same time and keep still, according to kind reminders on screen, inset USB disk with new edition process, press [▲] key which is corresponded to the red words "Ver 1.10", then software update prompt will display on screen , after finishing, press [PgUp] and [PgDn] keys at the same time once, instrument returns to the normal detection condition (but it will not change the stored data which has been saved in the STORE menu).

(2) **Parameters being returned to factory settings**: press [Power] key to start

up the instrument, and continuously press [↔] key in the self-checking process, then the instrument's parameters will be returned to the default settings of factory release (but it will not change the stored data which has been saved in the STORE menu).

(3) **Return to the state of factory release**: under power off, press [PgUp] and [PgDn] keys at the same time and keep still. Meantime press [Power] key, then the instrument's parameters and the stored data will be returned to the default settings of factory release. At this time, it will delete all the parameters and data stored after factory release. So you should pay more attention to it.

Note: after start up instrument it will make automatically Self-checking then enter regular working condition, if Self-checking shows irregular, turn off instrument then start up again, if it still can not pass the Self-checking (means software halted), return to state of factory release and update the system to reach regular working condition.

4.7   Important Basic Setting

4.7.1   Working Mode Setting

Set working mode of the instrument: single element or double elements.
Operating: press [PgUp] or [PgDn] or [▲] key for PULS main menu, press [◄] key to select DUAL submenu，press [+] or [−] key to set DUAL "on" or "off". "on" means double mode and "off" means single mode.

4.7.2   Language Setting

Languages for man-machine conversation: Chinese/English.
Operating: press [PgUp] or [PgDn] or [▲] key for CONFIG 1 main menu, press [◄] key to select language submenu, press [+] or [−] key to set language.

4.7.3   Unit Setting

Set unit for instrument's displayed parameter: "mm" or "inch"
Operating: press [PgUp] or [PgDn] or [▲] key for CONFIG 1 main menu, press [◄] key to select UNIT submenu, press [+] or [−] key to set unit for the parameters.

4.7.4 Brightness Setting

Adjust display brightness of screen, three grades for choices: low, middle, high. "low" means the least brightness, and "high" means the most brightness.

Note: the more bright the backlight is set, the more power consumes, and the battery working time will be shortened. So it is set as the lowest grade in case of high brightness being unnecessary.

Operating: enter LCD main menu, and select LIGHT submenu, then you can press [+] or [−] key for brightness.

4.7.5 Restraint Setting

Restraint function for reject clutter and promote signal to noise ratio. Height of restraint level will be displayed by percentage from total screen height, meantime, any wave signals lower than restraint level height will be shielded and can not be displayed. For instance, adjust restraint level to 20%, the screen only display signals with height more than 20%. 0% means instrument under non- restraint condition.

Instruction: if restraint level be higher the dynamic range of instrument will be smaller, the echo lower than restraint level will be not displayed, so it may have omission factor for tiny signals, after use restraint function the instrument should return to non-restraint condition.

Note: RESTRAINT >0%, right side of screen will display red "RJ" to avoid misoperation.

Operating: enter CONFIG 1 main menu, and select RESTRAINT submenu, then you can press [+] or [−] key to set restraint level.

Chapter 5   Menu Introduction

5.1   Normal Menus

PCE-USC 20 contains 17 main menus (in 4 pages), each main menu contains several submenus, and the specific structure, parameter setting and basic operations are as follows.

5.1.1   BASE Menu

The Main Menu "BASE" contains one-page's submenus. Refer to Table 5-1.

Table 5-1   BASE Menu

NO	Submenus	Details
1-1	RANGE	● "Detection Range": 0.500~9999mm (steel longitudinal wave); the default is "100mm".
		● Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value.
1-2	MTLVEL	● "Material Velocity": 1000~15000m/s; the default is 5920m/s.
		● Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value.
1-3	D-DELAY	● "Display Delay": -10~2000mm; the default is 0.00mm.
		● Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value.
1-4	THICKNESS	● "Thickness Range": 1~9999mm.
		● It is invalid if the normal probe N is selected.
		● It is used to set the workpiece thickness of the detection surface vertically if the angle probe A is selected, and the default is 100mm.
		● Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value.

5.1.2 PULS Menu

The main menu "PULS" contains one-page's submenus. Refer to Table 5-2.

<div align="center">Table 5-2   PULS Menu</div>

NO	Submenus	Details
1-1	DAMPING	● 50Ω/100Ω/200Ω/500Ω; the default is "50Ω".
		● Change the amplitude/width/resolution of echo by adjusting damping.
		● When damping is "high", you will get higher amplitude and wider echo width, but lower resolution; and vice versa.
		● Press corresponding submenu selection key or [+/-] key to switch damping value.
1-2	POWER	● high/low; the default is "low".
		● Adjust transmit power, chose "low" when higher resolution is needed, while "high" is suitable for huge workpiece or through transmission technique.
		● Press corresponding submenu selection key or [+/−] key to switch between high and low.
1-3	DUAL	● off/on; the default is "off".
		● off: single element mode; on: double elements mode.
		● Press corresponding submenu selection key or [+/−] key to select working mode.
1-4	FREQ BAND	● 0.5~22 /1~6 / 3~22MHz.
		● Chose appropriate frequency range of amplifier according to probe frequency.
		● Press corresponding submenu selection key or [+/−] key to select frequency band.

5.1.3 PROBE Menu

The main menu "PROBE" contains one-page's submenus. Refer to Table 5-3.

Table 5-3   PROBE Menu

NO	Submenus	Details
1-1	TYPE SPEC	● Input specifications of probe: probe type+ frequency + crystal material+ element size. ● "Probe Type": N (normal probe) / A (angle probe) ● Press corresponding submenu selection key to change the background into yellow among the submenus; press [+] key to increase or [−] key to decrease the value.
1-2	P-DELAY	● 0.00~199.9µs; the default is "0.00µs". ● Set the zero point of probe. ● Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value.
1-3	ANGLE	● Refraction angle: 0-85°. ● Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value. ● **Note: it is invalid when the normal probe is selected.**
1-4	X-VALUE	● Distance between front edge of angle probe and incidence point. ● 0.0~100.0mm; step by 0.1mm. ● Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value. ● **Note: it is invalid when the normal probe is selected.**

5.1.4 CAL Menu

The main menu "CAL" contains two-pages' submenus. Refer to Table 5-4.

Table 5-4   CAL Menu

NO	Submenus	Details
1-1	CAL SET	● Select the item needs to be calibrated: speed/delay.
		● Press corresponding submenu selection key or [+/−] key to select calibration items.
1-2	S-REF 1	● Set sound path of first reference echo; range : 0~2500mm.
		● Press corresponding submenu selection key to switch step; press [+] key to increase or [−] key to decrease the value.
1-3	S-REF 2	● Set sound path of the second reference echo; range : 0~5000mm.
		● Press corresponding submenu selection key to switch step; press [+] key to increase or [−] key to decrease the value.
1-4	CAL	● Press corresponding submenu key once to select "CAL".
		● Adjust gate A to capture the first echo, press [+] key once.
		● Move gate A to capture the second echo, press [+] key once again. If successful the calibration has been done.
2-1	CAL SET	● Select the item needs to be calibrated: angle /K value.
		● Press corresponding submenu selection key or [+/−] key to select calibration items.
2-2	HOLE DEPTH	● Range: 0~70mm; the default is "20mm".
		● Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value.
2-3	HOLE DIAM	● Range:0.5~50mm, the default is 10mm.
		● Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value.
2-4	CAL	● Press corresponding submenu key once to select "CAL".
		● Move gate A to capture the Arc echo, press [+] key once. If successful the calibration has been done.

5.1.5 a GAT Menu

The main menu "a GAT" contains one-page's submenus. Refer to Table 5-5.

<p align="center">Table 5-5   a GAT Menu</p>

NO	Submenus	Details
1-1	a LOGIC	• Used to select Gate A working mode and alarm logic; off/positive/negative; the default is "off". • off: Gate A un-visible, alarming and measurement function can not be used. • positive: if echo amplitude within Gate A is higher than the gate threshold, alarm light indicator will be on and there will be sound alarm when "Horn" is set to "on". • negative: if echo amplitude within Gate A is lower than the gate threshold, alarm light indicator will be on and there will be sound alarm when "Horn" is set to "on". • Press corresponding submenu selection key or [+/−] key to select working mode of Gate A.
1-2	a START	• 0.00~9999mm; the default is "35.00mm" when "positive" or "negative" is selected. • Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value.
1-3	a WIDTH	• 0.020~9999mm; the default is "25.00mm" when "positive" or "negative" is selected. • Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value.
1-4	a THRSH	• 5%~90%; step by 1%; the default is "57%" when "positive" or "negative" is selected. • Press corresponding submenu key to select; press [+] key to increase or [−] key to decrease the value.

5.1.6 DAC Menu

The main menu "DAC" contains four-pages' submenus. Refer to Table 5-6.

Table 5-6 DAC Menu

NO	Submenus	Details
1-1	DAC MODE off	● Select the DAC MODE: off.
		● Press corresponding submenu selection key or [+/−] key to select DAC mode.
2-1	DAC MODE record	● Select the DAC MODE: record.
		● Press corresponding submenu selection key or [+/−] key to select DAC mode.
2-2	DAC ECHO	● Display measurement dot number (10 at most).
		● Press corresponding submenu selection key or [+/−] key to select echo points.
2-3	GAIN AMEND	● 0.0~20.0dB, step 0.5dB; the default is "0.0dB".
		● Press [+/−] key to adjust dB value.
2-4	ASSESSLINE RATINELINE VOID LINE	● Adjustable within -20dB~+20dB of Generatrix line by step "0.5dB".
		● Press corresponding submenu key to switch among the three lines; press [+] key to increase or [−] key to decrease the value.
3-1	DAC MODE dac	● Select the DAC MODE: dac.
		● Press corresponding submenu selection key or [+/−] key to select DAC mode.
3-2	HIDE GENERATRIX	● Set the generatrix hide or not: yes/no; the default is "no".
		● Press corresponding submenu selection key or [+/−] key to set.
3-3	COMPENSATE	● Set the surface compensating value.
		● Press corresponding submenu key to select; press [+] key to increase or [−] key to decrease the compensating value.
3-4	FLAW EQUIVALENT	● Display the flaw equivalent value.
4-1	DAC MODE amend	● Select the DAC MODE: amend.
		● Press corresponding submenu selection key or [+/−] key to select DAC mode.
4-2	SAMP POINT	● Add sampling point on reflected echo, sampling point No. is no more than reference echo, and sampling point is valid only when sampling No. is more than 0.
		● Press corresponding submenu key to select; press [+] key to increase or [−] key to decrease the number of the sampling points.
4-3	HEIGHT	● Set the height of the four kinds of the DAC curves.
		● Press corresponding submenu key to select; press [+] key to increase or [−] key to decrease the value.
4-4	DELETE	● Delete the unsatisfied points.
		● Press corresponding submenu selection key or [+/−] key to delete.

5.1.7 AVG Menu

The main menu "AVG" contains four-pages' submenus. Refer to Table 5-7.

Table 5-7   AVG Menu

NO	Submenus	Details
1-1	AVG MODE off	● Select the AVG MODE: off.
		● Press corresponding submenu selection key or [+/−] key to select AVG mode.
2-1	AVG MODE >3N PLOT	● Select the AVG MODE: >3N PLOT.
		● Press corresponding submenu selection key or [+/−] key to select AVG mode.
2-2	APERTURE	● Input diameter of flat-bottomed hole when making AVG, the max value is related to probe type, the default is "10mm".
		● Press corresponding submenu key to switch step; press [+] key to increase or [−] key to decrease the value.
2-3	REF CURVE	● Input Φ value of lines , the default is 5.0mm.
		● Press corresponding submenu key to switch step; press [+] key to increase or [−] key to decrease the value.
2-4	PLOT	● Press corresponding submenu key to confirm, press [+] key to plot automatically.
3-1	AVG MODE <3N PLOT	● Select the AVG MODE: <3N PLOT.
		● Press corresponding submenu selection key or [+/−] key to select AVG mode.
3-2	AVG ECHO	● Display measurement dot number (20 at most).
		● Press corresponding submenu key to select; press [+] key to increase or [−] key to decrease the echo points.
4-1	AVG MODE avg	● Select the AVG MODE: avg.
		● Press corresponding submenu selection key or [+/−] key to select AVG mode.
4-2	REF CURVE	● Set ¢ value of lines; the default is "5.0mm".
		● Press corresponding submenu key to switch step; press [+] key to increase or [−] key to decrease the value.
4-3	COMPENSATE	
4-4	FLAW EQUIVALENT	● Display the flaw equivalent value.

5.1.8 AUTO SETUP Menu

The main menu "AUTO SETUP" contains one-page's submenus. Refer to Table 5-8.

Table 5-8   AUTO SETUP Menu

NO	Submenus	Details
1-1	AUTO GAIN	● Set amplitude of echo within gate A to desired height (can be adjusted).
		● Press corresponding submenu key or [+] key to adjust the value.
1-2	AGC	● 20%~80%; step 1%; the default is "50%".
		● Set amplitude of "auto gain".
		● Press corresponding submenu key to select; press [+] key to increase or [−] key to decrease the amplitude value.
1-3	SURF AMEND	● ¢10~¢2000mm or flat; the default is "flat".
		● Press corresponding submenu key to select or switch step; press [+] key to increase or [−] key to decrease the amplitude value.
		● It is invalid when the normal probe is selected.
1-4	PEAK HOLDING	● off/on; the default is "off".
		● on: A purple "×" will be displayed on top of the maximum echo inside the gate, if a new maximum echo appears in the gate, then the "×" will move to indicate the position of the new one, otherwise the "×" remains.
		● off: this function can not be used.
		● Press corresponding submenu key or [+/−] key to switch between "on" and "off".

5.1.9 WELD GRAPH Menu

The main menu "WELD GRAPH" contains one-page's submenus. Refer to Table 5-9.

Table 5-9 WELD GRAPH Menu

NO	Submenus	Details
1-1	WELD TYPE	● Select groove type: V/X/off. ● Press corresponding submenu key or [+/−] key to select groove type. ● It is invalid when the normal probe is selected.
1-2	P-PLACE	● 1~500mm; step by 1/10/100mm; the default is "100mm". ● Input the distance between probe front edge and weld center line. ● Press corresponding submenu selection key to switch step; press [+] key to increase or [−] key to decrease the value.
1-3	WELD WIDTH	● 1~200mm, step by 1/10mm; the default is "100mm". ● Input the width of groove. ● Press corresponding submenu selection key to switch step; press [+] key to increase or [−] key to decrease the value.
1-4	REFRESH √	● Press to generate the flaw position indication diagram. ● Press corresponding submenu key to select; press [+] key to confirm refresh.

5.1.10 STORE Menu

The main menu "STORE" contains two-pages' submenus. Refer to Table 5-10.

Table 5-10 STORE Menu

NO	Submenus	Details
1-1	CHANNEL ID (See the next page)	● The channel ID contains 1-30 ID，test parameters will be stored in the selected channel. ● Press corresponding submenu selection key to switch between "CHANNEL ID" and "DATA ID"; press [+] key to increase or [−] key to decrease the number.

NO	Submenus	Details
1-2	REMARKS (See the last page)	● Input letters or numbers as remarks information.
		● Press corresponding submenu selection key to switch circularly between the characters; press [+] key to increase or [−] key to decrease the value.
		● **Note: the remarks can only be input before saving the data, and it can't be changed after the data being saved.**
1-3	CHN RECALL √	● Recall parameters setting or data stored in the channel.
		● Press corresponding submenu key to select, press [+] key to recall.
1-4	SAVE/DELETE	● SAVE: save the current settings or data into the selected channel.
		● DELETE: delete the settings or data in the selected channel.
		● It displays "DELETE" when there has stored settings, otherwise displays "SAVE".
		● Press corresponding submenu key to select "SAVE" or "DELETE"; press [+] key to carry out.
2-1	DATA ID	● The DATA ID contains 1-30 ID，test data will be stored in the selected channel.
		● Press corresponding submenu selection key to switch between "CHANNEL ID" and "DATA ID"; press [+] key to increase or [−] key to decrease the number.
2-2	REMARKS	● Input letters or numbers as remarks information.
		● Press corresponding submenu selection key to switch circularly between the characters; press [+] key to increase or [−] key to decrease the value.
		● **Note: the remarks can only be input before saving the data, and it can't be changed after the data being saved.**
2-3	DATA RECALL √	● Replay the data stored in the selected channel.
		● Press corresponding submenu key to select; press [+] key to replay.
2-4	SAVE/DELETE	● Refer to 1-4 above.

5.1.11 SERIES STORE Menu

The main menu " SERIES STORE" contains one-page's submenus. Refer to Table 5-11.

Table 5-11   SERIES STORE Menu

NO	Submenus	Details
1-1	REC SPEED	● 5~15fps; step by 1fps; the default is "10fps".
		● Set recording speed (frames/s), this determines the max recording time.
		● Press corresponding submenu key to select; press [+] key to increase or [−] key to decrease the value.
1-2	START/STOP	● Control the start/stop of recording.
		● Press corresponding submenu key or [+/−] key to switch between "RECORDING" and "STOPPED".
1-3	SAVE	● Transfer the stored data to the U disk.
		● After inserting U disk, press corresponding submenu key to select; press [+] key to confirm.
1-4	REPLAY	● Replay recorded file.
		● Press corresponding submenu key or [+/−] key to switch between "REPLAY" and "STOPPED".

5.1.12 b GAT Menu

The main menu "b GAT" contains one-page's submenus. Refer to Table 5-12.

Table 5-12   b GAT Menu

NO	Submenus	Details
1-1	b LOGIC	● Used to select Gate B working mode and alarm logic; off/positive/negative; the default is "off". ● off: Gate B un-visible, alarming and measurement function can not be used. ● positive: if echo amplitude within Gate B is higher than the gate threshold, alarm light indicator will be on and there will be sound alarm when "Horn" is set to "on". ● negative: if echo amplitude within Gate B is lower than the gate threshold, alarm light indicator will be on and there will be sound alarm when "Horn" is set to "on". ● Press corresponding submenu selection key or [+/−] key to select working mode of Gate B.
1-2	b START	● 0.00~9999mm; the default is "14.00mm" when "positive" or "negative" is selected. ● Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value.
1-3	b WIDTH	● 0.020~9999mm; the default is "10.00mm" when "positive" or "negative" is selected. ● Press corresponding submenu selection key to switch between rough adjustment and fine adjustment; press [+] key to increase or [−] key to decrease the value.
1-4	b THRSH	● 5%~90%; step by 1%; the default is "50%" when "positive" or "negative" is selected. ● Press corresponding submenu key to select; press [+] key to increase or [−] key to decrease the value.

5.1.13   MEAS MODE Menu

The main menu " MEAS MODE" contains one-page's submenus. Refer to Table 5-13.

Table 5-13   MEAS MODE Menu

NO	Submenus	Details
1-1	TOF	• Set measurement mode; peak/flank; the default is "peak".
		• peak: select highest amplitude within the gate as measurement point.
		• flank: select cross point between first echo within the gate and gate itself as measurement point.
		• Press corresponding submenu selection key or [+/−] key to select measurement mode.
1-2	RECTIFY	• full wave /positive wave /negative wave /rf
		• Press corresponding submenu selection key or [+/−] key to select rectify mode.
1-3	ZOOM	• Used to magnify gate A; Gate A / off; the default is "off".
		• Gate A: magnify gate A to entire echo display area.
		• off: do not magnify Gate A.
		• Press corresponding submenu key or [+/−] key to switch between "Gate A" and "off".
		• **Note: this function can only be used when Gate A logic is not "off".**
1-4	ENVELOPE	• on/off, the default is "off".
		• on: enable envelope function.
		• off: disable envelope function.
		• Press corresponding submenu key or [+/−] key to switch between "on" and "off".

5.1.14   MEAS DOT Menu

The main menu " MEAS DOT" contains one-page's submenus. Refer to Table 5-14.

Table 5-14   MEAS DOT Menu

NO	Submenus	Details
1-1	MEAS-P1	• Select measurement value to be displayed at the lower side of the echo display area.
		• Options: Sa, Sb, Sb-a, Ha%, Hb%, Ha dB, Hb dB, R-start, R-end, La, Lb, Da, Db, Pa, Pb, Ra, Rb, Ha %crv, Hb %crv, DAC dB, AVG dB, off.
		• Press corresponding submenu key to select, then press [+/−] key to select options.
1-2	MEAS-P2	• Refer to "1-1" above.
1-3	MEAS-P3	• Refer to "1-1" above.
1-4	MEAS-P4	• Refer to "1-1" above.

5.1.15 LCD Menu

The main menu " LCD" contains one-page's submenus. Refer to Table 5-15.

Table 5-15   LCD Menu

NO	Submenus	Details
1-1	FILLED	● Switch between filled "on" and "off", the default is "off".
		● on: waveforms display in solid mode.
		● off : waveforms display in hollow mode.
		● Press corresponding submenu key or [+/−] key to switch between "on" and "off".
1-2	SCHEME	● Set the color of the display screen. 6 kinds available; the default is "1".
		● 1: black background, green waveform; 2: white background, dark blue waveform; 3: khaki background, green waveform; 4: black background, yellow waveform; 5: green background, yellow waveform; 6: black background, red waveform.
		● Press corresponding submenu key to select, then press [+/−] key to choose color mode.
1-3	LIGHT	● low/middle/high; the default is "high".
		● Press corresponding submenu key or [+/−] key to switch among the three light modes.
		● **Note: the higher the brightness is, the greater the power consumes, and the working hours will be reduced.**
1-4	SCALE	● Two modes to demonstrate time base: div/sound path, the default is "div".
		● div: display 1-10 scales in the lower side of the screen.
		● sound path: display sound path as time base.
		● Press corresponding submenu key or [+/−] key to switch between the two modes.

5.1.16 CONFIG 1 Menu

The main menu " CONFIG 1" contains one-page's submenus. Refer to Table 5-16.

Table 5-16   CONFIG 1 Menu

NO	Submenus	Details
1-1	LANGUAGE	● Set language of the instrument; Chinese / English; the default is "Chinese".
		● Press corresponding submenu key or [+/−] key to switch between languages.
1-2	UNIT	● Set measuring unit: mm/inch; the default is "mm".
		● Press corresponding submenu key or [+/−] key to switch between units.
1-3	HORN	● Set alarm mode: alarm/off; the default is "off".
		● alarm: sound alarm will act if it satisfies the alarm condition.
		● Press corresponding submenu key or [+/−] key to switch between "alarm" or "off".
1-4	RESTRAINT	● Range: 0%~50%; the default is "0%".
		● To eliminate unwanted waves, such as structural noise from detected material or other clutter waves. Any wave which is lower than restraint value will be eliminated, else remains.
		● Press corresponding submenu key to select; press [+] key to increase or [−] key to decrease the value.
		● **Note: be cautious to use this function, for it may eliminate echoes from flaws. Thus it is not permitted to use in many detection standards.**

5.1.17   CONFIG 2 Menu

The main menu " CONFIG 2" contains one-page's submenus. Refer to Table 5-17.

Table 5-17   CONFIG 2 Menu

NO	Submenus	Details
1-1	PRINT SET	● Select print mode: screen print / data print; the default is "screen print".
		● screen print: print waveform on the screen.
		● data print: print waveform on the screen as well as test parameters, then form test report.
		● Press corresponding submenu key or [+/−] key to switch between the two modes.
1-2	PRINTER	● hp print 1 / hp print 2; the default is "hp print 1".
		● Press corresponding submenu key or [+/−] key to switch between printers.
1-3	DATE	● The format is "yyyy mm dd"; for example: "2011 08 09" means August 9, 2011.
		● Press corresponding submenu key to highlight the digit to be edited; press [+] key to increase or [−] key to decrease the value; press repeatedly to switch among year, month and date.
		● Move the highlighted cursor out unit it disappears to complete data setting.
1-4	TIME	● The format is "hh mm ss"; for example: "14 27 56" means 14:27:56.
		● Press corresponding submenu key to highlight the digit to be edited; press [+] key to increase or [−] key to decrease the value; press repeatedly to switch among hour, minute and second.
		● Remove highlighted cursor unit disappears to complete time setting.

5.2   Special Menus

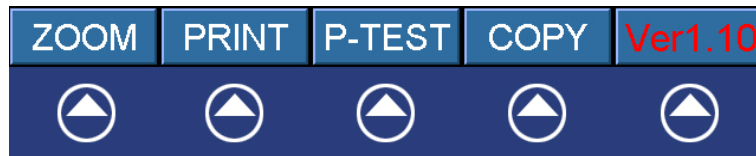The special menus of PCE-USC 20 are as follows, see Figure 5-1.

Figure 5-1   Special Menus

(1) **ZOOM:** press once to zoom in echo zone to entire screen, press again to
        return to original state.
(2) **PRINT:** print the flaw detecting reports or screen waveform, or save data to U
        disk or other storing devices by image format.
(3) **P-TEST:** test echo spectrum features and display. It is available only in the
        condition of "rf" is selected in the submenu "RECTIFY".
(4) **COPY:** copy data to the U disk or other storing devices.
(5) **Ver 1.10:** software update key.
**Note: press [PgUp] and [PgDn] keys at the same time to enter the special
        menus. After inserting the U disk with update software, press the
        corresponding main menu key to enter the updating system.**

Chapter 6　Function Instruction

6.1　Calibration Function

In order to locate tested flaws accurately, parameter calibration must be performed before test to guarantee incident point locates at surface of workpiece (calibrate probe delay and X-value), sound velocity of workpiece matching up to actual value (calibrate workpiece sound velocity), incidence angle of ultrasonic wave accuracy (calibrate incidence angle). For providing customers with convenience in parameter calibration, the instrument can realizes automatic calibration operation automatically.

Calibration principle: the instrument makes sound velocity and probe delay calculations through arrival time (T1 and T2) of two echoes (B1 and B2) with known sound path (S1 and S2).

Taking the CSK-ⅠA test block as an example, we will introduce three kinds of calibration methods as follows.

6.1.1　Auto-calibration of Longitude-wave incident zero point and Velocity of Normal Probe

The specific operation steps are as follows.

(1) Put the normal probe on the test block, and make sure the coupling is good. Refer to Figure 6-1.
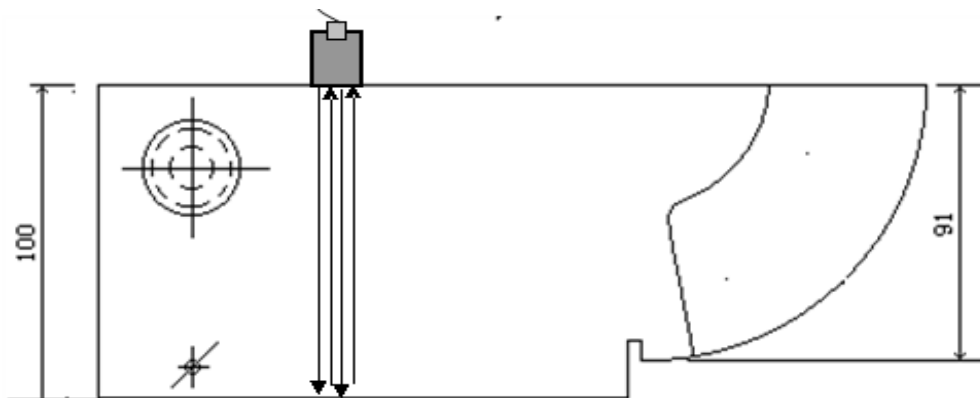

Figure 6-1　Velocity/Delay Auto-Calibration of the Normal Probe

(2) Adjust the test range twice than the workpiece thickness (>200.0mm), sound

velocity 5920m/s, gain appropriate value.

(3) Enter the CAL menu, select: CAL SET: speed/delay; S-REF 1: 100.0mm; S-REF 2: 200.0mm.

(4) Move Gate A to capture the first bottom echo (refer to Figure 6-2). Enter the CAL submenu, and press [+] key to confirm echo 1, then "0" is turned to "1" in CAL submenu.
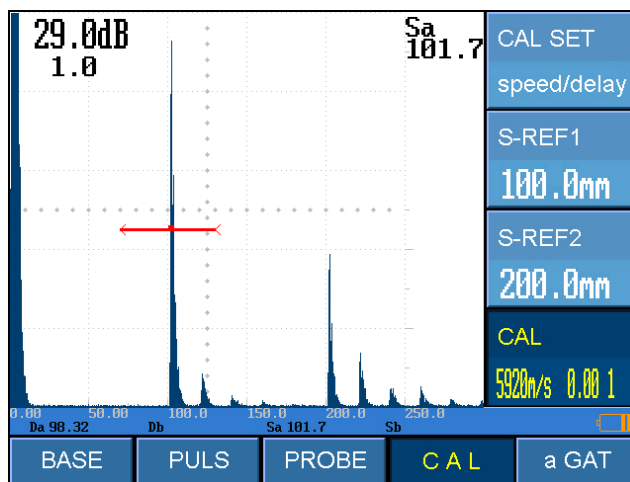

Figure 6-2   Move Gate A to Capture the First Bottom Echo

(5) Move Gate A to capture the second bottom echo (refer to Figure 6-3). Enter the CAL submenu, press [+] key to confirm echo 2 (after "calibration completed" being displayed in the screen, "1" is turned to "0" in CAL submenu), then the delay calibration value will display in CAL submenu and also in P-DELAY submenu.
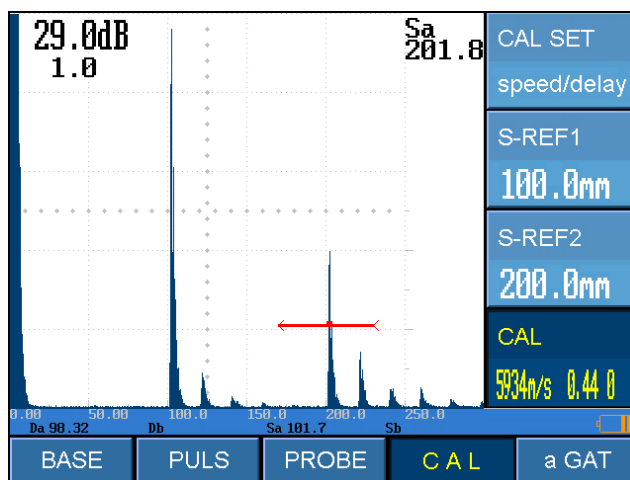

Figure 6-3   Move Gate A to Capture the Second Bottom Echo

6.1.2   Delay Auto-Calibration of Angle Probe

The specific operation steps are as follows.

(1) Put the angle probe on the test block, and make sure the coupling is good. Refer to Figure 6-4.

(2) Adjust the test range to more than 100.0 mm, sound velocity 3250m/s. Adjust gain appropriately. Move the probe to find the highest reflected echo of R50 and R100 arc surface.

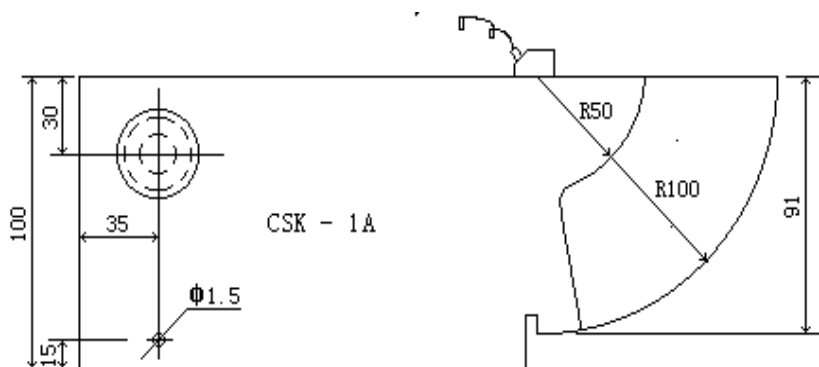(3) Enter the CAL main menu, select "speed/delay" calibration, S-REF 1: 50.0mm; S-REF 2: 100.0mm.

Figure 6-4   Speed/Delay Auto-Calibration of Angle Probe

(4) Move Gate A to capture the echo of R50 arc (refer to Figure 6-5). Enter the CAL submenu and press [+] key to confirm, then echo1 is recorded.
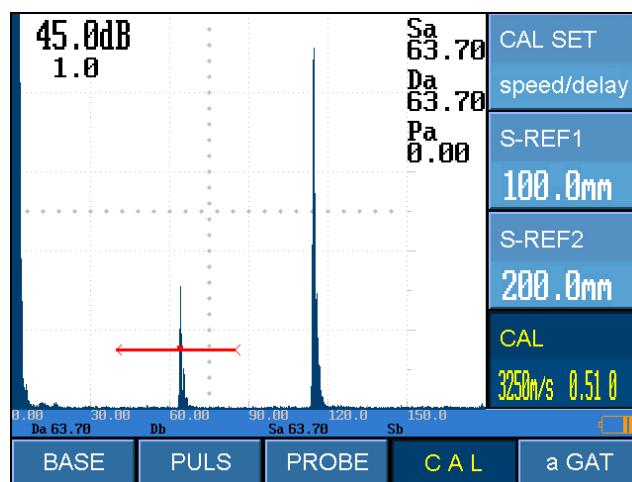

Figure 6-5   Move Gate A to Capture the Echo of R50 arc

(5) Move Gate A to capture the echo of R100 arc (refer to Figure 6-6). Enter the CAL submenu and press [+] key to confirm, then echo 2 is recorded. Meantime,

the actual velocity is calculated and calibrated "speed/delay" is set automatically. After that, the calibration is finished.
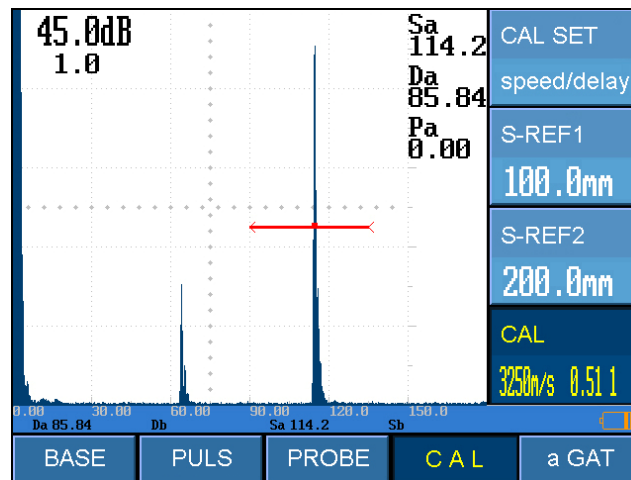

Figure 6-6　Move Gate A to Capture the Echo of R100 Arc

6.1.3　Angle (K value) Auto-Calibration of Angle Probe

The specific operation steps are as follows.

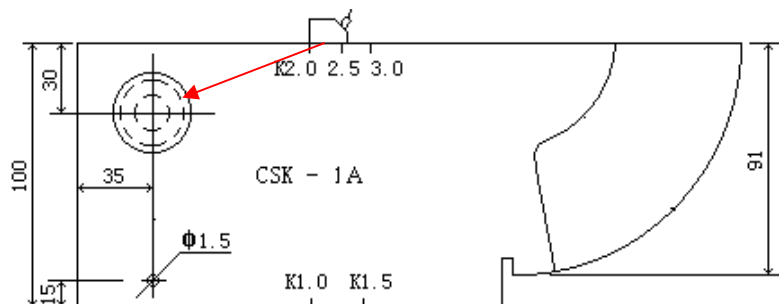(1) Make angle probe tightly coupled on the test block. Refer to Figure 6-7.

Figure 6-7　Angle Auto-Calibration of the Angle Probe

(2) Enter the CAL main menu, choose: CAL SET: angle/ k value; HOLE DEPTH: 30.0mm; HOLE DIAM: 50.0mm. Adjust gain appropriately and move the probe to find the highest echo of ¢50.0mm hole.

(3) Move Gate A to capture the highest reflected echo of ¢50mm hole (refer to Figure 6-8). Enter the CAL submenu and press [+] key to finish calibration, and then the result will be displayed in "angle/K value" submenu.
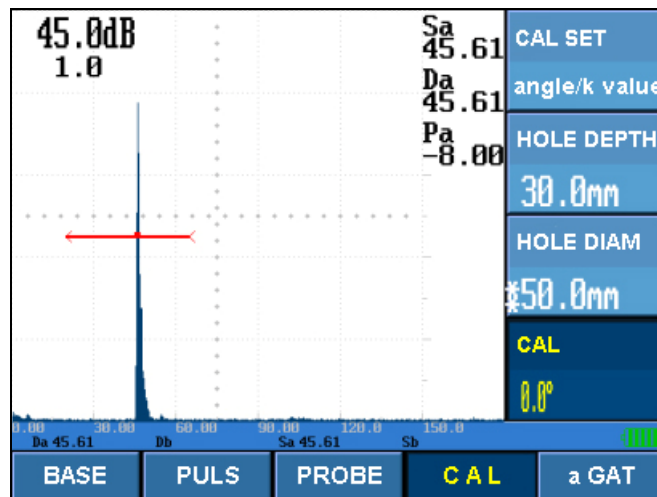
Figure 6-8　Move Gate A to Capture the Highest Reflected Echo of ¢50.0mm Hole

6.2　DAC Function

6.2.1　DAC Making

DAC (distance-amplitude curve) is used for describing the echo amplitude variation of some regular reflector along with distance. As the sound field theory of transverse wave is very complex and immature in flaw detection, distance-amplitude curve is commonly used for flaw quantization and evaluation.

Two points or more is needed to make DAC and ten points at most.

The specific operation steps are as follows.

(1) Enter the DAC menu, choose DAC MODE: record.

(2) Make the probe tightly coupled on the test block CSK-ⅢA. Refer to Figure 6-9.

(3) Put probe in position 1, aim at the first datum hole(10.0mm depth), move probe to seek the highest amplitude (echo 1) of 10.0mm depth hole and adjust gain to set amplitude to 80%. Move Gate A to capture the echo 1 (refer to Figure 6-10), select DAC ECHO and press [+] key, then DAC ECHO 0 changes to DAC ECHO 1.

(4) Put probe in position 2, aim at the second datum hole(20.0mm depth), move probe to seek the highest amplitude (echo 2) of 20.0mm depth hole. Move GATE A to capture the echo 2, select DAC ECHO and press [+] key, then DAC ECHO 1 changes to DAC ECHO 2.
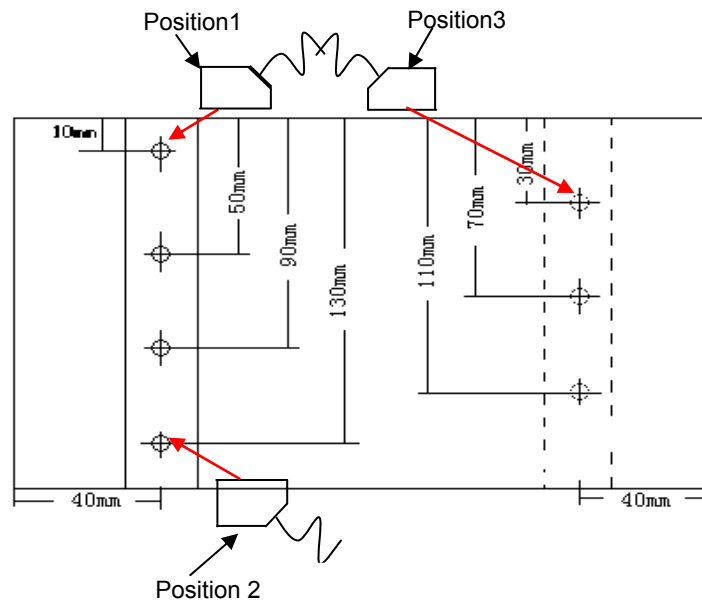
36

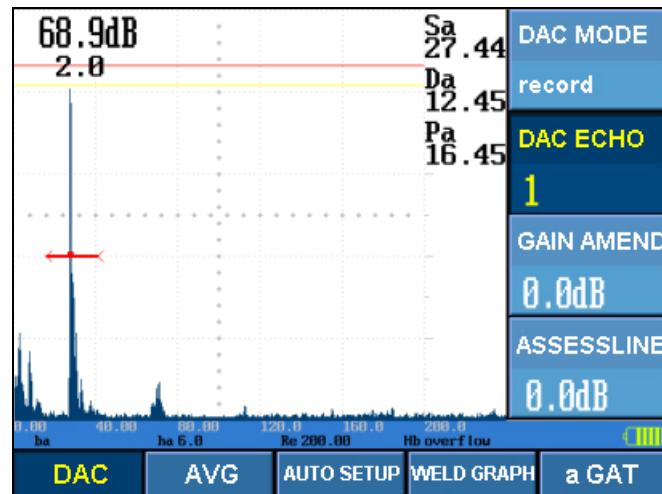Figure 6-9　the Operation Diagram of DAC Recording
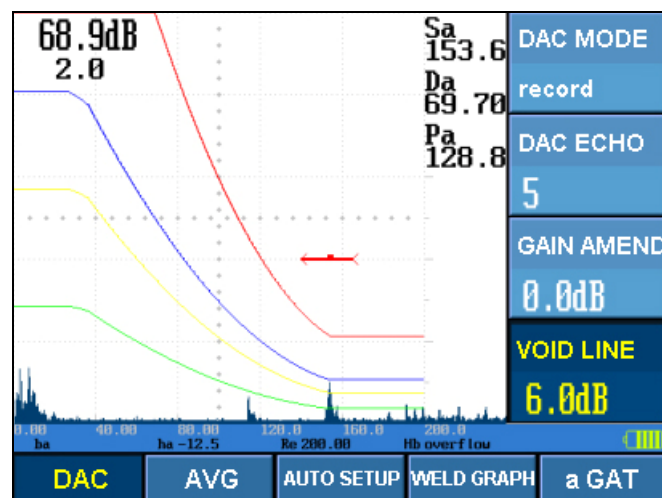

Figure 6-10　the First Section of DAC Curve

Figure 6-11　a Completed DAC Curve

(5) Continues like this until detection depth is enough, finishing curve Making. Refer to Figure 6-11.

Note: ① **there are four curves in the screen (refer to Figure 6-11). The default displaying order from bottom to top are: access line (-9dB), ration line (-3dB), generatrix line (0dB), void line (+5dB). The offset of access line, ration line and void line can be adjust flexibly according to different flaw detect standards.**

② **for convenience, it is permitted to make DAC by staggering the points. For example, firstly use 20mm, 40mm and 60mm depth points to make the DAC, then 30mm, 50mm and 70mm depth points. When all the points are finished, the instrument will reorganize them automatically and make it a complete set of DAC.**

6.2.2   DAC Application

Change DAC mode into dac, then enter DAC application mode.

As DAC is made on test block with highly polished surface, surface compensation must be made according to surface coupling state before flaw detect, input related compensate dB value in "COMPENSATE" submenu.

In DAC application mode, instrument can automatically calculate flaw equivalent and display on upper side of screen as "DAC+**dB".

6.2.3   DAC Amendment

Curve amend: if there is inflexion point on DAC due to hole jamming or unsatisfied coupling, use amend function to make partial adjustment. Change DAC mode into amend, choose the point to be modified, adjust the height of it.

6.2.4   Curve deletion

If you are unsatisfied with the completed DAC curve and you want to delete the all points or some point, you need to select the points you want to delete in the "SAMP POINT" submenu first. After that, press the [◄] key associated with "DELETE" submenu, then it will be deleted by pressing the associated [◄] once again or [+] key once. If you press [+] key for some time, it will delete the all points on the DAC curve.

6.3 AVG Function

6.3.1 Summarize

In ultrasonic flaw detection, the shape, nature and direction of natural flaws are different from each other, flaws with same echoes amplitude actually differ greatly, thus introduce "equivalent size" to evaluate flaws size. Under same detect condition, if the echo amplitude of natural flaw equal to that of regularly shaped artificial flaw, the artificial flaw size is defined as the natural flaw equivalent size. The curve used for describing relations among distance, amplitude and equivalent size of regular reflector is called distance-amplitude-equivalent size curve, in German called AVG, in English called DGS.

6.3.2 AVG Making

Operating Steps: (taking 2.5P20 normal probe, CS-1-5 test block, 200¢2 flat bottom hole as an example).

(1) Set instrument and probe parameters;

(2) Calibrate instrument and probe;

(3) Make the probe tightly coupled on the CS-1-5 block, move probe to seek the highest echo of flat bottom hole, refer to Figure 6-12;

(4) Enter AVG menu, adjust aperture to 2mm, equivalent of reference curve can be set according to requirement (here take 1mm for example). Move gate A to capture flat bottom hole echo, select "COMPLETE", then press [+] key to confirm AVG making. Refer to Figure 6-13.
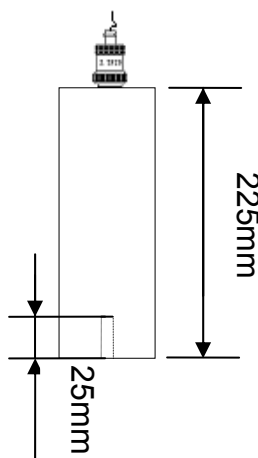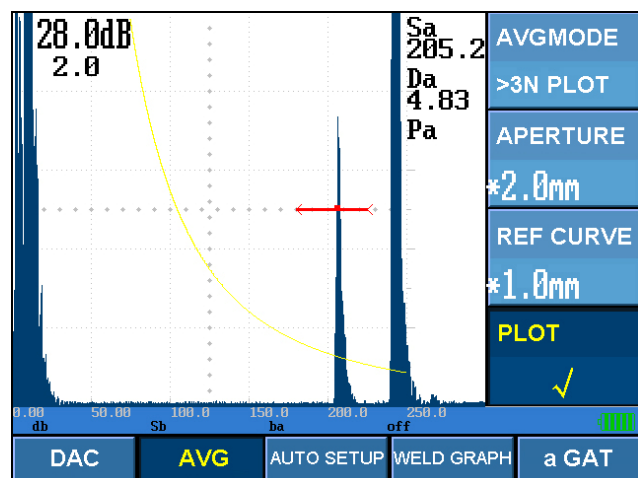

Figure 6-12   the Making Diagram of AVG

Figure 6-13   AVG Waveform Display

6.3.3 Notes

Before Making AVG , you should pay attention to whether probe frequency and crystal size is suitable, whether the probe parameter settings agree with the actual and reference curve range is "0.5~23.5mm, ∞" or not.

6.3.4 AVG   Application

In theory, the AVG curve is effective only beyond the triple near field area. Probes produced by different manufactures have quite different sound field characteristics within tripe near field area, so you should make AVG by sampling multiple points or verifying the test block first; otherwise it may occur unnecessary error easily. The attenuation coefficient between test block and work piece is not considered when using the AVG.

Compensate should be made when coupling condition changes (different surface condition of test block and work piece).

6.4   Envelope Function

6.4.1   Summarize

Envelope means profile of echo peak track when probe moves on workpiece, it is given different color to distinguish from echo itself. According to envelope shape, users can easily find the highest echo and also make qualitative analysis of flaw properties. This function can be used along with "Peak Holding" function.

6.4.2   Operation Steps

Enter main menu "MEAS MODE", adjust Envelope submenu item into "on" state.

6.5   Curve Surface Amend

6.5.1   Summarize

When using angle probe to detect cylindrical surface in circumferential direction, it is difficult to precisely locate the flaw because curve flaw location is indicated by work piece arc length and depth. For convenience, the instrument will make automatically calculation and amendment according to curvature of work piece.

6.5.2　Operation Steps

(1) Enter "AUTO SETUP " main menu;

(2) Select SURF AMEND submenu, press [+/-] key to adjust curvature radius, curvature radius is planar means flat workpiece.

6.6　Welding Graphic Illustration

6.6.1　Summarize

Under welding inspection, use sectional graph demonstrate reflector position and ultrasonic propagation.

6.6.2　Operation Steps

(1) Enter "WELD GRAPH" main menu.

(2) Select weld type: X mode, V mode or close welding graphic illustration function, weld mode means groove mode.

(3) Input weld width value, namely groove width.

(4) Input probe position, namely distance from probe front edge to weld center, it changes along with the probe migration. Therefore input the newest probe position timely when using this function.

(5) Press corresponding key of Refresh menu, instrument make the newest illustrative graph picture as follow. (Refer to Figure 6-14.)
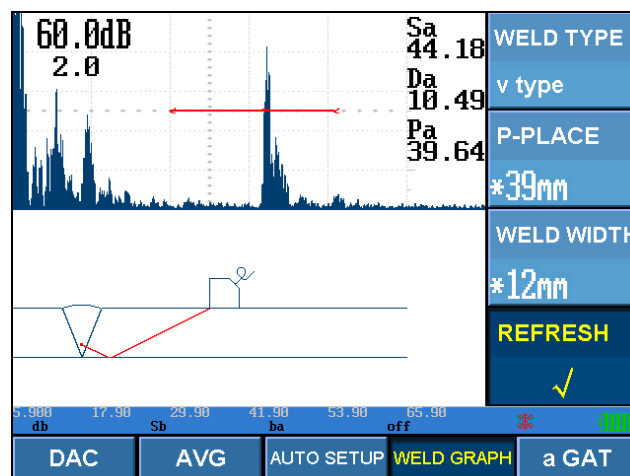

Figure 6-14　Weld Diagram

6.7   Series Store Function

6.7.1   Summarize

It is like video function, can continuously record waveform data in the screen.

6.7.2   Operation Steps

(1) Enter "SERIES STORE" main menu. Refer to Figure 6-15.

(2) Record speed: record picture frames per second, continuously adjustable;

(3) START/STOP: press this key to start or stop record. The record is stored in flash memory, and will disappear after turning off or cut down electricity, so transfer it to U disk timely.

(4) SAVE: press this key to transfer recorded document in U disk or other storage.

(5) REPLAY: play recorded document.

Note: ① the longest time for recording is about half an hour.

② the instrument only store one record document, each record operation will overwrite previous recorded data.
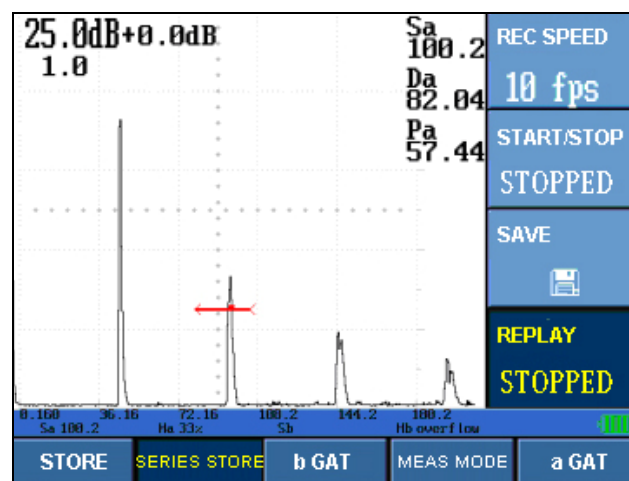

Figure 6-15   Series Store

6.8   Peak Holding

6.8.1   Summarize

When Peak Holding function is on, instrument will automatically catch peak of dynamic echoes within gate, and a purple "×" will be displayed on top of the

maximum echo. This helps to determine the position and amplitude of highest echo in practical flaw detection and probe detection.

6.8.2   Operation Steps

Choose "AUTO SETUP" main menu, press corresponding key of Peak Holding submenu to enable or disable Peak Holding function. When enable, a purple "×" will be displayed on top of the maximum echo inside the gate, if this echo declines, the "×" remains; if it rises or moves, the "×" will move to indicate the position of the new highest point.

6.9   Auto Gain Adjustment

6.9.1   Summarize

Automatically adjust gain so that target echo height be the desired amplitude, this is commonly used in forging test.

6.9.2   Operation Steps

(1) Move gate and capture under tested echo.
(2) Choose "AUTO SETUP" main menu, press Auto Gain submenu related key, instrument makes gain control automatically to adjust the highest echo amplitude within gate reaching 80% height of vertical coordinates (this height can be set in parameters by operator, only need to adjust submenu "AGC").

6.10   Rectification

6.10.1   Summarize

This instrument sets four rectify methods: full-wave, positive rectify, negative rectify, and RF. As to test task, mostly use is full-wave method. But in some special application, choose unipolar rectify or RF will be more available because of different purposes. Choose suitable rectify method for different applications to improve resolution, increase the ratio of signal to noise and sensitivity.

6.10.2 Operation Steps

Enter main menu MEAS MODE, adjust RECTIFY submenu optional item.

6.11 Parameters Store and Recall

6.11.1 Summarize

As many kinds of probes are needed in the flaw detection to meet variable detect conditions. When one kind of flaw detection condition change into another one, lots of parameters need to reset, this will bring troubles on site. This instrument has parameter store and recall function, which allow the user to preserve parameter with high frequency usage in different channel, when changing flaw detect condition, user can directly recall corresponding parameters, this will improve working efficiency and avoid misoperation .

6.11.2 Operation Steps

(1) Enter CHANNEL ID submenu under "STORE" main menu, menu interface as follows. Refer to Figure 6-16.
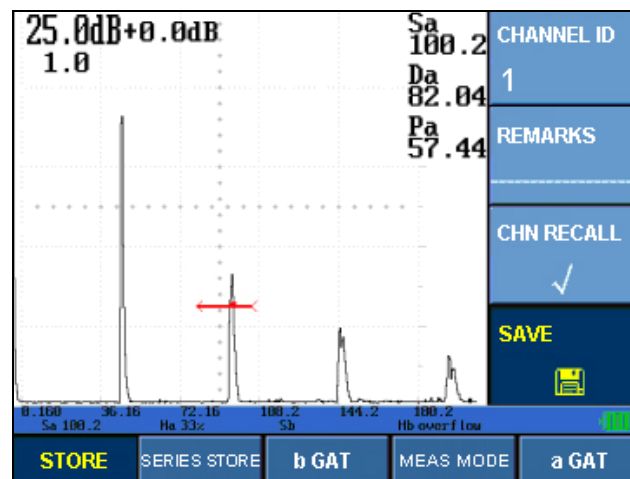

Figure 6-16   Parameter Store and Recall

(2) Press [+/−] key to select CHANNEL ID.
(3) Store: Select SAVE submenu, press [+] key to confirm parameter storage. In front of the channel with storage parameter has "*" mark. On the contrary, it does not have "*" mark for blank channel.
(4) Recall: Select CHN RECALL submenu, press [+] key, then stored detect

44

parameters of current channel is recalled.

(5) Deletion: Select DELETE submenu, press [+] key, then stored detect parameters of current channel is deleted.

Note: as to "SAVE/DELETE" submenu, the default is "DELETE" when there be stored parameters in DATA ID; otherwise the default is "SAVE".

6.12   Data Store and Replay

6.12.1   Summarize

Lots of echo data need to be recorded in flaw detection process, users can keep required echo and data in the instrument as important content of flaw detection report. The data may be directly replayed in the instrument for viewing, also can be kept in computer for unified store through communication interface.

6.12.2   Operation Steps

(1) Enter STORE main menu, select the top submenu DATA ID, menu interface as follows. Refer to Figure 6-17.

(2) Press [+/−] key to select DATA ID.

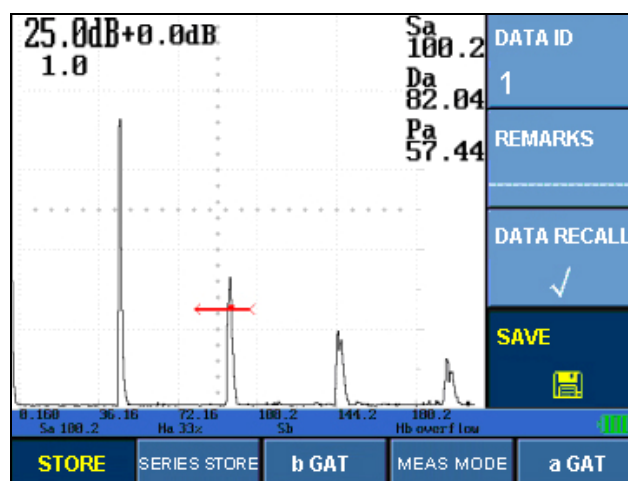

Figure 6-17   Data Store and Replay

(3) Store: Select SAVE sub-menu, press [+] key to confirm data storage. In front of the channel with storage data has "*" mark. On the contrary, it does not have "*" mark for blank channel.

(4) Recall: Select DATA RECALL sub-menu, press [+] key, then stored waveform

data of current channel is recalled.

(5) Deletion: Select DELETE sub-menu, press [+] key, then stored waveform data of current channel is deleted.

Note: as to "SAVE/DELETE" submenu, the default is "DELETE" when there has data stored in DATA ID, otherwise the default is "SAVE".

Chapter 7   Communication and Printing

PCE-USC 20 is equipped with three USB interfaces including A and B type, and can realize the function of communicate with host PC and control serial printer printing flaw detect report . Connect instrument to USB interface of PC, enter special operating software Data View of instrument through PC, thus can begin to communicate.

7.1   Interfaces

Interface Definition:
● PIN-NO Description Signal Direction Level
● 1 USB- USB Low Signal USB
Note: if the communication failure occurs due to abnormal condition, please restart instrument.

7.2   Data Communication

(1) Click "PCE-USC 20 Driver" in installation document, double click "setup.exe" file and complete drive installation.
(2) Then click "Data View" in installation document, double click "setup.exe" file. When installation is finished, a logo of "Data View" will appear on computer desktop.
(3) Turn on the power of instrument, connect instrument with computer, connect method: one end of USB communicate cable connects USB interface of instrument, another end connects any USB interface of PC.
(4) Double click logo of "Data View" on desktop to start software.
(5) The saved images and data are transferred into compute through USB interface, and can be edited/stored/printed by "Data View" software.
Note: if connect instrument for application, please connect the computer and start up communication software after the instrument finish startup.

7.3 Instructions

7.3.1 Menu Structure

It contains five main menus such as "File", "View", "UI Language", "Print Language" and "Video".

(1) "File" menu, refer to Figure 7-1.
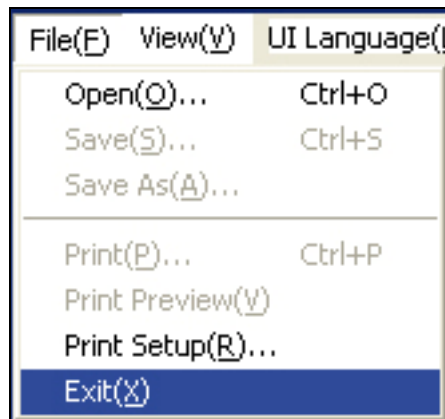
Figure 7-1   "File" Menu

Open: open the data documents in the computer or the records in the instrument.

Save: save modified data to the original file.

Save as: save modified data to a new file.

Print: print the results of the data.

Print Preview: display the effect of print.

Print Settings: set print options.

Exit: exit the software.

(2) "View" menu, refer to Figure 7-2.

Figure 7-2   "View" Menu

Toolbar: show and hide the toolbars.

48

Status Bar: show and hide the status bar.
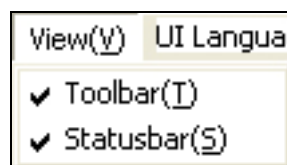

(3) "UI Language" menu, refer to Figure 7-3.

Figure 7-3   "UI Language" Menu

Chinese: change interface language to Chinese.

English: change interface language to English.

(4) "Print Language" menu, refer to Figure 7-4.

Figure 7-4   "Print Language" Menu

Chinese: set print language to Chinese.

English: set print language to English.

(5) "Video" menu, refer to Figure 7-5.

Figure 7-5   " Video " Menu

Start: Start real-time recording.

Stop: Stop recording.

7.3.2   Display Interface Structure

It mainly contains "Waveform Display", "Data Recall", "Config", "Result", "Gate A", "Gate B" and "Information Entry", etc.. Refer to Figure 7-6.
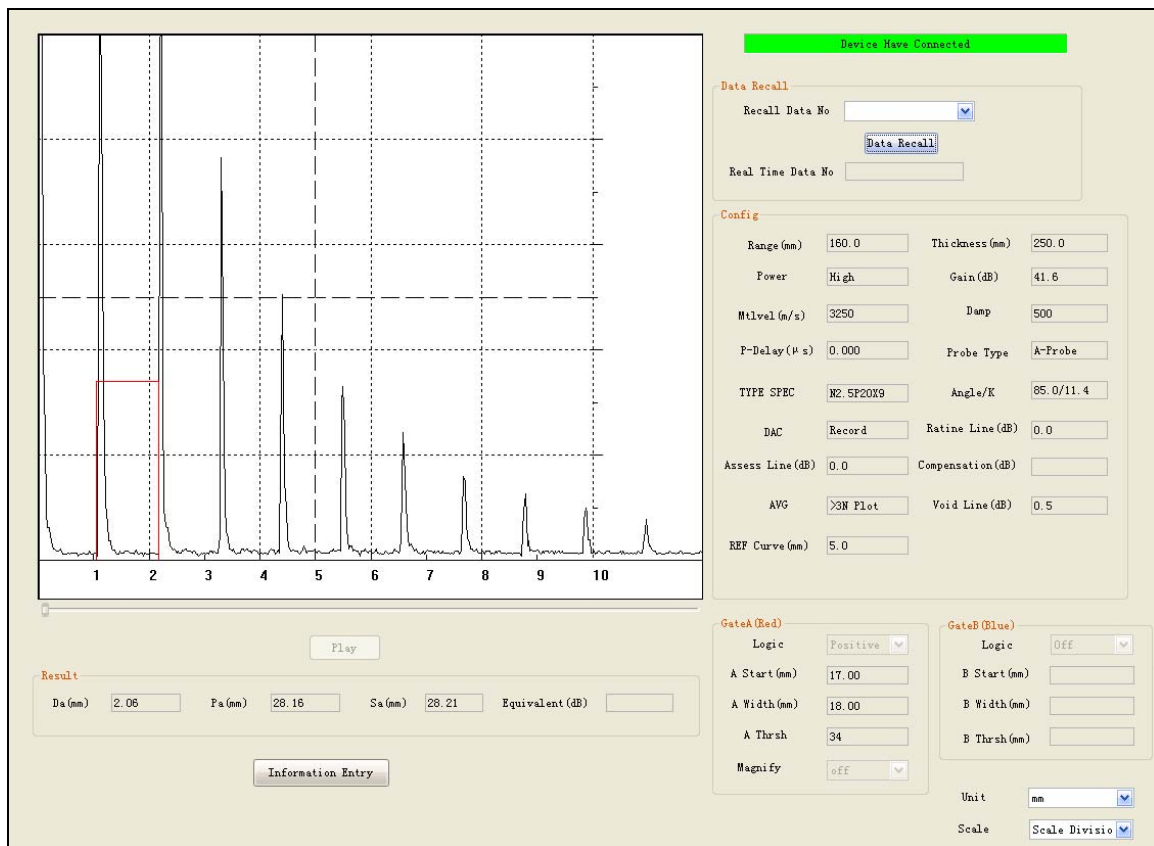
Figure 7-6   Display Interface

(1) Waveform Display

It displays replayed data and video file. If the replayed data contains the Gate A displaying data, you can change the start point, width and threshold of the gate by dragging the mouse. The corresponding results are displayed in the results of Gate A and B.

(2) Data Recall

Select the DATA ID No. to be recalled, click "data replay" to display the data in the DATA ID on corresponding position of the software.

(3) Config

It displays configuration values corresponding to current data ID.

(4) Gate A

It displays start point, width and threshold of Gate A.

(5) Gate B

It displays start point, width and threshold of Gate B.

(6) Information Entry

Click information entry button to fill out relevant content of detection information, refer to Figure 7-7.

Figure 7-7　Input the Test Information

After input, click "OK" button to confirm, then the information will be saved to the file; if you close the window before confirming, it will not be saved.

(7) Unit

Select the unit or change the display unit.

(8) SCALE

Select the display mode of the baseline.

7.4　Test Report

This instrument provides four kinds of information for test reports as follows.

(1) Through "PRINT" menu (Special menu), copy screen graphics and main parameters to U disk.

(2) Through "SAVE" submenu (main menu "STORE"), copy instrument parameters to U disk, and then view them via online software.

(3) In "SAVE" submenu (main menu "SERIES STORE"), transfer dynamic echo recordings to U disk, and then view them via online software.

(4) After the connection between matched USB cable and PC, detection information on the software interface can be part of test report.

Chapter 8   Flaw Evaluation and Influence Factors of the Detection Precision

Please read following information before use PCE-USC 20 ultrasonic flaw detector, acquaint with and abide by related requirements, it is very important to avoid wrong flaw detect results caused by misoperation. Illegal operation also possibly causes personal safety accident or property damage.

8.1   Necessary Condition for Using

(1) Training for the operators.
(2) Knowledge about the requests and limits of the special technical test.
(3) Choose the suitable test devices.

8.2   Training For Operators

Operating ultrasonic inspect facilities requests the operators to receive normal training about the method of flaw detection. Normal training includes following contents:
(1) ultrasonic propagation principles;
(2) influence to test materials sound velocity;
(3) sound wave characteristic of different materials interface;
(4) influence from sound attenuation and surface condition to tested materials.
Lack of these knowledge may cause unforeseeable and wrong flaw detect results, please contact related NDT institutes or our company to obtain information about operators training and grade examination of qualification certificate.

8.3   Technical Requirements for Detection

Specific technical requirements must be followed in every ultrasonic detection, and the most important requirements are as follows:
(1) defining the detection range;
(2) choosing the suitable detection methods;
(3) considering the material characteristics;
(4) deciding the ranges of the record and evaluation.

8.3.1 Detection Range

Signals gained from ultrasonic flaw detection only involves the part of tested material which probe beam covers, conclusions from tested part applies to un-tested part should be cautious. Generally, these conclusions only can be adopted under the condition of proved to be correct by abundant experience and statistical data. Beams can be full reflected form interface inside tested material , flaws and reflection point in deep area maybe not be detected. So it is very important to keep the whole tested part of material covered by the probe beam.

8.3.2 Ultrasonic Wall Thickness Measurement

All of ultrasonic wall thickness measurement are based upon transmit time measurement. Constant sound velocity of tested objects is required for accurate measurement results. Tested materials made by steel (even various kinds of alloy components),changes of sound velocity are very little and it will not influence test precision but for high quality measuring. In other materials (e.g. nonmetal or plastic), changes of sound velocity may be very large, so influence measuring precision.

8.3.3 Surplus Wall Thickness Measurement

For surplus wall thickness measurement to factory facilities (e.g. interior corroded pipeline, vessels and various reaction vessels), a suitable thickness gauge is required, users should especially pay attention to probe's selection and operation. Operators should know related rated surplus wall thickness and possible wall thickness loss.

8.4 Influence Factors of the Detection Precision

(1) Materials of the tested objects
(2) Temperature
(3) Surface roughness concentration
(4) Attachment
(5) Magnetic field
(6) Shape and characteristics of flaw
(7) Acoustic impedance of flaw

(8) Surface characteristics of flaw (e.g. smooth or not)

(9) Optional methods of flaw detection

All of the flaw locating is based upon the measurement of the ultrasonic echo signals. Constant sound velocity is a very important influence factor to test results, so it is required for achieving higher measurement accuracy.

8.4.1 Material Influence

Among tested materials, steel for example, even includes many different kinds of alloying components, its sound velocity is considered to be basically constant. But in many other materials, such as lots of nonferrous metals or plastic, changes of velocity are extremely distinct, thus affect measurement accuracy. If materials of tested objects are not isotropic, sound velocity will be different in different direction. In this case, average value of sound velocity within tested range must be used for calculation. The average value is obtained by calculating the velocity of the referenced test blocks with equivalent velocity to that of the workpiece.

8.4.2 Temperature Influence

Material sound velocity will change along with material temperature. If the instrument is calibrated in a relative low environment temperature but applied in a relative high environment temperature, in this situation the test result will deviate from the actual one. To avoid temperature influence, the methods is to preheat reference tested blocks before instrument calibration to achieve the same temperature with environment for use; or the measurement result will be multiplied by a temperature influence factor.

8.4.3 Surface Roughness Influence

Surface roughness of detected objects affects flaw detection. Influence will increase along with roughness degree increases. The rough surface can cause system error and accidental error, so multimetering is needed to avoid accidental error when testing.

8.4.4 Attachment Influence

It needs to eliminate the attachment before flaw detection so as to make sure that

the probe is directly contact with the tested object.

8.4.5 Magnetic Field Influence

It will disturb the flaw detection seriously by the strong magnetic field generated by the electrical equipment around.

8.4.6 Flaw Evaluation Method

In the present flaw detection, there are generally two different flaw evaluation methods:

- if the acoustic beam diameter is smaller than the flaw size, it can be used to detect the flaw boundary and fix the area.
- if the acoustic beam diameter is bigger than the flaw size, the biggest echo of the flaw should be compared with that of the artificial flaw.

(1) Flaw Boundary Method

The smaller the acoustic beam diameter is, the more precise of the flaw boundary and area are. But if the acoustic beam is relatively wide, the fixed flaw area may be obviously different from the actual one. Therefore, it is cautious for you to choose the probe which can obtain the concentrated acoustic beam as narrow as possible in the flaw area.

(2) Echo Comparison Method

A natural flaw reflection echo is usually lower than that of an artificial flaw (e.g. similar size disc flaw). This situation is caused by rough surface of natural flaw or an unfavorable angle coming out when sound beam transmits onto flaw. If it is not considered in the natural flaw evaluation, there may be risk of underestimating the equivalent value. Regarding irregular or split flaw, for example shrinkage holes in castings, will possibly appear strong acoustic scattering on surface of flaw boundary, thus do not produce any echoes. In this case, different analysis method should be taken, for example using bottom surface echo attenuation method in analysis. Distance sensitivity of flaw echo plays an important role in huge work piece flaw detection. When choose artificial contrast flaws, you should pay attention that these flaws also follow the distance variation rules, same with natural flaws.

Ultrasonic waves will attenuate when propagating in any materials, generally this

kind of acoustic attenuation speed is very small, for example, components made by fine texture steel and other small components made by various materials. However, if ultrasonic waves propagate long distance in material, highly accumulated acoustic attenuation may be produced (even if material acoustic attenuation is very small). This may lead to danger of underestimating natural flaw size, so estimate the influence of attenuation in evaluation and take it under consideration when necessary. If surface of tested objects is rough, a part of incident sound energy will be lost due to beam scattering on object surface, this affects detection. When scattering gets stronger, reflection echo gets lower, leading to bigger errors in evaluation results. So it is very important for the echo amplitude that the surface condition of the tested objects.

Chapter 9   Maintenance and Repair

9.1 Environmental Challenge

(1) Strictly avoid collision, heavy dust, humidity, intense magnetic field, grease dirt.

(2) Forbid cleaning housing with dissolved matters.

9.2 Battery Charge

Battery status on LED screen demonstrates the battery real-time voltage situation. When the battery voltage is too low, namely the battery condition symbol is under voltage status (from green into yellow), you should charge the instrument as soon as possible.

Charging methods are as follows (it can be charged whenever power on or off).

(1) Connect the power plug of the adapter to the charge socket.

(2) Connect the power adapter to 220V/50Hz commercial power, then the charge indicator light (green) turns on.

(3) It needs about 4.5 hours to charge the battery fully.

(4) Pluck the charge plug and it is finished.

Note: ① input voltage of power adapter is 220V AC, output voltage is 15V DC, the maximum charging current is 2000mA, the maximum charging time is 6h.

② PCE-USC 20 is equipped with the Lithium battery. Please charge the battery in time when the under voltage symbol appears. It will damage the battery by over discharge.

③ PCE-USC 20 can work while charging.

9.3 Battery Replacement

Renewal battery method is as following.

(1) Screw off the two fast fixed nuts located in the battery cover at the back of host Equipment.

(2) Remove the battery cover, take out the invalid battery.

(3) Install the new battery according to the original form. (Please aim at the power supply faucet first, and then install slowly.)

(4) Firmly press the battery with hands, turn on the power switch to check if

instrument works normally

(5) If instrument works normally, install the battery cover, screw down fast fixed nuts, then Renewal battery is finished.

9.4   Trouble Elimination

If instrument appears the following irregular working condition:

(1) instrument can not turn on/off automatically;

(2) cannot test;

(3) keystrokes don't work;

(4) measured value inconstant.

Please do not dismantle instrument and repair by yourself. After filling out the maintenance and repair card, post it with equipment to our company maintenance department. It is highly appreciated if you send the equipment along with a brief description about the trouble situation.

9.5   Safety Tips

This instrument design conforms to related security standards, its application must satisfy external environment condition, it is also required for operators to have corresponding technical background to guarantee safe operation. Before application, please read following safety tips.

Note: this instrument is a nondestructive inspection instrument applying to materials inspection, forbidden to use as medical instrument. It is only limited to laboratory and industry environment application.

9.5.1   System Power

This instrument can supply power through external power supply adapter or lithium ion battery. For power supply adapter or battery, please choose recommended products by us. For battery charge and renew please follow reference operating steps.

9.5.2   System Software

Any software could not avoid mistakes, but we try our best to decrease probability of it to minimum. This instrument software has received comprehensive and strict test.

9.5.3   Unexpected Failure

Following abnormal conditions indicate unexpected failure of the instrument, please turn off power supply, take battery out if necessary, send it to assigned service place for maintenance.

(1) Instrument has obvious mechanical damage (for example serious extrusion or collision in transportation);

(2) Instrument keyboard or screen display abnormal;

(3) Storage in high temperature, high-moisture or corrosive environment for long time.

Appendix

Appendix Ⅰ User Guidelines

(1) After users purchase our products, please fill out the "Warranty Registration Card" and affix the official seal. Please mail the First union and purchase invoice copy to our Customer Service Department, or commend the instrument sold unit to mail. Please send the Second union to the local subsidiary company maintenance station to go through registration formalities. If you are in the area out of our maintenance stations, please mail the First union and the Second union together to our Customer Service Department. For incomplete paperwork, provide non-warranty maintenance only.

(2) From the date users purchase our products, if it appears quality fault (except for non-warranty accessories) within the first year, please depend on "maintenance card" (user reserve union) or purchase invoice copy to contact subsidiary company maintenance station in each area for maintenance, within the warranty period, can't bring forth maintenance card or purchase invoice copy, We will calculate the warranty period in accordance with factory warranty for a period of one year.

(3) Beyond warranty period, failure of our product, service stations around responsible after-sale service provide repair and maintenance service and fees charged according our maintenance regulations.

(4) Except finalized products, "special configuration" (peculiar type probe, special software, etc) charges cost according to company regulations.

(5) User-disassembly of our products, due to transportation, improper storage or incorrect operating contrary to "product manual" resulting in product damage, as well as secretly altered the warranty card, without purchases certificate, under these conditions warranty un-supported by our company.

Appendix Ⅱ   Range and PRF

Range (L)	PRF
L＜125mm	40Hz/250Hz/1000Hz
125mm≦L≦1400mm	40Hz/250Hz
L＞1400mm	40Hz

Appendix Ⅲ   Interfaces

PCE-USC 20 is equipped with three USB interfaces including A and B type, and can realize the function of communicate with host PC and control serial printer printing flaw detect report . The definition of interfaces is as follows.

Interface definition:

Pin NO.	Instruction	Input/ Output	Type
1	USB	Output	USB
2	ALARM	Output	TTL

Appendix Ⅳ Definition of Measurement Point Data

Data	Definition
Sa	Sound path of first echo inside Gate A
Sb	Sound path of first echo inside Gate B
Sa-b	Sound path difference between first echo inside Gate A and Gate B
Sa-a	Echo spacing inside Gate A
Ha%	Amplitude of highest echo inside Gate A (in percentage)
Hb%	Amplitude of highest echo inside Gate B (in percentage)
Ha dB	Difference between amplitude of echo measurement point inside Gate A and gate threshold (in dB)
Hb dB	Difference between amplitude of echo measurement point inside Gate B and gate threshold (in dB)
R-start	Starting position on the screen, that is, "DISP DELAY" settings
R-end	Ending position on the screen, that is, actual value of " range"
Da	Depth from the test-piece surface (the probe-contacted side) to the reflector represented by the first echo in Gate A
Db	Depth from the test-piece surface (the probe-contacted side) to the reflector represented by the first echo in Gate B
Pa	Projection distance from the probe's front edge to the reflector represented by the first echo in Gate A
Pb	Projection distance from the probe's front edge to the reflector represented by the first echo in Gate B
Ra	Projection distance from the probe's beam incident point to the reflector represented by first echo in Gate A
Rb	Projection distance from the probe's beam incident point to the reflector represented by first echo in Gate B
DAC dB	dB difference between echo magnitude inside the gate and rating line of DAC
AVG dB	dB difference between echo magnitude inside the gate and rating line of AVG