CTS-30A
CTS-30B
CTS-30C

Digital Ultrasonic Thickness Gauge

SIUI

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NOTE

This operation manual shall apply to the CTS-30A/CTS-30B/ CTS-30C digital ultrasonic thickness gauge. For the differences of the two models on functions and specifications, see Appendix C-1. *The* compilation of this operation manual is based on the model CTS-30A, and the parameters and the operation shall apply to the CTS-30A. As the operation of the CTS-30B/ CTS-30C is compatible with the CTS-30A, for additional functions and operation, see Appendix B and Appendix C.

Table of Contents

DCY2.781.30A/30B/30CSS/V1.3/D-E

1 . General

The digital ultrasonic thickness gauge CTS-30A, adopts micro-processor technology and advanced manufacture process design, can do measurement of thickness and velocity on metal and many materials based on ultrasound measurement principle and the configuration of dual-element thickness gauge probes. Measurement features, such as high sensitivity, good detectability, multiple measurement modes, are available on the system, more features such as multi-language menus, data storage, computer communication and compact structure can be found on the unit. It is suitable for ultrasound thickness measurement in machinery, chemical, ship building, aeronautical and aerospace industries.

2 . Main Specifications

2.1 Display Method:

128X64 pixels, LCD with backlight

2.2 Display Digit:　4

2.3 Measurement Range:

0.8mm~300.0mm (steel)

2.4 Testing Error:

(Display error with standard configuration probe)

0.80mm ~ 9.99mm	± 0.05mm
10.00mm ~ 99.99mm	± (1‰H + 0.04) mm
100.0mm ~ 300.0mm	± 3‰H mm

Note: H is the measured thickness value.

2.5 Display Value Accuracy:

0.01mm / 0.1mm　or　0.001inch / 0.01inch

2.6 Velocity Range:

1000m/s~9999 m/s

2.7 Measurement Period:

2 times/second for general scan

2.8 Compatible Probes:

TG5-10 (standard configuration)

2.9 Pipe Wall Thickness Measurement:

Measurable for diameter not less than 20mm and wall thickness not less than 2.0mm.

2.10 Adjust Method:

Auto adjust with the configured standard test block on the system. Custom adjust

2.11 Menu Language:

English, French, German, Spanish, Portuguese, Russian, Czech, Swedish and Hungarian.

2.12 Storage Function:

Store up to 5000 sets of measurement data and 100 sets of parameter data

2.13 Power Supply:

2 size AAA batteries, operation for not less than 30 hours

2.14 Auto Shutoff Time:

Turn off after 1/ 2/ 5 minutes (optional)

2.15 Operating Environment:

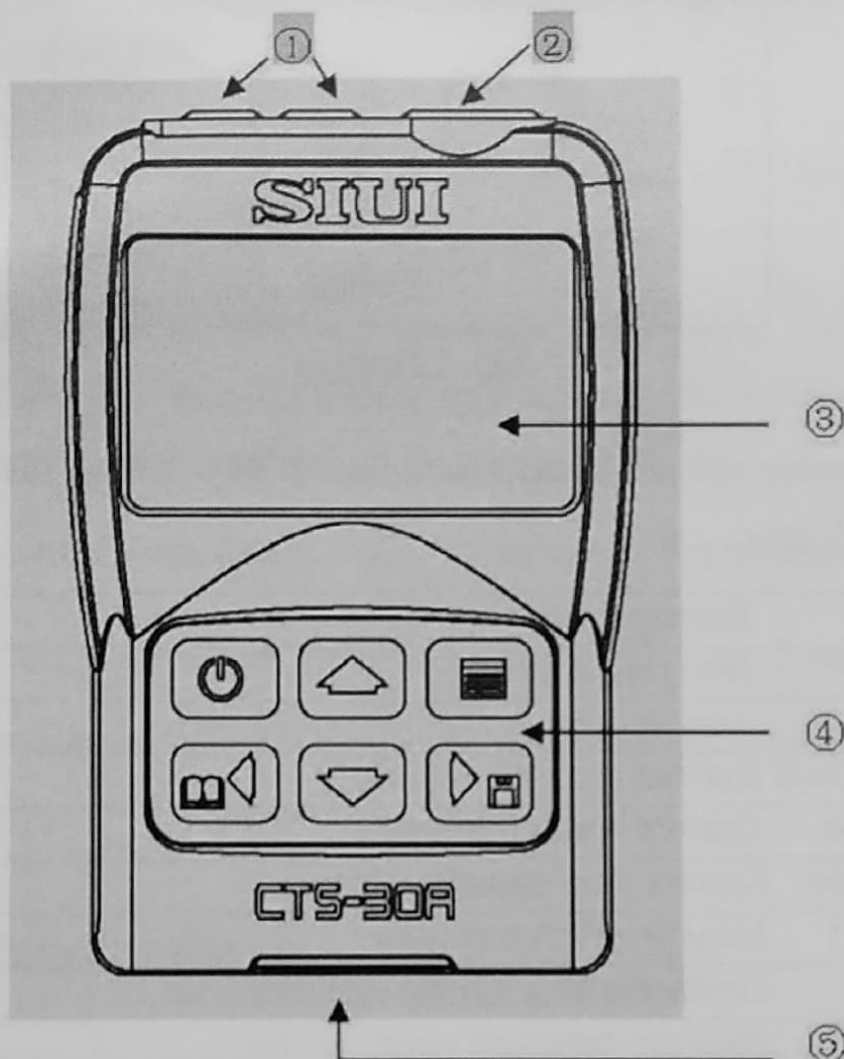Operating temperature: -10℃ ~ 40℃

Storage temperature: -20℃ ~ 70℃

2.16 Dimension:

Main unit (W×H×D) 65mm×98mm×24mm

2.17 Weight:

Approx. 120g (including batteries).

3 System Appearance and Display

① Dual probe socket   ② Test block

③ LCD   ④ Keypad

⑤ USB port

Fig. 1 CTS-30A System Appearance

3.1 System Appearance

The CTS-30A system appearance is shown in Fig. 1.

3.2 Display

Fig. 2 Display

The display content of LCD is shown in Fig. 2. The descriptions are as follow:

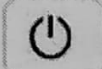|		
1) ☼		Backlight indicator
2) ⊥		Measure coupling
3) ▭		Low voltage
4) 5920m/s Current acoustic velocity		
5) 5MHz		Current probe frequency
6) D0000		Current data storage address
7) 10.01		Measured value display
8) H/L		Limitation after setting high/low limit
9) 3		Average measure point number
10) mm/in		Measurement Unit
11)STD/MIN/AVG/DIFF	Standard/ Minimum/ Average/ Difference measurement	
12) — Displays when measurement is difference (DIFF) and the measurement value is lower than the set reference thickness.		

4 Operation

4.1 Power on

Press ⏻ for 1 second to turn on the system, and it displays

1) Logo

2) When it enters measurement state, it displays: 0.0mm or 0.00mm (0.00in or 0.000in is selectable), velocity value, the selected probe and the current storage address.

In menu setup state, press ⏻ to return to the measurement state. When powered on, press and hold ⏻ for 2 seconds, and the system will store the current parameter settings and turn off.

4.2 Measurement

Two methods for entering measurement state are available:

1) Power on the system and it enters the measurement state.

2) After menu operation, press ⏻ to enter the measurement state.

4.3 System Adjust

After replacing the probe or when errors are found in measurement, please adjust the system.

4.3.1 Auto Adjust

1) Measure the test block provided on the system.

2) Press ▼ and if the probe is not coupled, the system displays **Put on the probe and repeat.**

3) If the probe is in good coupling, the system displays **Adjust completed!** and the buzzer beeps to prompt. Then the adjustment is finished.
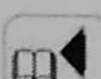
NOTE: Please use the equipped test block for auto adjust, so as to ensure measurement accuracy.

4.3.2 Custom Adjust

If velocity or thickness of the tested work piece is known, second adjust can be done by using Custom Adjust function.

1) Press ▦ to enter the menu.

2) Press ▲ or ▼ to select **Custom Adjust** items:

3) Press ▶▤ to enter the item and it displays: **"1 Point"**.

Press ▶▤ to enter the selected item.

4.3.2.1 1 Point Adjust

1) Press ▶▤ to enter the item and display thickness value of the test block.

2) Press ▯◀ or ▶▤ to move the position of the triangle symbol and select different revised position. Press ▲ or

▼ to change the data of the triangle symbol's indicated position.

3) Press ▦ to enter normal measurement state. If the probe is not coupled, the system displays *Put on the probe and repeat.* If the probe is in good coupling, adjust is done according to the set thickness value and the buzzer beeps to prompt.

NOTE: The measurement accuracy after performing 1 Point Custom Adjust function depends on the accuracy of the known thickness of the work piece. The optimal measurement accuracy is achieved if testing the same material within the thickness range of ±10%. In addition, the test block and the tested block should have the same material and the similar temperature.

4.4 Built-in Status Display and Operation

Many built-in functions are available on the system.

Press ▦ to go to the menu, and press ▲ or ▼ to select:

1. Velocity	2. Probe
3. Precision / Unit	4. Custom adjust
5. Arithmetic	6. Average point
7. Memory	8. Limitation
9. Overload horn	10. Language
11. Shutdown	12. To default

13. Communication   14. About

Press ▶🖫 to go to the selected content.

4.4.1 Measurement Arithmetic

When in **Arithmetic**, press ▶🖫 to select the desired Arithmetic.

1. Standard

2. Minimum

3. Average

4. Difference

4.4.1.1 Standard

When **Standard** is selected, a symbol **STD** is displayed on the bottom left of the screen. The system will measure and display following the general measurement method. This method is suitable for general measurement requirement.

4.4.1.2 Minimum

When **Minimum** is selected, a symbol **MIN** is displayed on the bottom left of the screen, and the displayed data is the minimum value of multiple measurements with consecutive effective coupling.

This testing method is suitable for corrosion surface measurement or environment required for minimum measurement.

4.4.1.3 Average

When **Average** is selected, a symbol **AVG** is displayed on the bottom left of the screen, and the displayed data is the average value of multiple measurements points.

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An average function for 2 to 9 points of measured values is available. Set the point number for average measurement, and the system will run this function.

1) Press ▦ to enter the menu.

2) Press ▲ or ▼ to select **Arithmetic**.

3) Press ▶▤ to enter the option.

4) Press ▲ or ▼ to select **Average**.

5) Press ▦ to confirm. Now the set measurement point number is displayed on the left of the measurement value. When performing this function, the steps are as follows:

a) Measure the object to be measured and ensure that the measurement is good. The current measurement value and the measurement point number will be displayed on the screen.

b) Move the probe away and the system confirms this measurement, the measurement point number is added by 1 and displayed.

c) Repeat steps a and b. When the measurement point number has been added up to the set average number, the system will calculate the average value automatically and display it, and the buzzer beeps once to prompt.. Now the average measurement is completed.

4.4.1.4 Difference

When **Difference** is selected, a symbol **DIFF** is displayed on the bottom left of the screen, and the displayed data is the difference

between the measurement result and the set reference thickness. The reference thickness can be set in *Limitation* of the function menu. See 4.4.6.

4.4.1.5 Average Point

In *Average point* item, press [▶🖫] to enter and press [▲] or [▼] to change the average point value. When Arithmetic is Average, the current measured point value is display at the top left of the screen, and the average point value is displayed in the measurement result area.

4.4.2 Velocity

Press [▶🖫] to enter velocity state, which displays:

1. Vel Setting
2. Vel Measuring

Press [▶🖫] to go to the selected option.

4.4.2.1 Vel Setting

If the velocity of material is known, the user may use the velocity manual adjustment function to adjust the built-in velocity with reference to velocity values in the appendix.

1) Press [📖◀] or [▶🖫] to change the position of the triangle symbol and select different change positions.

2) Press [▲] or [▼] to change the data that the triangle symbol points at.

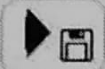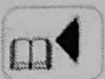3) Press [▤] to confirm change of data and save the

changed data.

4.4.2.2 Vel Measuring

If the velocity of material is unknown, the user may calculate the material velocity with the provided velocity measurement function.

NOTE: When using this function, please prepare a test block with the same quality of the material to be tested and with known thickness.

The specific steps are as follows:
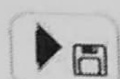
1) Under the current system state, measure the prepared test block (this step is very important for the precision of velocity calculation).

2) Press ▶🖫 to enter the selected velocity measurement state, and it will display the thickness of the test block.

3) Press 🔲◀ or ▶🖫 to change the position of the triangle symbol and select different change positions. Press 🔺 or 🔻 to change the data that the triangle symbol points at.

4) Press 🔳 to enter **Vel Measuring** mode and the screen displays the measured velocity value. Press 🔻 key may set the the measured velocity value as current system velocity.

5) In the **Vel Measuring** mode, press ⏻ to enter normal measuring mode and press 🔳 to enter the menu.

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4.4.3 Probe Select

The user may set up probe state according to Section 5.3 and the actual measurement requirement.

1) Press [icon] to enter the menu.

2) Press [up arrow] and [down arrow] to select Probe.

3) Press [icon] to enter that option:

1. **NORMAL 5.0MHz**: The standard configured TG5-10 probe.
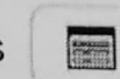
2. **OTHER**: When used with any probe from other manufacturers, it cannot make sure that the measurement range and accuracy up to the level of the TG5-10 probe.

4) Press [up arrow] and [down arrow] to select the required probe.

5) Press [icon] to confirm the option.

4.4.4 Precision / Unit

The user can select the measurement precision and format to be displayed based on actual situation. If high precision is selected, to acquire precise data, the surface on the work piece to be measured has to be smooth.

1) Press [icon] to go to the menu.

2) Press [up arrow] and [down arrow] to select **Precision / Unit**.

3) Press [icon] to enter the option:

   1. 0.1 MM

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2. 0.01 MM
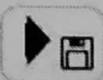
3. 0.01 IN

4. 0.001 IN

4) Press ⬆ and ⬇ to select the required item;

5) Press ▦ to confirm.

4.4.5 Memory

To store the setup item, Press ▶🖫 to go to **Memory** and it displays:

1. Data Addr
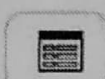
2. Data Clear

3. Param Addr

4. Param Clear
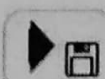
4.4.5.1 Data Addr

The thickness gauge provides 5000 sets of storage space, and the data storage address can be set. The address setup positions are: 0000~4999.

1) Press ▦ to enter the menu.

2) Press ⬆ and ⬇ to select **Data Addr**.

3) Press ▶🖫 to enter the option.

4) Press ▣◀ or ▶🖫 to change the position of the triangle symbol and select different change positions. Press ⬆ or
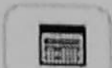
to change the data that the triangle symbol points at.

5) Press 🖼 to confirm.

4.4.5.2 Data Clear

The user may clear the storage content in the memory.

1) Press 🖼 to enter the menu.

2) Press ▲ and ▼ to select **Data Clear**.

3) Press ▶🖫 to enter the option. At this moment, the screen displays two 4-digit numbers. These two numbers are the start and end addresses of the records to be cleared.

4) Press 📖◀ or ▶🖫 to change the position of the triangle symbol and select different change positions. Press ▲ or ▼ to change the data that the triangle symbol points at.

5) Press 🖼 to confirm. The system will clear the records from the start to the end addresses. At this moment, the screen displays **Wait please...**
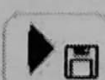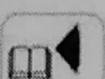
4.4.5.3 Param Addr

The thickness gauge provides 100 sets of storage space for parameters (system setup), and the data storage can be set via the address setup. The address setup range are: 00~99.

1) Press 🖼 to enter the menu.

2) Press ▲ and ▼ to select **Param Addr**.

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3) Press ▶🖫 to enter the option.

4) Press 🕮◀ or ▶🖫 to change the triangle symbol location and select different locations to be changed. Press ▲ or ▼ may change the data that the triangle symbol pointing at.

5) Press ▦ to confirm.

4.4.5.4 Param Clear

The user can clear the parameter storage content.

1) Press ▦ to enter the menu.

2) Press ▲ and ▼ to select **Param Clear**.

3) Press ▶🖫 to enter the option. At this moment, the screen displays two 4-digit numbers, which are the start and end addresses to be cleared.

4) Press 🕮◀ or ▶🖫 to change the triangle symbol location and select different locations to be changed. Press ▲ or ▼ may change the data that the triangle symbol pointing at.

5) Press ▦ to confirm. The system will clear the memory from the start address to the end address. At this moment, the screen displays **Wait please...**

4.4.6 Limitation

Low limit, high limit and reference value (used in DIFF measurement) can be set on the system for quick measurement.

1) Press ▣ to enter the menu;

2) Press ▲ and ▼ to select **Limitation**.

3) Press ▶▣ to enter the option.

4) Press ▣◀ or ▶▣ to change the triangle symbol location and select different locations to be changed. Press ▲ or ▼ may change the data that the triangle symbol pointing at.

5) Press ▣ to confirm.

NOTE: The limit range of high/low limit setup is 0.8 mm~299.99 mm.

4.4.7 Overload Horn

When the measured data is over the set high/low limit, **Overload horn** can be selected. If **Sign+Sound** is selected, the system alarms and displays **L** or **H**, which indicates that it is below the low limit or above the high limit. If **Sign** is selected, the system displays **L** or **H** but does not alarm. If **Off** is selected, the system does not alarm or display.

1) Press ▣ to enter the menu.

2) Press ▲ and ▼ to select **Overload Horn**

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3) Press ▶🖫 to enter the option.

4) Press ▲ and ▼ to select the desired option.

5) Press ▦ to confirm.

4.4.8 Communication

The system transfers the data from the USB connector to a PC. With this function, the stored data sets and parameter saved in the system can be transferred to a PC, and the user can edit a report or store the original data.

Run the communication software, connect the system to a PC with the communication cable. The PC will receive data automatically and work out a file (*.TXT). Operations step is as below:

1) Press ▦ to enter the menu.

2) Press ▲ and ▼ to select **Communication.**

3) Press ▶🖫 to enter the option.

4) Press ▲ and ▼ to select **Data** or **Parameter** transmission. Press ▶🖫 to enter the option.

5) Press ▲ and ▼ to select the start and end addresses of the transferred data.

6) Press ▦ to confirm.
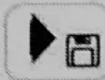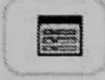
At this moment, the system has entered standby mode to transmit the data.

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Click *Transmit* button on the communication software to build up connection between the system and the PC, and start to transmit the data. At the same time, the process bar at the bottom of the list box displays the transmission process. When the transmission is finished, data will be automatically displayed in the list box in a readable format. Press **Save** to input the file name and store the transmitted data in the text file.

NOTE: Correct address for transmitting should be selected because address only corresponds to the stored data.

4.4.9 Language

If the thickness gauge is sold in Mainland China only, Chinese language is provided. For sales outside Mainland China, English, French, German, Spanish, Portuguese, Russian, Czech, Swedish and Hungarian are available.

1) Press ▦ to enter the menu.

2) Press ▲ and ▼ to select **Language**.

3) Press ▶▣ to enter the option.

4) Press ▲ and ▼ to select the required language.

5) Press ▦ to confirm.

4.4.10 Shutdown

1) Press ▦ to enter the menu.

2) Press ▲ and ▼ to select **Shutdown**.

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3) Press ▶🖫 to enter the option.

4) Press ▲ and ▼ to select the required time for shutdown. Within this period, if the user does not press the button and the probe without coupling, the system will auto shut down. If the user select **Off**, the system will close the shutdown function.

4.4.11 To default

If there is any problem in setting the system, the user can select **To default** and the system will return to factory default setup automatically.

1) Press 🖩 to enter the menu.

2) Press ▲ and ▼ to select **To default.**

3) Press 🖩 to default and the screen will prompt

   completed.

4.4.12 Last reading

Hold: When the coupling is lost, the measurement reading remains at the value of the last coupling state.

Off: When the coupling is lost, the measurement reading is cleared.

Note: Since the last reading disappears in a way that conflicts with the measurement algorithm- AVG, when using AVG for measurements, the last reading should be manually changed to Hold.

4.5 Data Storage Function
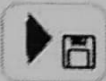
In normal measurement state, based on the preset start address for data/parameter storage in Section 4.4.5, the user can press ▶🖬 to store the measured data/parameter according to the measurement result. The storing address will increase by 1 in order. When the parameter address has added up to 99, it will return to 00 and continue to increase. When the data address has added up to 4999, it will return to 0000 and continue to increase.

NOTE: Only when it is in good coupling (the coupling symbol ⊥ displays), measurement data/parameter can be stored by pressing ▶🖬 key. If some address has stored records, press ▶🖬 again to cover the previous stored records.
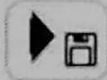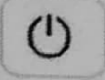
4.6 Data Read and Recall Function

In normal measurement state, the users can press 📖◀ to read stored records.

1) If there is no stored record, the screen displays **No Memory**.
2) If there are stored records, the screen displays data address, velocity and measured thickness. Press 📖◀ and ▶🖬 to turn the page. Press ▲ and ▼ to select different records.

At this moment, press ⏻ to return to normal measurement

state. For parameter storage record, press ▣ may read detailed parameters of the record. Press ▣ again may recall the record and the system will automatically make the record as the current parameter settings. Press ◀ or ▶ to turn pages. Press ⏻ to return to normal measurement sate without recalling the record.

4.7 Backlight Function

Backlight function is available on the system for reading the measured values in dark place. Save the battery power supply, if possible.

In measurement display state, Press ▲ to turn on the backlight, and a backlight indicator ☼ is displayed on top left of the screen.

Press ▲ again to turn off the backlight, and the indicator ☼ disappears.

5 Preparation before Thickness Measurement

5.1 Material Velocity

Before measuring thickness of work pieces with the system, follow Section 4.4.2.1 on setting acoustic velocity of materials. If the material velocity is unknown, follow Section 4.4.2.2 to carry out measurement on unknown acoustic velocity.

5.2 Pre-process of Work Piece Surface

The surface status of work pieces, such as roughness, painting layer and cinder, may result in errors in thickness measurement. Therefore, research on the work piece surface and necessary process, such as polishing with relieving tool, grinding wheel or steel brush should be done before thickness measurement.

The system has good sensitivity and detectability. Requirement on work piece surface status is low. Even for a work piece with 12.5µm roughness or with a little cinder and painting layer, it can do the measurement well. It is very convenient for field application.

5.3 Selection of Probes and Coupling Gel

Before measurement, select the suitable probe based on specific requirement. The system configured TG5-10 probe is for general

use. When compatible with probes from other manufacturers, measurement range and accuracy can not make sure to reach the standard as compatible with TG5-10 probe.

When doing measurement, apply coupling gel between the probe and the work piece. Use machine oil for general work piece. When measuring wall thickness of pipe with small diameter or a work piece with rough surface, use coupling gel with good viscosity (e.g. glycerol) to ensure stable coupling.

6 Measurement Method

6.1 General Measurement

6.1.1 Single Measurement

Measure each measurement point once. It is for new work piece or work piece with low erosion. Usually, it works for situation when non-parallelism between the measured surface and the inner surface is less than 1/4 wavelength (for the standard configuration probe, the non-parallelism should be less than 0.3mm)

6.1.2 Twice Measurement

For each measured point, measure once respectively before and after changing the dual probe interface based on 90°. The smaller display value is the measured value.

6.1.3 Multiple Point Measurement for Diameter of 30mm

Use this method for terrible erosion or doubtful measurement result. Centered against a measured point, carry out multiple point

measurement within a circle with diameter of 30mm. Among the multiple point measurements, the smallest display value shall be considered as the measured value.

6.2 Continuous Measurement

Use single point measurement to do measurement continuously along a specified trace, with spacing not less than 5mm. Choose the minimum value as the thickness of the measured target. Use this method when the erosion is in line shape, and it is difficult to discover part of the terrible erosion.

6.3 Pipe Wall Measurement

When doing measurement, the separation surface of the probe can measure along the axis of the pipe or the axis normal to the pipe.

If the pipe diameter is big, measure in the direction normal to the axis; if the pipe diameter is small, measure in two directions, move the probe slowly and choose the minimum value as the thickness.

7 Maintenance

The system is a precision electronic device. Maintenance is required for daily use.

7.1 Power Check

When the battery is in low voltage, a low voltage indicator " ▭ " is displayed at bottom right. At this time, change new batteries as required to ensure measurement precision.

As there is high battery consumption for the backlight, it is better not to turn on backlight for a long time.

If the system is not for use for a long period, take out the batteries.

7.2 System Maintenance

Do not throw or drop the system. It is harmful for the system to work in environment with high temperature or humidity. If it is not for use, store it in a dry place. Do not drip any liquid or erosive gas into the system.

After use, clean the system with cotton soaked with absolute alcohol and keep it clean.

If a problem is found on the system, check the power supply first. If it is not a power supply problem, do not disassemble the system at will. Contact SIUI or our authorized distributor immediately or send it to the specified location for service.

7.3 Probe Maintenance

Do not throw, drop or pull the probe forcibly. When using the probe, hold the metal section of the cables if plugging or unplugging the two cables of the probe to avoid probe disconnection.

During field operation, avoid rubbing the probe on a coarse surface to prolong the probe life.

After using the probe, remove the coupling gel on the probe immediately and keep it clean.

Appendix A:　How to Use the Software CD

Test data in the system can be transferred to a PC for data post-processing. Here is the instruction to use this function:

Open the CD, and find the installation software for the system.

Run the communication software (*exe* file) under the root directory.

According to the operations in 4.4.8, set the required transmission data address range on the system. Press [icon] on the system and click **START** on the communication software to start data transmission.

After data transmission, store the data on the PC for data post-processing or printing.

Click **EXIT** to exit the software.

Appendix B: About CTS-30B

B.1 Comparison between CTS-30A and CTS-30B

The differences of CTS-30A/CTS-30B digital ultrasonic thickness gauges in terms of functions and specifications are listed below:

Table B-1

Item \ Model	CTS-30A	CTS-30B
Measurement Range	0.8~300mm	0.8~400mm
Compatible Probe	TG5-10 (Standard)	TG5-10L (Standard) TG7.5-6L TG2-12L TG5-10HL TG5-6L TG5-8L
Gain	Standard	Low/Standard/High
Custom Adjust	1 point	1 point/2 points
Fast Scan		√
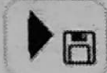
Note:

The actual measurement range is subject to the probe, test material, temperature and the setup selected.

The mark √ in the table above indicates the corresponding model has such function or specification.

B.2 CTS-30B Function Main Menu

Press ▦ to go to the menu, and press ▲ or ▼ to select:

1. Velocity	2. Probe
3. Precision / Unit	4. Custom adjust
5. Arithmetic	6. Gain
7. Average point	8. Memory
9. Limitation	10. Overload horn
11. Language	12. Shutdown
13. To default	14. Communication
15. About	

Press ▶▤ to go to the selected content.

CTS-30B Display
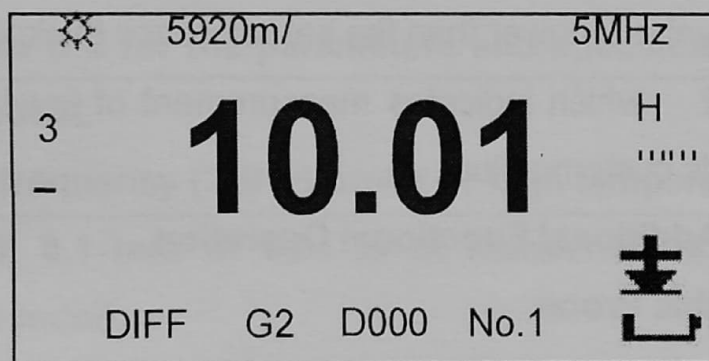
Fig. B-1 Display

The display content of LCD is shown in Fig. B-1. The descriptions are as follows:

1) ☼	Backlight indicator	
2) ⊥	Measure coupling	
3) ▭	Low voltage	
4) 5920m/s	Current acoustic velocity	
5) 5MHz	Current probe frequency	
6) D0000	Current data storage address	
7) 10.01	Measured value display	
8) H/L	Limitation after setting high/low limit	
9) 3	Average measure point number	
10) mm/in	Measurement unit	
11) STD/MIN/AVG/DIFF/FAST Standard/Minimum/Average/Difference/ Fast measurement		
12) G1/G2/G3 Low/Standard/High gain setting		
13) — Displays when measurement is difference (DIFF) and the measurement value is lower than the set reference thickness.		
14) No.1/ No.2 which indicates measurement of low/high test block in 2 Points custom adjust.		

B.3 CTS-30B Additional Functional Operation

B.3.1 Compatible Probe

CTS-30B can be compatible with probe models: TG5-10L (Standard), TG7.5-6L, TG2-12L, TG5-10HL, TG5-6L, and TG5-8L.

Operation:

1) Press ▦ to enter the menu.

2) Press ▲ or ▼ to select *Probe*

3) Press ▶▤ to enter that option:

1. Normal 5.0MHz: for the standard configured TG5-10L probe

2. 7.5 MHz: for the TG7.5-6L probe

3. 2MHz: for the TG2-12L probe

4.Temperature: for the TG5-10HL high temperature(200°C) probe

5. 5MHz-6: for the TG5-6L probe

6. 5MHz-8: for the TG5-8L probe

7. Other: When used with any probe from other manufacturer, the measurement range and accuracy are not foreseeable and warranted.

4) Press ▲ or ▼ to select the desired probe.

5) Press ▦ to confirm the option.

Note:

See Table B-2 for the parameters and specifications of each probe model.

If a low frequency (2MHz) probe or high temperature probe is selected, 0.1 mm or 0.01 in of measurement precision is recommended.

When used with any probe other than the probe model listed above, the measurement range and accuracy are not foreseeable and warranted.

Table B-2

Probe Model	Frequency (MHz)	Type	PZT Diam. (mm)	Contact Diam. (mm)	Range (mm)
TG5-10L	5	Standard General	10	11.8	0.8~300 (Steel)
TG7.5-6L	7.5	Standard Thin plate	6	9	0.8~100 (Steel)
TG2-12L	2	High penetration	12	16	3~400 (Steel) 3~30 (ductile cast iron)
TG5-10HL	5	High temperature 200°C	10	12	3~300 (Steel)
TG5-6L	5	Standard	6	10	0.8~200 (Steel)
TG5-8L	5	Standard	8	11.8	1~300 (Steel)

B.3.2   2 Points Adjust

If velocity or thickness of the tested work piece is known, second adjust can be done by using Custom Adjust function.

1)   Press ▣ to enter the menu.

2)   Press ▲ or ▼ to select **Custom Adjust** items:

3)   Press ▶▤ to enter the current item and display:

   1 Point

   2 Points

If **2 Points** is selected, press ▶▤ to enter the current item and display the preset thickness of the low and high tested blocks. Press ▥◀ or ▶▤ to move the position of the triangle symbol and select the desired position for revision. Press ▲ or ▼ to change the data indicated by the triangle symbol.

Press ▣ to enter 2 Points adjust measurement state. Now **No. 1.** is displayed at the bottom right of the screen. Couple the probe on the low test block, press ▼ to confirm and it will change to display **No. 2**. Then couple the probe on the high test block, press ▼ to confirm, and **No. 2** will disappear from the screen. 2 Points adjust is finished. Now velocity and zero are adjusted at the same time.

NOTE: The measurement accuracy after performing 2 Points Custom Adjust function depends on the accuracy of the

known thickness of the work piece. The low and high test blocks must be the same material. The optimal measurement accuracy is achieved if testing the same material within the thickness range between the low and high test blocks, and the temperature is also similar.

B.3.3 Fast Scan

When in **Arithmetic**, press ▶🖫 to select the desired Arithmetic:

1. Standard
2. Minimum
3. Average
4. Difference
5. FastScan

When **FastScan** is selected, a symbol **FAST** is displayed on the bottom left of the screen. The system measurement cycle is then increased to approx. 20 times/second, and the display data is the minimum value in multiple valid measurements of the fast scan. In the fast scan, the interruption of probe coupling less than 2 seconds (At this time, you can see a process bar at the upper side of "FAST") is ignored. Only when the interruption of probe coupling is more than 2 seconds, a new fast scan will be started to capture the minimum value.

This testing method is suitable for special conditions when fast scan and measurement on corrosion surface to get the minimum value is required and non-coupling for a brief period is allowed.

B.3.4 Gain

On the CTS-30B system, select gain setting from *Gain* menu.

Operation:

1) Press [icon] to enter the menu.

2) Press [up arrow] or [down arrow] to select Gain.

3) Press [icon] to enter the current item.

    1. Low

    2. Normal

    3. High

4) Press [up arrow] or [down arrow] to select the desired gain

5) Press [icon] to confirm the current item.

Generally **Normal** is selected for measurement. If the measurement reading changes abnormally, or when measuring material with strong ultrasound reflected signals such as aluminum, select **Low**; if the measurement reading is too high, hard to measure the thickness of the lower measurement range, or surface condition of workpiece is poor, select **High**. At the mid bottom of the screen, the display of **G1** stands for low gain, **G2** for standard gain, or **G3** for high gain.

Appendix C: About CTS-30C

C.1 Comparison between CTS-30A, CTS-30B and CTS-30C

The differences of CTS-30A/ CTS-30B/ CTS-30A digital ultrasonic thickness gauges in terms of functions and specifications are listed below:

Table C-1

Model Item	CTS-30A	CTS-30B	CTS-30C
Measurement Range	0.8~300mm	0.8~400mm	0.8~400mm
Compatible Probe	TG5-10 (Standard)	TG5-10L (Standard) TG7.5-6L TG2-12L TG5-10HL TG5-6L TG5-8L	TGM5-10CL TG5-10L TG7.5-6L TG2-12L TG5-10HL TG5-6L TG5-8L

Probe WorkMode	Standard (built-in) (R-B1, transmit pulse to the first echo)	Standard (built-in) (R-B1, transmit pulse to the first echo)	Standard (R-B1, transmit pulse to the first echo, for all optional probes) Thru-coating (B1-B2, the first echo to the second echo, for probe TGM5-10CL only)
Gain	Standard	Low/Standard/ High	Low/Standard/High
Custom Adjust	1 point	1 point/ 2 points	1 point/ 2 points
Fast Scan		√	√

Note:

The actual measurement range is subject to the probe, test material, temperature and the setup selected.
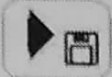
The mark √ in the table above indicates the corresponding model has such function or specification.

C.2 CTS-30C Function Main Menu

Press ▦ to go to the menu, and press ◤ or ◢ to select:

    1. Velocity   2. Probe

    3.WorkMode   4. Precision / Unit

    5.Custom adjust   6. Arithmetic

7. Gain   8. Average point

9. Memory   10. Limitation

11. Overload horn   12. Language

13. Shutdown   14. To default

15. Communication   16. About

Press ▶🖳 to go to the selected content.

```
☼        5920m/                    5M10E

3                                     H
                                    ......
 _      10.01
                                       ⊥

        DIFF    G2   D000   No.1    └┘
```
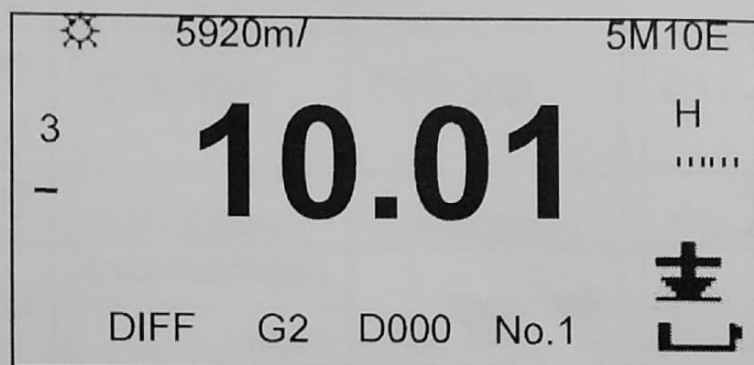
Fig. C-1 CTS-30C Display

The display content of LCD is shown in Fig. C-1. The descriptions are as follows:

1) ☼ Backlight indicator	
2) ⊥ Measure coupling When performing thru-coating measurement, if only the first echo signal is detected, but no second echo signal detected, the coupling symbol is displayed hollow, which means unstable coupling; if the first and second echo signals can be measured stably, the coupling symbol turns solid.	
3) ▭ Low voltage	
4) 5920m/s Current acoustic velocity	
5) 5M10ET current probe type and WorkMode symbol. Wherein "5M10" is the probe type, "E" is for thru-coating	

measurement based on echo-to-echo principle, without the display "E" it is Normal mode; "T" is for thickCoat measurement, without the display "T" it is thinCoat measurement.

6) $-$ $-$ $-$For thickness range identified by the software in Thru-Coating measurement mode, with three steps available: Thin, Mid and Thick.

The display "-" indicates the workpiece (including coating) thickness is approx.≤12.5mm (longitudinal wave in steel), which belongs to thin plate;

The display "- -" indicates the workpiece (including coating) thickness is approx. >12.5mm (longitudinal wave in steel), which belongs to mid plate; and

The display "- - -" indicates the workpiece (including coating) thickness is approx. >26.5mm (longitudinal wave in steel), which belongs to thick plate.

The system automatically adjusts test parameters and signal identification based on the recognized thickness range of workpiece, and the operator may roughly determine whether software identification is normal in combination of the actual plate thickness. If software identification indicates noncompliance with the actual situation, generally you need to adjust the gain or the thickness measurement mode for thin/ thick coating based on the actual situation.

7) D0000	Current data storage address
8) 10.01	Measured value display
9) H/L	Limitation after setting high/low limit
10) 3	Average measure point number

11) mm/in   Measurement unit
12) STD/MIN/AVG/DIFF/FAST Standard/Minimum/Average/Difference/ Fast measurement
13) G1/G2/G3 Low/Standard/High gain setting
14) — Displays when measurement is difference (DIFF) and the measurement value is lower than the set reference thickness.
15) No.1/ No.2   which indicates measurement of low/high test block in 2 Points custom adjust.

C.3 CTS-30C Additional Functional Operation

C.3.1 Compatible Probe

CTS-30C can be compatible with probe models: TGM5-10CL, TG5-10L,TG7.5-6L,TG2-12L,TG5-10HL,TG5-6L,TG5-8L.

Operation:

1) Press [icon] to enter the menu.

2) Press [up arrow] or [down arrow] to select **Probe**

3) Press [play/save icon] to enter that option:

   1. **5M10**: refers to TGM5-10CL probe, which is a special probe for thru-coating measurement.

   2. **Normal 5.0MHz**: for the standard configured TG5-10L probe

   3. **7.5 MHz**: for the TG7.5-6L probe

   4. **2MHz**: for the TG2-12L probe

   5. **Temperature**: for the TG5-10HL high temperature(200°C) probe

   6. **5MHz-6**: for the TG5-6L probe

7. **5MHz-8**: for the TG5-8L probe

8. **Other**: When used with any probe from other manufacturer, the measurement range and accuracy are not foreseeable and warranted.

4) Press [▲] or [▼] to select the desired probe.

5) Press [▣] to confirm the option.

Note:

See Table C-2 for the parameters and specifications of each probe model.

If a low frequency (2MHz) probe or high temperature probe is selected, 0.1 mm or 0.01 in of measurement precision is recommended.

When used with any probe other than the probe model listed above, the measurement range and accuracy are not foreseeable and warranted.

Table C-2

Probe Model	Frequency (MHz)	Type	PZT Diam. (mm)	Contact Diam. (mm)	Range (mm)

Probe Model	Frequency (MHz)	Type	PZT Diam. (mm)	Contact Diam. (mm)	Range (mm)
TGM5-10CL	5	Standard, Thru-coating	10	11.8	Standard: 1~200mm Thru-coating: 3~50mm
TG5-10L	5	Standard General	10	11.8	0.8~300 (Steel)
TG7.5-6L	7.5	Standard Thin plate	6	9	0.8~100 (Steel)
TG2-12L	2	High penetration	12	16	3~400 (Steel) 3~30 (ductile cast iron)
TG5-10HL	5	High temperature 200°C	10	12	3~300 (Steel)

Probe Model	Freq uenc y (MHz)	Type	PZT Diam. (mm)	Contact Diam. (mm)	Range (mm)
TG5-6L	5	Standard	6	10	0.8~200 (Steel)
TG5-8L	5	Standard	8	11.8	1~300 (Steel)

C 3.2 WorkMode

The CTS-30C has optional WorkModes subject to probe type selection. If the probe type is 5M10 (TGM5-10CL), the WorkModes available are: **Normal**, **ThinCoat**, and **ThickCoat**. Other probes support **Normal** only.

Normal measurement is to measure the sound time between transmit pulse and the first echo (R-B1), which is available for all optional probes.

Thru-coating measurement (including **ThinCoat** and **ThickCoat**) is to measure the sound time between the first echo and the second echo (B1-B2), which is for the probe type 5M10 (TGM5-10CL) only.

1) Press ▤ to enter the menu.

2) Press ▲ or ▼ to select **WorkMode**.

3) Press ▶▤ to enter and display the option.

1. Normal

2. ThinCoat

3. ThickCoat

4) Press ▲ or ▼ to select **WorkMode**. Press 🖩 to confirm and return the menu. Press ⏻ to return to the measurement state directly.

C.3.2.1 Normal measurement

Here are the basic settings and operation in Normal measurement:

Select the probe model and **Normal** mode from the system menu. The default gain is G2, run the probe zero calibration.

When performing measurement, if no coupling symbol appears or the coupling symbol flashes after multiple couplings, increase the gain to G3; For aluminum measurement, if the reading is abnormal, jumps and unstable after multiple measurements, change the gain to G1 .

C.3.2.2 Thru-coating measurement

Here are the basic settings and operation in thru-coating measurement:

1) Preparation for measurement:

● Select the probe model supporting thru-coating measurement from the system menu.

● Subject to the basic situation of workpiece coating, select the WorkMode ThinCoat or ThickCoat.

● Set the gain for testing.

● Before each testing upon bootup, perform probe zero

calibration.

2) Selecting ThinCoat or ThickCoat as WorkMode.

If the coating thickness is estimated to be 0.3mm or above, choose ThickCoat, otherwise choose the default ThinCoat. The selection of thick or thin coating is also subject to the coating material and status, which shall be determined based on the actual situation.

It is in Normal measurement if no character is displayed as the suffix of the probe type at the upper right of the measuring screen; or in ThinCoat mode if "E"is displayed as the suffix; or in ThickCoat mode if "ET"is displayed as the suffix.

3) Selecting gain

Typically select G2 as the testing gain.

- If the software indicates it is a thin plate, while the actual workpiece should be a thick plate, the gain might be too high. Now try to decrease the gain to G1 for measurement.
- If the hollow coupling symbol flashes continuously for a long time, generally it is due to insufficient gain. Try to increase the gain to G3 for measurement.
- If no coupling symbol appears after multiple coupling, try to increase the gain to G3 for measurement.

If the reading is abnormal or jumps unstably after multiple measurements, try to change the gain to G1 for measurement, for example, the aluminum measurement.

4) When performing thru-coating measurement, it takes longer time in coupling the probe till the reading becomes stable than in standard measurement. If the signal does not comply

with validity check of the internal software, the system will start the process of parameter auto fine adjustment and retesting, thus increasing the time for detection. As a result when testing different thickness or positions, there is a difference in the time interval from probe coupling to the appearance of valid reading. Usually the longest interval is <2 seconds. Therefore, when the hollow coupling symbol appears in the detection process, keep the coupling state stable for 1-2 seconds, enabling the software to perform testing parameter auto adjustment before achieving the normal detection. If the reading has been unstable or the coupling symbol has been "hollow", lift up the probe and re-couple for measurement. ;

If the normal detection cannot be achieved, try to change the gain or the coating mode.

Note:

- After probe replacement or turning on the system, probe zero calibration is required before measurement.

- Fast zero calibration can be achieved by using the configured test block in different work modes. The zero calibration result fits for different WorkModes.

- If the probe WorkMode is non- Normal (i.e. in thru-coating measurement), the functions of Custom Adjust, Vel Measuring and Fast Scan are blocked.

C.3.3 2 Points Adjust

If velocity or thickness of the tested work piece is known, second adjust can be done by using Custom Adjust function.

1) Press ▦ to enter the menu.

2) Press ▲ or ▼ to select **Custom Adjust** items:

3) Press ▶🖫 to enter the current item and display:

1 Point

2 Points

If **2 Points** is selected, press ▶🖫 to enter the current item and display the preset thickness of the low and high tested blocks. Press ▥◀ or ▶🖫 to move the position of the triangle symbol and select the desired position for revision. Press ▲ or ▼ to change the data indicated by the triangle symbol.

Press ▦ to enter 2 Points adjust measurement state. Now **No. 1.** is displayed at the bottom right of the screen. Couple the probe on the low test block, press ▼ to confirm and it will change to display **No. 2**. Then couple the probe on the high test block, press ▼ to confirm, and **No. 2** will disappear from the screen. 2 Points adjust is finished. Now velocity and zero are adjusted at the same time.
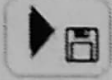
NOTE:

● **The measurement accuracy after performing 2 Points Custom Adjust function depends on the accuracy of the known thickness of the work piece. The low and high test blocks must be the same material. The optimal**

measurement accuracy is achieved if testing the same material within the thickness range between the low and high test blocks, and the temperature is also similar.

● If WorkMode is non-Normal (i.e. in thru-coating measurement), the Custom Adjust function is blocked. You can fast adjust based on the configured test block only.

C.3.4 Fast Scan

When in **Arithmetic**, press ▶🖫 to select the desired Arithmetic:

1. Standard

2. Minimum

3. Average

4. Difference

5. FastScan

When **FastScan** is selected, a symbol **FAST** is displayed on the bottom left of the screen. The system measurement cycle is then increased to approx. 20 times/second, and the display data is the minimum value in multiple valid measurements of the fast scan. In the fast scan, the interruption of probe coupling less than 2 seconds（At this time, you can see a process bar at the upper side of "FAST"）is ignored. Only when the interruption of probe coupling is more than 2 seconds, a new fast scan will be started to capture the minimum value.

This testing method is suitable for special conditions when fast scan and measurement on corrosion surface to get the minimum
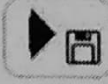
value is required and non-coupling for a brief period is allowed.

Note: If WorkMode is non-Normal (i.e. in thru-coating measurement), the FastScan function is blocked.

C.3.5 Gain

On the CTS-30C system, select gain setting from *Gain* menu.

Operation:

1) Press [icon] to enter the menu.

2) Press [▲] or [▼] to select Gain.

3) Press [▶] to enter the current item.

1. Low

2. Normal

3. High

4) Press [▲] or [▼] to select the desired gain

5) Press [icon] to confirm the current item.

Generally *Normal* is selected for measurement. If the measurement reading changes abnormally, or when measuring material with strong ultrasound reflected signals such as aluminum, select *Low*; if the measurement reading is too high, hard to measure the thickness of the lower measurement range, or surface condition of workpiece is poor, select *High*. At the mid bottom of the screen, the display of *G1* stands for low gain, *G2* for standard gain, or *G3* for high gain.

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Appendix D   Acoustic Velocity of Materials

List of materials	Longitudinal acoustic velocity(m/s)	in/us
Aluminum	6260	0.2465
Brass	4300	0.1693
Cast iron	4600	0.1811
Chromium	6200	0.2441
Copper	4720	0.1858
Glass	5600	0.2205
Gold	3240	0.1276
Iron	5930	0.2335
Lead	2400	0.0945
Magnesium	5750	0.2264
Nylon	2680	0.1055
Silver	3700	0.1457
Stainless steel	5740	0.2260
Steel	5920	0.2331
Titanium	5990	0.2358
Zinc	4170	0.1642
Tungsten	5174	0.2037
Tin	3230	0.1272
Water (20℃)	1480	0.0583
Glycerol	1920	0.0756
Soluble glass	2350	0.0925
Acrylic resin	2730	0.1075

NOTE: The velocities above are approximate values for reference only.

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