CL 5

Operating Manual

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Important Notice

The following information must be read and understood by any user of a GE Inspection Technologies ultrasonic thickness gauge. Failure to follow these instructions can lead to errors in thickness measurements or other test results. Decisions based on erroneous results can, in turn, lead to property damage, personal injury or death.

General Warnings

Proper use of ultrasonic test equipment requires three essential elements:

- Selection of the correct test equipment.
- Knowledge of the specific “test application requirements.”
- Training on the part of the instrument operator.

This operating manual provides instruction in the basic set up and operation of the thickness gauge. There are, however, additional factors which affect the use of ultrasonic test equipment. Specific information regarding these additional factors is beyond the scope of this manual. The operator should refer to textbooks on the subject of ultrasonic testing for more detailed information.

Operator Training

Operators must receive adequate training before using ultrasonic test equipment. Operators must be trained in general ultrasonic testing procedures and in the set up and performance required by a particular test. Operators must understand:

- Soundwave propagation theory.
- Effects of the velocity of sound of the test material.
- Behavior of the sound wave where two different materials are in contact.
- Areas covered by the sound beam.

More specific information about operator training, qualification, certification, and test specifications is available from various technical societies, industry groups, and government agencies.

Testing Limitations

In ultrasonic testing, information is obtained only from within the limits of the sound beam. Operators must exercise great caution in making inferences about the test material outside the limits of the sound beam. For example, when testing large materials it may be impossible or impractical to inspect the entire test piece.

When a less-than-complete inspection is to be performed, the operator must be shown the specific areas to inspect. Inferences about the condition of areas not inspected, based on data from the evaluated areas, should only be attempted by personnel fully trained in applicable statistical and probability techniques. In particular, materials subject to erosion or corrosion, in which conditions can vary significantly in any given area, should only be evaluated by fully trained and experienced operators.

Sound beams reflect from the first interior surface encountered. Because of part geometry and overlapped flaws or overlapped surfaces, thickness gauges may measure the distance to an internal flaw rather than to the back wall of the material. Operators must take steps to ensure that the entire thickness of the test material is being examined.

Ultrasonic Thickness Measurement Critical Operating Procedures

The following operating procedures must be observed by all users of ultrasonic thickness gauges in order to minimize errors in test results.

1. *Calibration of Sound Velocity*

The principle of operation of an ultrasonic thickness gauge is that the instrument measures the time of flight of an ultrasonic pulse through the test piece and multiplies this time by the velocity of sound in the material. Thickness measuring error is minimized by ensuring that the sound velocity to which the instrument is calibrated is the sound velocity of the material being tested. Actual sound velocities in materials often vary significantly from the values found in published tables. In all cases, best results are obtained if the instrument is calibrated on a velocity reference block made from the same material as the test piece; this block should be flat and smooth and as thick as the maximum thickness of the test piece.

Operators should also be aware that the sound velocity may not be constant in the material being tested; heat treating, for example, can cause significant changes in sound velocity. This must be considered when evaluating the accuracy of the thickness provided by this instrument. Instruments should always be calibrated before testing, and the calibration should be checked after testing, to minimize testing errors.

2. *Probe Zero Procedure*

When performing a one-point calibration with a contact probe, the probe zero procedure must be performed as described in this manual. The probe zero block should be clean, in good condition, and without noticeable wear. Failure to properly perform the probe zero procedure will cause inaccurate thickness readings.

3. *Effects of Temperature on Calibration*

Temperature variations change the sound velocity of materials and transducer delay lines and, therefore, calibrations. All calibrations should be performed on-site, and with test blocks at the same temperature as the test piece, to minimize errors due to temperature variations.

4. *Transducer Selection*

The transducer used in testing must be in good condition without noticeable wear of the front surface. Badly worn transducers will have a reduced effective measuring range. The specified range of the transducer must include the complete range of thicknesses to be tested. The temperature of the material to be tested must be within the transducer's temperature range.

5. *Use of Couplants*

Operators must be familiar with the use of ultrasonic couplants. Testing skills must be developed so that couplant is used and applied in a consistent manner to minimize variations in couplant layer thickness and errors in test results. Calibration and actual testing should be performed under similar coupling conditions, using a minimum amount of couplant and applying consistent pressure on the transducer.

6. *Doubling*

Ultrasonic thickness gauges will, under certain conditions, display readings which are twice (or, in some cases, three times) the actual material thickness

being measured. This effect, commonly known as "doubling," can occur below the minimum specified range of the transducer. If the transducer being used is worn, doubling is possible at a thickness greater than the minimum of the specified range.

When using a new transducer, any reading which is less than twice the minimum specified range of the transducer may be a "doubled" reading, and the thickness of the material being tested should be verified by the use of other methods. If the transducer shows any sign of wear, doubling may occur at a second echo or other echo signal combinations may produce a readable signal. The instrument reading and apparent thickness are up to about twice the actual value, resulting in a thickness greater than twice the minimum of the specified range. This thickness should be determined by calibrating the instrument/transducer combination on reference blocks that represent the complete range of possible thicknesses that may be encountered in testing. This is particularly important when the test piece is being ultrasonically measured for the first time or in any case where the history of thickness of the test specimen is unknown.

Safety Information

Attention:

The CL 5 is an instrument for materials testing. Any use for medical applications or other purposes is not allowed.

The CL 5 may only be used in industrial environments.

The CL 5 can be operated with batteries or while plugged into an electrical outlet using the AC charger.

The power supply unit has the electrical safety class II.

Batteries:

For the battery operation of the CL 5, we recommend the use of a lithium-polt battery pack provided. Operation using alkaline batteries, NiMH or NiCAD cells is possible. You should only use the products recommended by us for the battery operation. Do not attempt to use any lithium batteries that are not provided with the instrument. Do not attempt to charge the provided batteries on an outside charger.

Software:

According to the current state of the art, software is never completely free from errors. Before using any software-controlled test equipment, please make sure that the required functions operate perfectly in the intended combination.

Defects/errors and exceptional stresses

If you have reason to believe that a safe operation of your CL 5 is no longer possible, you have to disconnect the instrument and secure it against unintentional reconnection. Remove the batteries if necessary.

A safe operation is no longer possible –e.g.:

- The instrument shows visible damages
- The instrument no longer operates perfectly
- After prolonged storage under adverse conditions like exceptional temperatures and/or especially high air humidity, or corrosive environmental conditions.
- Being subjected to heavy stresses during transportation

Service

Every effort has been made to provide you with a reliable product. However, should service become necessary, GE Inspection Technologies, has established a number of Factory Trained Service Centers. For the location of the nearest facility refer to section 9.4 of this manual.

General Information 1

The CL 5 is an ultrasonic precision thickness measurement device. It's available with optional live A-Scan display, acoustic velocity measurement capability, and a data recorder in which as many 10,000 thickness measurements per file can be stored.

This chapter of your manual introduces the key features of the CL 5 and the contents of this operating manual. The next chapter explains the keypad functions and display-menu contents. Closely reviewing the material in these two chapters will help you make better use of the more detailed information found throughout the rest of this manual.

In this chapter, you'll learn

- How to install batteries or connect the AC power adapter to the instrument (Section 1.1)
- How to Power on and off the instrument (Section 1.2)
- The features of the instrument and base instrument package contents (Section 1.3)
- The general content of each chapter in this manual (Section 1.4)

1.1 Supplying Power to the CL 5

- The instrument is powered by a Lithium (Li) battery pack.
- It will also accept three "AA" size Alkaline, NiCAD, or NiMH (nickel metal hydride) battery types.
- The Lithium battery, which is recommended, will provide up to approximately 25 hours of service life. This pack (and *only* this pack) may be recharged in the instrument using the charger provided with your instrument.
- When other types of rechargeable batteries are used, they must be removed from the instrument for charging.

To install batteries, remove the battery-compartment cover as shown in Figure 1-1. After inserting the Li pack or three "AA" batteries according to the polarity indicated in the battery compartment, replace the compartment cover. Instructions on specifying battery type are found in Section 3.2.

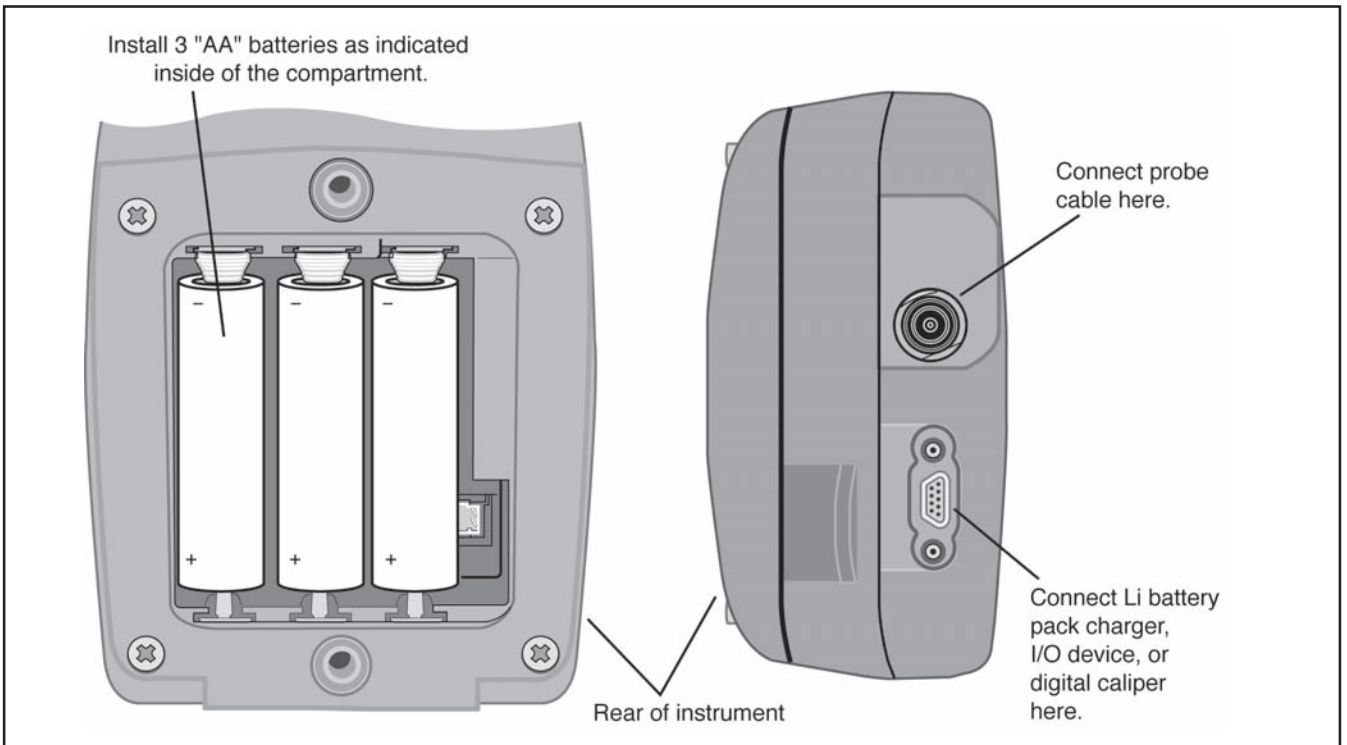

FIGURE 1-1—Insert batteries as shown here. Notice the location of the External Power Connector to which the instrument's Li battery pack's charger be connected.

☞ **Note:**

When the battery indicator is in the last quarter as indicated by the display-screen symbol , replace the batteries as soon as possible. The CL 5 automatically shuts off when batteries are too weak for reliable operation. However, settings are saved and restored when the instrument is turned on again. When testing in remote locations, always carry spare batteries.

☞ **Note:**

The instrument can be operated while the Li battery pack's charger is connected. This charger is connected to the instrument though the connector shown in Figure 1-1. When the charger is powering the instrument, AC appears on the display screen. The charger may only be connected when the GE Inspection Technologies Li battery pack is installed in the instrument.

1.2 Powering On and Off the Instrument

After a power source has been provided, power on the instrument by pressing and holding CAL ON until the instrument turns on. Press and hold CAL ON when the instrument is on to turn if off.

1.3 Key Features of the CL 5

- Large Hollow/filled thickness digits
- Alarm Bar Graph
- Standard and Custom parameter setups
- Supports delay and contact probes
- Alphanumeric naming of data locations
- Lockout feature with password access
- Lightweight – .75 lbs (.34 Kg)
- Large LCD Display with Backlight and Adjustable Contrast

- Approximately 25 hours life – with the Li battery pack or 3 “AA” alkaline batteries
- Easy-to-use, single-level menu system
- Multiple display-screen languages
- User-selectable measurement resolution to 0.0001 inch (0.001 mm)
- Normal (thickness), Min-Scan, Max-Scan, and Differential/Rate of Reduction Measurement Modes are Standard
- Optional A-Scan provides A-Scan plus Thickness
- Optional Data Recorder stores up to 10,000 thickness measurements with A-Scan images attached in as many as 120 data recorder files
- Optional Velocity Measurement Mode includes an electronically connected digital caliper for exact measurement and automatic input of nominal thickness
- Field upgrades available via the GE Inspection Technologies web site
- Compatible with UltraMATE© and UltraMATE LITE© software programs

CL 5 Precision Thickness Measurement Base Instrument

Contents of the CL 5 Base Instrument

- CL 5 Instrument
- Lithium Battery Pack
- Lithium Battery Pack Recharger
- Plastic Carrying Case
- Wire Stand
- Two-Point Check Block (uncertified)
- Couplant Sample
- Firmware Upgrade CD-ROM (requires Serial PC cable)
- Operating Manual
- Operating Instruction Card
- Certificate of Conformity

Instrument Options

- A-Scan Upgrade Option
- Data Recorder Upgrade Option
- Velocity Measurement Option

1.4 What's in this Manual

The CL 5 Operating Manual is divided into ten chapters. All chapters except 4 and 5 apply to all instruments. The last two sections of Chapter 4 apply only to instruments equipped with the A-Scan or Velocity measurement options. Chapter 5 applies only to instruments equipped with the Data Recorder option. Note that any CL 5 can be retrofitted to incorporate these options. Following is a summary of Chapters 1 through 10:

Chapter 1—General Introduction

- Supplying Power to the instrument
- Powering on and off the instrument
- Overview of instrument features
- Explanation of the operating manual contents

Chapter 2—Understanding the Keypad, Menu System, and Displays

- Operations performed by each key
- Navigating the display screens
- Overview of menu functions
- Explanation of display features (base model, data recorder, and A-Scan equipped instruments)
- Definition of icons

Chapter 3—Setting Up the CL 5

- Install a probe and configure the instrument by loading a setup file
- Set up the instrument display appearance (for base model and A-Scan equipped instruments) and make other configuration settings

- Adjust the instrument gain setting
- Specify the nominal material thickness
- Calibrate and zero the instrument/probe combination
- Set maximum and minimum alarm values
- Create and erase custom setup files
- Lock and unlock instrument controls

Chapter 4—Measuring Thickness

- Specify and use the Normal measurement mode (No A-Scan)
- Operate in Min-Scan and Max-Scan Measurement mode
- Operate in Differential/Rate of Reduction measurement mode
- Select and interpret the A-Scan plus Thickness measurement mode (Optional)
- Magnify the displayed A-Scan using the Zoom control
- Freeze the thickness reading and A-Scan
- Connect the digital caliper and measure acoustic velocity (Optional)

Chapter 5—Using the Optional Data Recorder

- Create, recall, and delete data recorder files
- Store A-Scan and thickness readings in data recorder files
- Navigate data recorder file locations
- Attach notes to the data recorder file
- Print reports

Chapter 6—I/O Technical Details

- Configure the instrument to communicate with PCs and printers
- Thickness value format
- Remote control codes

Chapter 7—Specifications

Chapter 8—Maintenance

Chapter 9—Appendix

- Reset the operating software
- Upgrade the operating software
- EMC documentation
- How to obtain service

Chapter 10—Index

Understanding the Keypad, Menu System, and Displays 2

The CL 5's display, keypad, and functional commands are easy to interpret and use. In this chapter you'll find a brief explanation of all display and keypad features. You'll also find references to manual sections where more detailed information is available.

Note that the CL 5's display screen contents vary depending on the optional features installed and the operational settings selected. Display screens shown in this chapter represent those found in all instrument configurations including:

- Base Model
- A-Scan Option Installed
- Data Recorder Option Installed
- A-Scan and Data Recorder Options Installed

2.1 Keypad Features

The instrument's keypad includes dedicated keys ([CAL ON] and [MODE]), arrow keys ([↑], [↓], [←], [→]), and three virtual function keys ([▲]). Key functions are described in Figure 2-1.

2.2 Interpreting Display Screens

This section of your manual describes the layout of the CL 5's primary display modes including the:

- **Measurement Display Mode –** Indicates measured thickness, contains status icons, displays data recorder location and file name (when this option is installed and activated), and the live A-Scan display (when this option is installed and activated). Figure 2-2 shows four representative display screens.

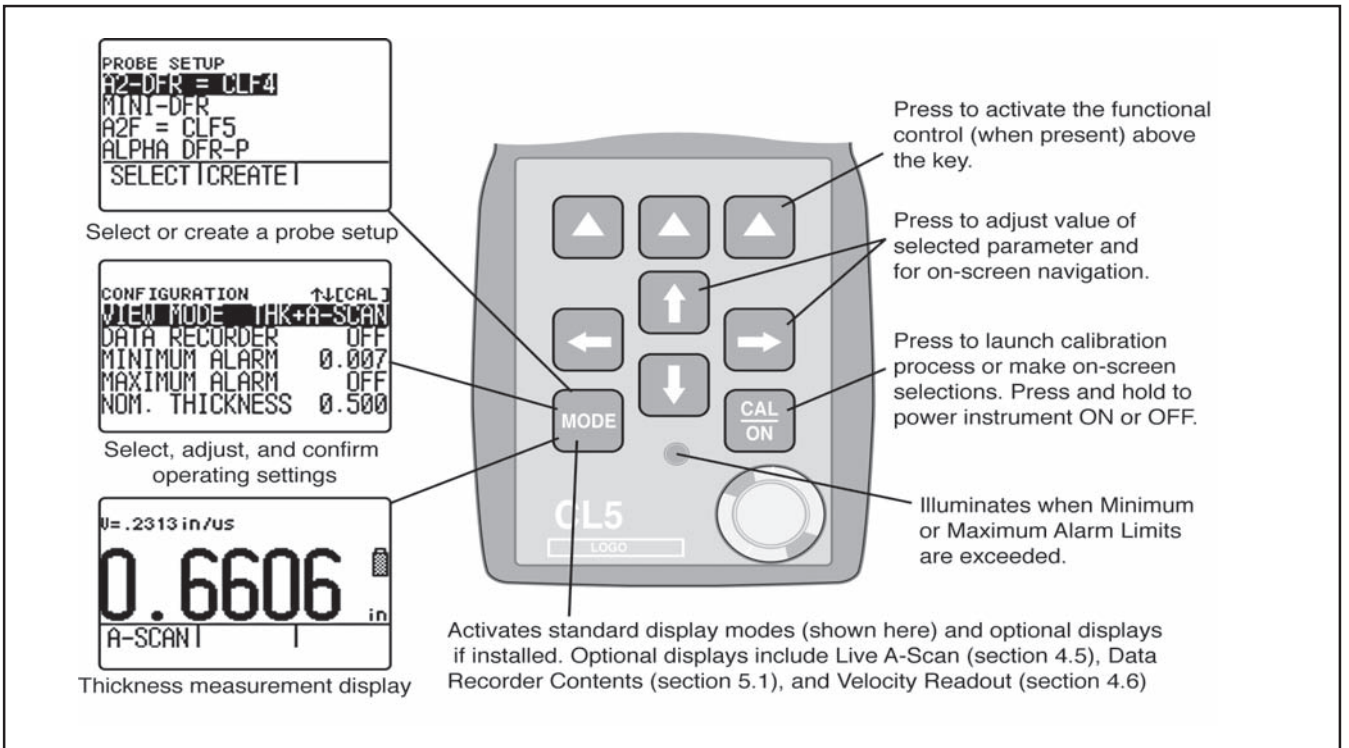

FIGURE 2-1—Key Functions

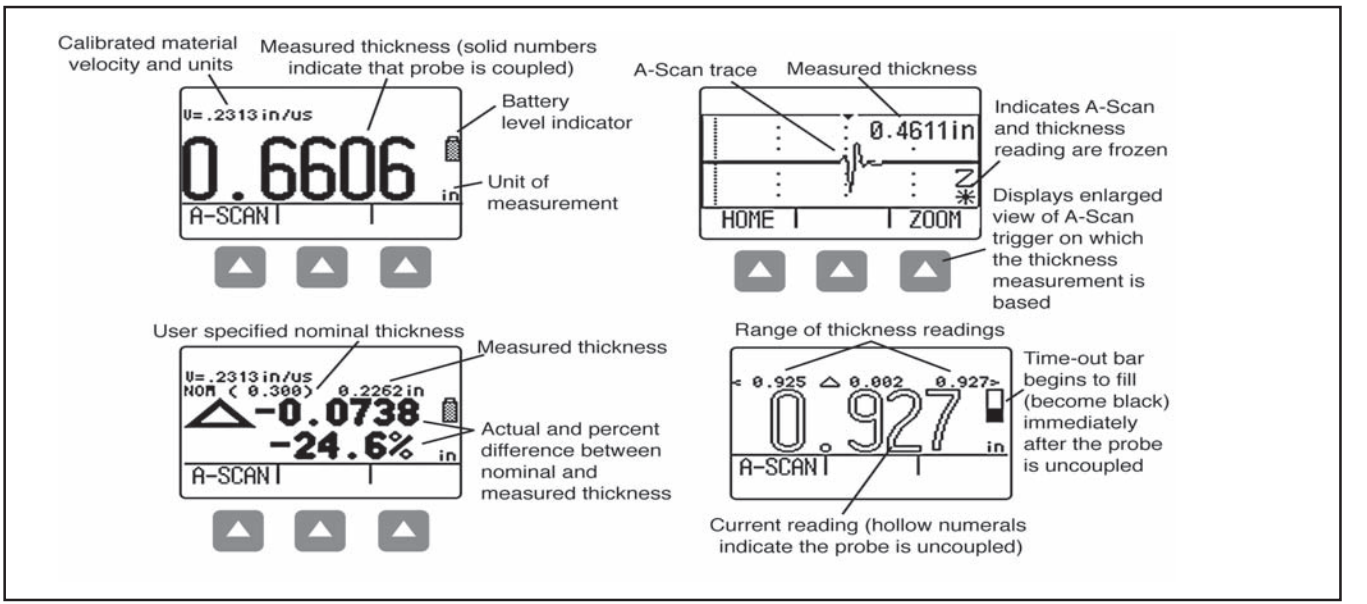

FIGURE 2-2—MEASUREMENT DISPLAY MODE – The display's appearance varies based on installed instrument options as well as instrument display settings. NORMAL view mode is available in all instruments regardless of the installed options. Additional measurement view modes are available when the A-Scan or Data Recorder options are installed. Depending on the view selected, the display may contain the current thickness value, a live A-Scan, minimum thickness value, maximum thickness value, and differential value in the unit of measurement or as a percentage when compared to a nominal value.

- **Probe Setup Display Mode –** Allows the user to select a standard preloaded instrument setup (each matched to a specific probe model) or a custom user-defined setup. Custom Setups are created using this display screen. They can be downloaded to a PC using the UltraMATE© software package and then downloaded into any CL 5 instrument. The contents of a Custom Setup file vary depending on the instrument's configuration. See Section 3.5 for information on custom setups. (Figure 2-3).
- **File Display Mode –** Allows the user to create and store thickness readings in data recorder files. This feature is only available when the data recorder option is installed and activated. Accompanying A-Scans can be stored with thickness readings by holding ▲ below the SEND Function for three seconds. (Figure 2-4)
- **Configuration Display Mode** – Instrument controls are accessed through this screen. The controls listed on the configuration display screen vary depending on the installed options. (Figure 2-5)

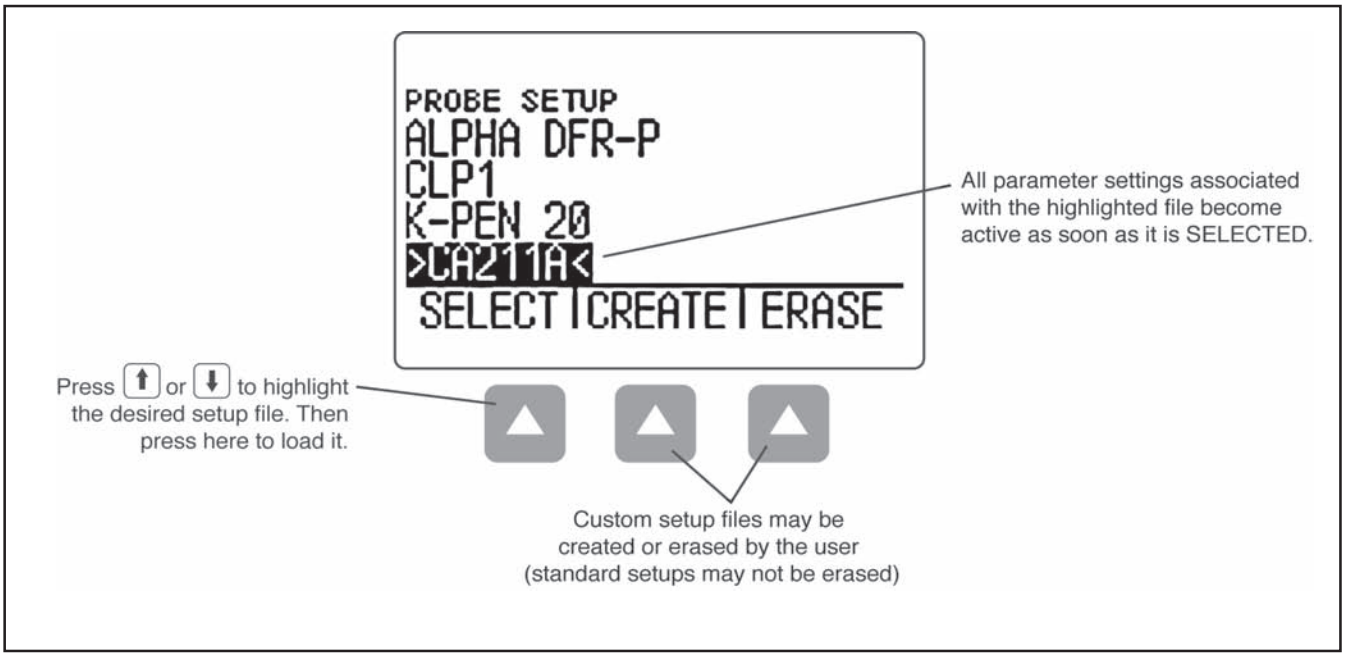

FIGURE 2-3—PROBE SETUP DISPLAY MODE – Allows selection of a preloaded or Custom Setup file, which automatically recalls all parameter settings. Note that Custom Setups can be downloaded from an UltraMate© equipped PC to any instrument, or created using this display (see Section 3.5 for information on Custom Setup files).

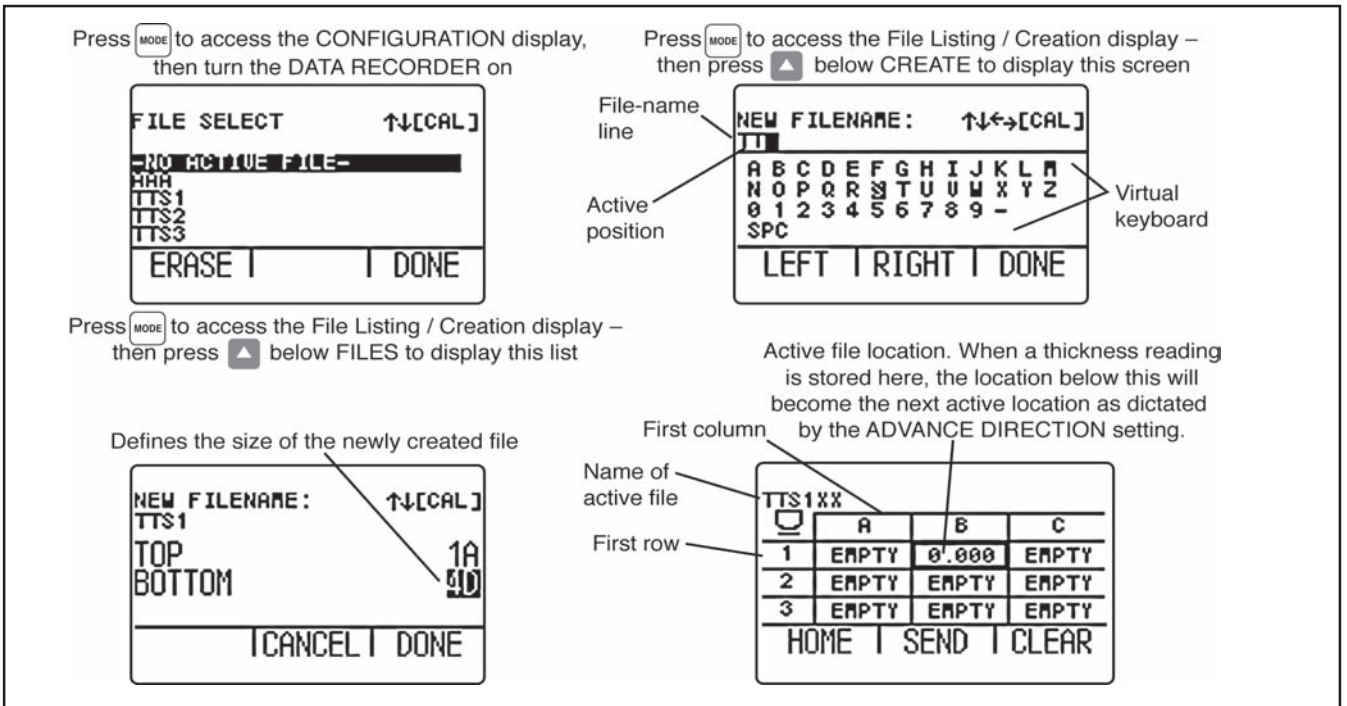

FIGURE 2-4—FILE DISPLAY MODE – When installed and activated, the data recorder option allows users to create data recorder files, store thickness readings (and accompanying A-Scans), and navigate through file contents as shown here. See Chapter 5 to work with Data Recorder files.

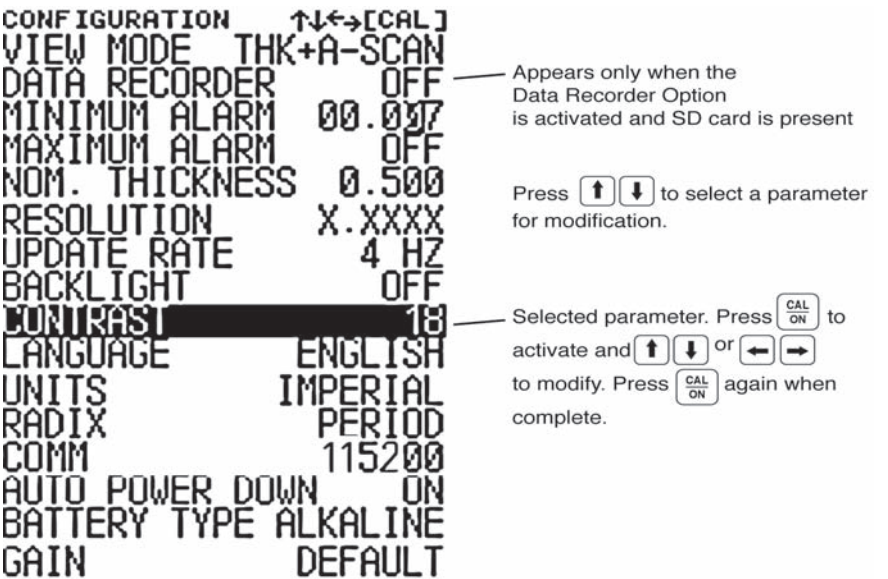

FIGURE 2-5—CONFIGURATION DISPLAY MODE – The contents of the Configuration display depend on the instrument's installed-option configuration. All settings listed on the Configuration display are described in Section 2.3.

2.3 Working with the Configuration Display

The Configuration display is accessed by pressing MODE. With this screen displayed, you can adjust most CL 5 controls.

VIEW MODE – In base-model units this parameter offers 4 settings. In A-Scan equipped instruments this parameter allows the measurement and live A-Scan to be displayed. See Section 4.1 to select the view to be displayed.

DATA RECORDER – When the optional data recorder is installed, setting this parameter to ON activates the file recording capability and the data recorder file display.

MINIMUM ALARM – Enables and sets the minimum alarm value. (Section 3.4)

MAXIMUM ALARM – Enables and sets the maximum alarm value. (Section 3.4)

NOMINAL THICKNESS – Set the nominal thickness value that is then used to calculate and the differential and rate of reduction measurement values when selected by the VIEW MODE parameter. (Section 3.2.3)

RESOLUTION – Controls the format (number of decimal places) of the thickness measurement displayed, printed in a report, and stored in a Data Recorder file. (Section 3.2)

UPDATE RATE – Rate at which the measurement reading is updated. (Section 3.2.2)

BACKLIGHT – Turns the display's backlight feature to ON, OFF, or AUTO (AUTO switches backlighting on whenever a key is pressed or the probe is coupled)

CONTRAST – Sets the display's contrast level (select then press ↑ or ↓ to change contrast)

LANGUAGE – Sets the instrument display's language (Section 3.2)

UNITS – Sets the unit of measurement to inches or millimeters (Section 3.2)

RADIX – Selects a period (.) or comma (,) to be used as a decimal point (Section 3.2)

COMM – Specifies the baud rate of the attached printer or PC

AUTO POWER DOWN – Selects the battery-life saving ON, which powers down the instrument if no key presses or measurement occur for four minutes, or the OFF setting, which will only power down the instrument when CAL/ON is pressed.

BATTERY TYPE – Select the installed battery type to ensure accurate remaining battery-life indication. Choose from Alkaline, NiMHD, or NiCAD. (See Section 1.1 to install batteries)

GAIN – Selects the default or reduced level of gain corresponding to the active setup file (Section 3.2.1)

Setting Up the CL 5 3

Prior to measuring thickness, the instrument must be properly setup. This chapter explains the steps that must be taken prior to measurement, to ensure that the display appearance, ultrasonic settings, and measurement mode match the desired configuration. The steps described in this chapter apply to all instruments, regardless of whether or not they incorporate the A-Scan or Data Recorder options.

Most fundamental instrument parameters are automatically set to a default value based on the Setup file selected by the user. The instrument is supplied with standard Setup files, named to match the probe for which they are intended. Loading these standard setup files (or a Custom Setup file like the ones described in Section 3.5) is the first step to setting up the instrument.

In preparation for measuring thickness, this chapter explains how to

- Install a probe and configure the instrument by loading a Setup file (Section 3.1)
- Set up the instrument display appearance (Section 3.2)
- Set the instrument‘s Gain and Update Rate (Section 3.2)
- Calibrate the instrument/probe combination (Section 3.3)
- Set maximum and minimum alarm values (Section 3.4)
- Create and Erase Custom Setup Files (Section 3.5)
- Lock and unlock instrument controls (Section 3.6)

3.1 Connecting a Probe and Loading a Setup File

Prior to measuring thickness, you must connect a probe to the instrument and select a setup file that's compatible with the probe (Figure 3-1). The CL 5 supports delay line and contact probe types (see Chapter 7 for specifications).

Once a probe is connected, press MODE to activate the Probe Setup display. The Probe Setup display, which is shown in Figure 3-2, allows the user to select a standard or Custom Setup file (see Section 3.5 to create or erase Custom Setup files).

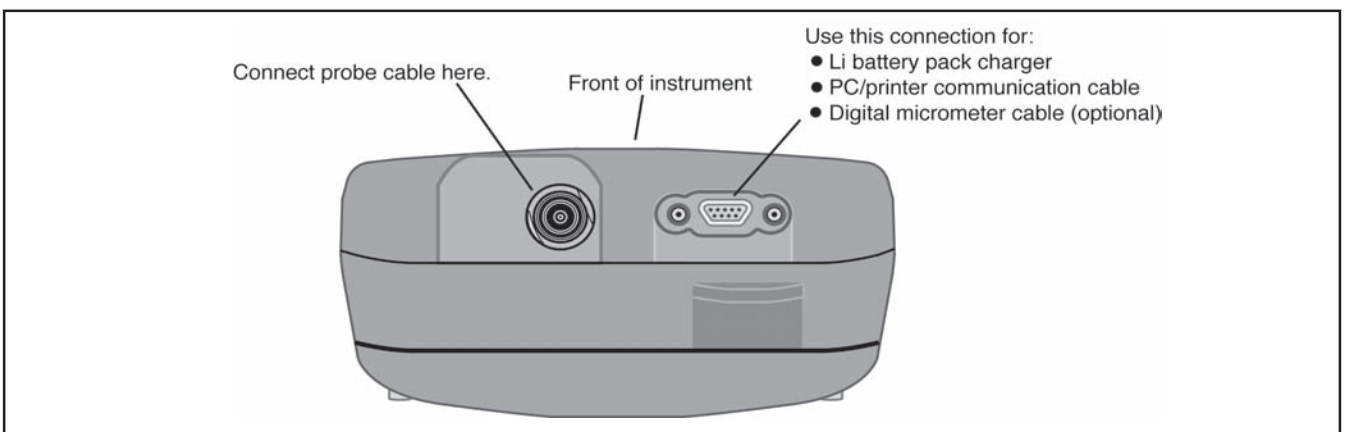

FIGURE 3-1—Connecting a Probe Cable

The following instrument settings are automatically adjusted when the Setup file is activated:

Custom Setup Filename
Source Setup Filename
View Mode
Gain
Measured Value display resolution
Measurement Mode
Nominal Thickness — when Differential, %RR, or Velocity modes are selected
Minimum Alarm Setting
Maximum Alarm Setting
Zero Offset – for contact probes only
Velocity

☞ **Note:**

While Custom Setups can be created in any instrument, the parameter settings, which may be modified and then saved in a Custom Setup, depend on the instrument's configuration. In a base model instrument, only the setup name, material velocity value (determined via calibration), alarm thickness values, and UT settings related to the probe setup can be modified and stored in a custom setup.

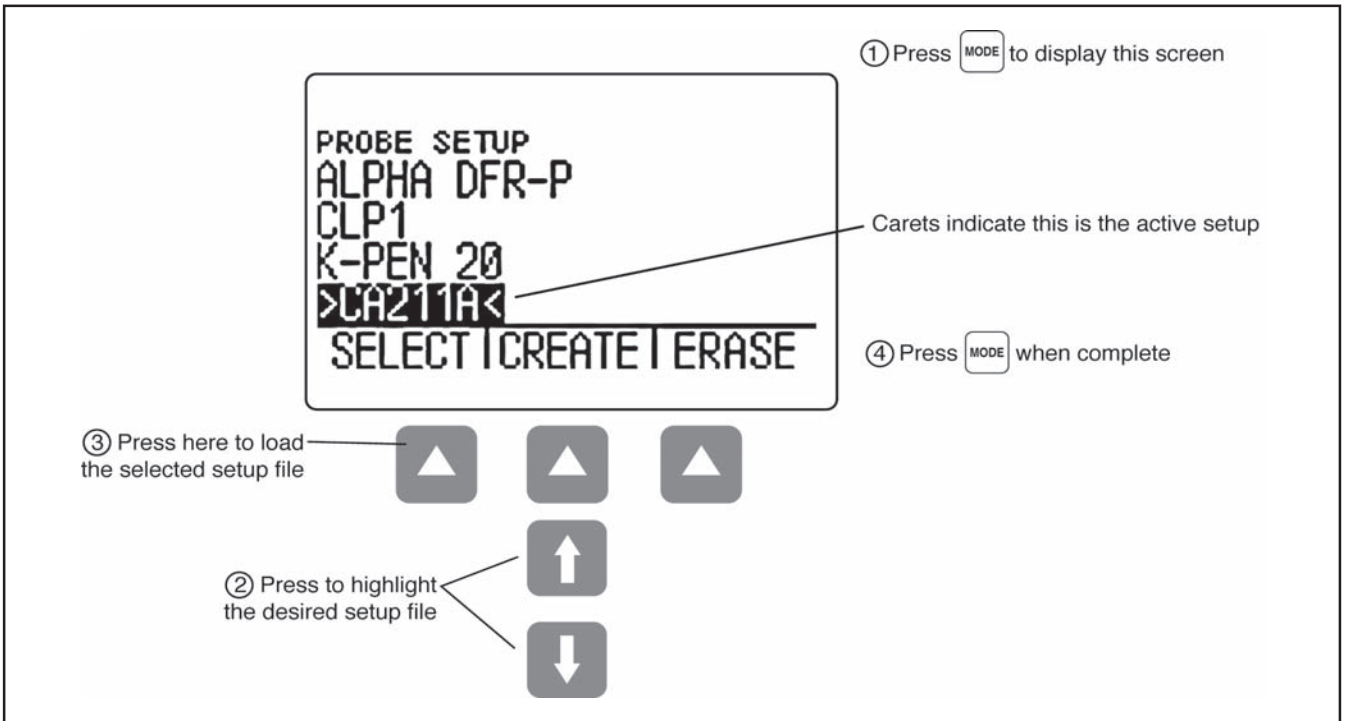

FIGURE 3-2—Selecting a Setup File

3.2 Configuring the Instrument

Prior to using the CL 5 to measure thickness, some or all of the following parameters must be specified using the Configuration display shown in Figure 3-3.

- Language – Set the displayed language to English, German, French, Spanish, Italian, etc.
- Units – Set the unit of measurement to inches or millimeters
- Resolution – Sets the number of decimal places to which thickness measurements are displayed
- Update Rate – Update the displayed measurement at a rate of 4 or 8 Hz
- Radix – Select a period (.) or comma (,) to be used as a decimal point
- Battery Type – Select from Alkaline, NiCAD, or NiMH
- Auto Power Down – Select ON to automatically turn the instrument off five minutes after the last key press (no data will be lost) or OFF to allow the instrument to remain on until manually powered off.
- Contrast – Adjusts the display contrast
- Backlight – Adjusts the display lighting (a setting of ON increases battery usage, a setting of AUTO causes backlighting to illuminate and remain on for Five Seconds after each key press.)

Each of these parameters is set the same way:

Step 1: Press [MODE] multiple times to access the display (shown in Figure 3-3).

Step 2: Press [↑] or [↓] to select each parameter you would like to modify.

Step 3: When the desired parameter is highlighted, press [CAL ON] to activate it.

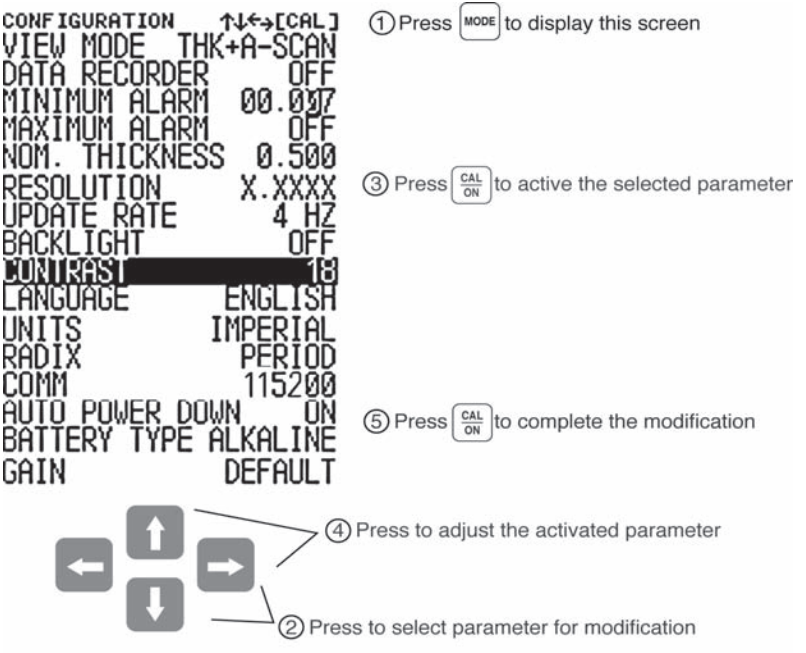

FIGURE 3-3—Changing Parameter Settings

Step 4: Press ↑ or ↓ to adjust the parameter's value.

Step 5: Press CAL ON when the parameter is set to the desired value.

Step 6: Continue selecting other parameters for modification as outlined in Steps 2 through 5. When complete with all modifications, press MODE to return to the measurement display.

3.2.1 Setting Instrument Gain

Instrument gain level is set to either a DEFAULT value or to a noise-reducing LOW setting. To select the instrument gain setting:

Step 1: Press MODE

Step 2: Select the GAIN control

Step 3: Press CAL ON to activate the control, then ↑ or ↓ to adjust the setting.

Step 4: Press CAL ON when the adjustment is complete.

3.2.2 Setting Update Rate

Measurements are updated at a rate of 4 or 8 Hz, as selected by the user. To select the measurement update rate:

Step 1: Press MODE

Step 2: Select the UPDATE RATE control

Step 3: Press CAL ON to activate the control, then ↑ or ↓ to adjust the setting.

Step 4: Press CAL ON when the adjustment is complete.

3.2.3 Specifying Nominal Thickness

When the VIEW parameter is set to DIFF/RR%, the displayed thickness includes two differential values (in the instruments units and as a percentage) that represent the variation from user-specified nominal thickness (Section 4.4). Nominal thickness is also

used to calculate material velocity when the velocity measurement option is installed. In VELOCITY view mode, nominal thickness can be manually input or directly measured using a connected digital micrometer (Section 4.6). To manually input or modify the nominal thickness:

Step 1: Press MODE

Step 2: Select the NOM THICKNESS control

Step 3: Press CAL ON to activate the control, then ↑ or ↓ to adjust the selected place value and ← or → to select another value.

Step 4: Press CAL ON when the adjustment is complete.

3.3 Instrument Calibration

Before measuring thickness with the CL 5, the instrument and connected probe must be calibrated. It's important that the setup file corresponding to the attached probe be selected prior to launching the calibration process.

Calibration requires the use of one or more standards of known thickness. When a contact probe is installed, either a one or two point calibration can be specified. Note that contact probe types require zeroing and the zeroing process is automatically accomplished as part of calibration. To calibrate the instrument, follow the instructions in Figure 3-4 and on your instrument's display screen.

☞ **Note:**

Proper calibration affects the accurate operation of the instrument. The instrument should be calibrated if there is a change in the type or temperature of the material being tested, if the attached probe is changed, after performing any parameter adjustment, or at intervals specified in your test procedures.

3.4 Setting the Maximum and Minimum Alarms

The CL 5 is equipped with a red LED (at the bottom center of the instrument's key pad) that illuminates whenever the user-inputted minimum or maximum

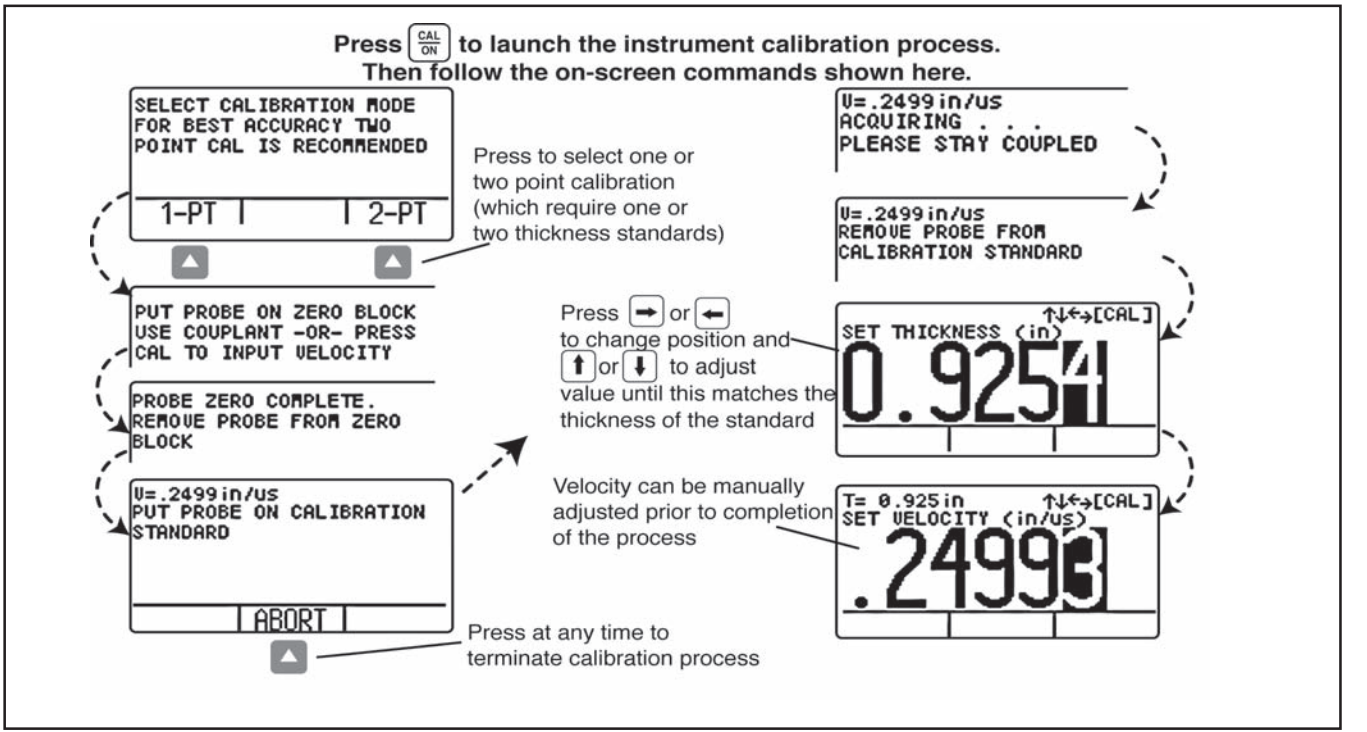

FIGURE 3-4—Instrument Calibration Procedure

alarm is violated. Note that the inputted alarm value will correspond to a thickness except when the VELOCITY measurement option is installed and activated. In this case the alarm settings will represent velocity values. To input a minimum or maximum alarm:

Step 1: Press MODE to access the Configuration display (shown in Figure 3-3).

Step 2: Press ↑ or ↓ to select

MINIMUM ALARM or **MAXIMUM ALARM**

Step 3: When the desired parameter is highlighted, press CAL ON to activate it.

Step 4: Press ← or → to change the selected position in the alarm thickness and ↑ or ↓ to adjust the value of the selected position. To switch the alarm setting to OFF from any other value, simultaneously press ↑ and ↓.

Step 5: Press CAL ON when the alarm thickness is set to the desired value.

3.5 Creating and Erasing Custom Setup Files

After loading a Standard Setup and performing the necessary adjustments to optimize performance for a given application, the instrument settings can be stored and named as a Custom Setup file. The instrument is capable of storing up to 5 Custom Setup files, which can be erased at any time (Figure 3-5).

Custom Setups can be created from any CL 5 keypad. Custom Setups created using a base-model instrument include the following settings:

- User-assigned Custom Setup file name
- VELOCITY

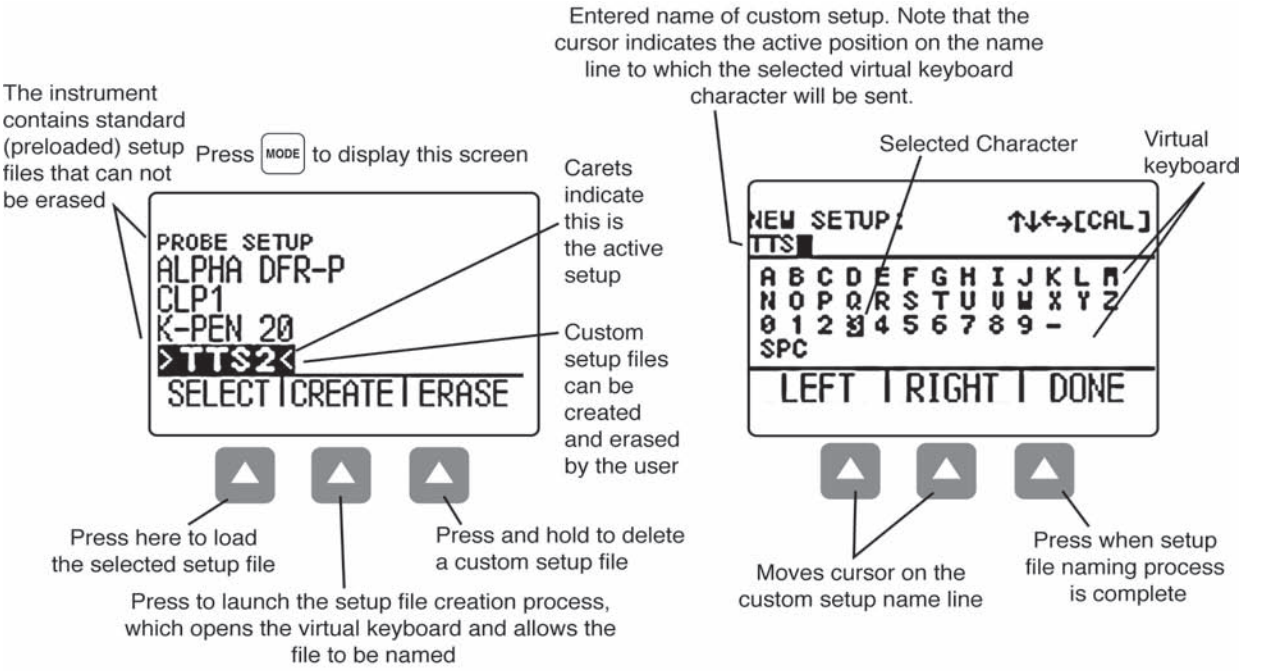

FIGURE 3-5—Follow this procedure to create or erase a Custom Setup file. Custom Setup file names may contain up to 16 characters.

- MINIMUM ALARM
- MAXIMUM ALARM

Custom Setups created using instruments equipped with an optional A-Scan display store the same parameters as a base-model unit as well as settings that affect measurement. A full listing of parameter settings stored in Custom Setup files is found in Table 3-1.

Whenever a Standard or Custom Setup file is recalled, all of the instrument settings revert to those settings stored in the file. Note that thickness measurements are part of Data Recorder files (see Chapter 5) and are not stored in Setup files.

☞ **Note:**

UltraMATE can be used to transfer Custom Setup files to a PC where they are stored. The stored Setup file can then be downloaded to any CL 5.

Table 3-1

CUSTOM SETUP FILE CONTENTS

Custom Setup File Name	Nominal Thickness—when differential, %RR, or Velocity mode is selected
Source Setup File Name	Minimum Alarm Thickness
Gain	Maximum Alarm Thickness
Resolution of Displayed Values	Zero Offset
View Mode	Velocity
Measurement Mode	

3.6 Locking and Unlocking Instrument Controls

Any instrument function can be made nonoperational (locked) using the lockout display. Note that this display is only accessible from the measurement screen. Follow the instructions in Figure 3-6 to access this display and lockout (or enable) some or all function keys.

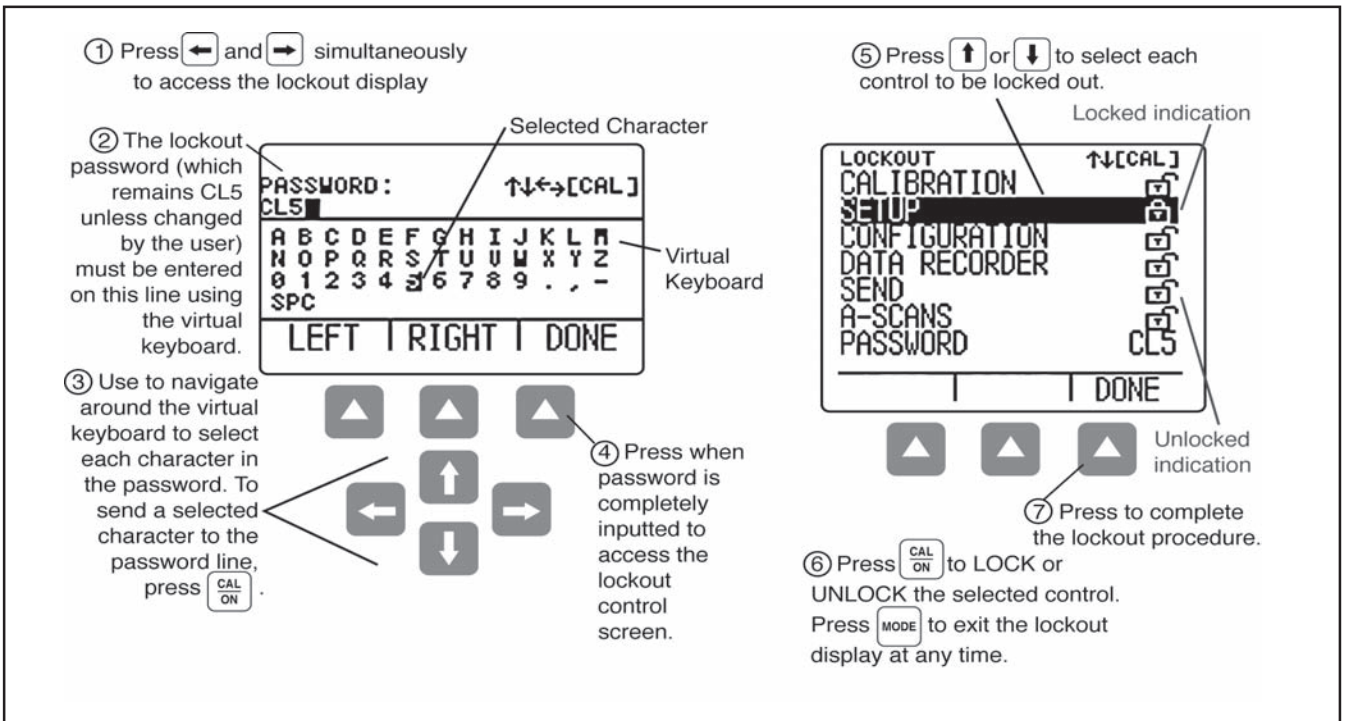

FIGURE 3-6—Procedure for locking and unlocking function keys

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Measuring Thickness 4

After setting up the instrument, as described in Chapter 3, additional adjustments can be made to select the type of measurement made and the way in which it is displayed. In this chapter, you'll also find information related to configuring and working with the optional A-Scan display including how to:

- Select the measured value to view (Section 4.1)
- Work with Normal measurement mode (Section 4.2)
- Use the Min Scan and Max Scan measurement modes (Section 4.3)
- Interpret the Differential/Rate-of-Reduction measurement mode (Section 4.4)
- Work with the optional Thickness + A-Scan measurement mode (Section 4.5)
- Use the optional Velocity measurement mode (Section 4.6)

☞ **Note:**

Load a Setup file corresponding to the connected probe prior to making the adjustments described in this chapter. Loading a Setup file after these adjustments are made will force certain settings back to the default value stored in the file.

☞ **Note:**

After making some or all of the adjustments described in this chapter, the modified instrument setup can be stored by creating a Custom Setup file. Your instrument will store up to 5 Custom Setup files, which are created (and erased) via the setup display. See Section 3.5 for step-by-step instructions to create a Custom Setup file.

4.1 Selecting the Displayed View

The measurement displayed by the instrument is modified by

Step 1: Press MODE multiple times to access the configuration menu

Step 2: Press ↑ or ↓ to select the VIEW MODE parameter

Step 3: Press CAL ON to activate this parameter

Step 4: Scroll through the available modes by pressing ↑ or ↓. Press CAL ON to select the displayed mode (described below).

Base model instruments offer four display modes. In addition, two more display modes are available depending on the installed options. Display modes include:

NORMAL (Thickness Only) – The thickness value appears as large digits in the center of the display. No live A-Scan is displayed but an A-Scan snapshot of the triggering echo can be accessed (Section 4.2).

MIN SCAN (Minimum Thickness Scan) – Allows the user to continuously evaluate material thickness (provided the probe remains coupled or is uncoupled only briefly) then, when the evaluation period is complete, the minimum material thickness is displayed. During the evaluation period, thickness is displayed along with the minimum and maximum observed thickness values (and the calculated difference between the two). The display also includes a time-out bar, which begins to fill as soon as the probe is uncoupled. Recoupling the probe before the time-out period expires allows the user to continue with the same evaluation period. When the evaluation period is complete (after the probe is uncoupled and the time-out bar fills), the minimum thickness observed during the evaluation period is displayed. Its corresponding A-Scan can also be displayed by pressing ▲. At this point the screen is frozen. Recouple the probe to reactivate the display screen (Section 4.3).

MAX SCAN (Maximum Thickness Scan) – Allows the user to continuously evaluate material thickness (provided the probe remains coupled or is uncoupled only briefly) then, when the evaluation period is complete, the maximum material thickness is displayed. During the evaluation period, thickness is displayed along with the minimum and maximum observed thickness values (and the calculated difference between the two). The display also includes a time-out bar, which begins to fill as soon as the probe is uncoupled. Recoupling the probe before the time-out period expires allows the user to continue with

the same evaluation period. When the evaluation period is complete (after the probe is uncoupled and the time-out bar fills), the maximum thickness observed during the evaluation period is displayed. Its corresponding A-Scan can also be displayed by pressing ▲. At this point the screen is frozen. Recouple the probe to reactivate the display screen (Section 4.3).

☞ **Note:**

During the placement of a very sensitive probe on the part surface, excess couplant may cause erroneous results. To eliminate the effect of excessive couplant, couple the probe firmly to the part, then press ▲ under the ASCAN function, then press ▲ under HOME. This restarts the scanning session while the probe is properly in contact with the part.

DIFF / RR% (Differential / Rate-of-Reduction) – The currently measured and user-inputted nominal thickness appear along the top of the display while the difference between these two values (measured minus nominal values expressed in percentage and dimensional terms) appears in the middle of the display. Note that the displayed differences can have positive or negative values (Section 4.4).

THK + A-SCAN (Thickness and A-Scan) – An A-Scan appears in the center portion of the display and the thickness value is shown in the display's upper right-hand corner (Section 4.5).

VELOCITY (Material Velocity) – The material velocity value appears as large digits in the center of the display. This velocity calculation requires an accurate NOMINAL THICKNESS value which can be inputted by the user or by using the connected digital caliper. Note that no live A-Scan is displayed but an A-Scan snapshot of the triggering echo can be accessed (Section 4.6).

4.2 Normal Measurement Mode (No Live A-Scan)

When NORMAL view mode is active, the display only contains a thickness reading (see Section 4.1 to select view mode). While no live A-Scan is available, an A-Scan Snapshot can be accessed at any time by pressing ▲ directly below A-SCAN on the function bar (Figure 4-1).

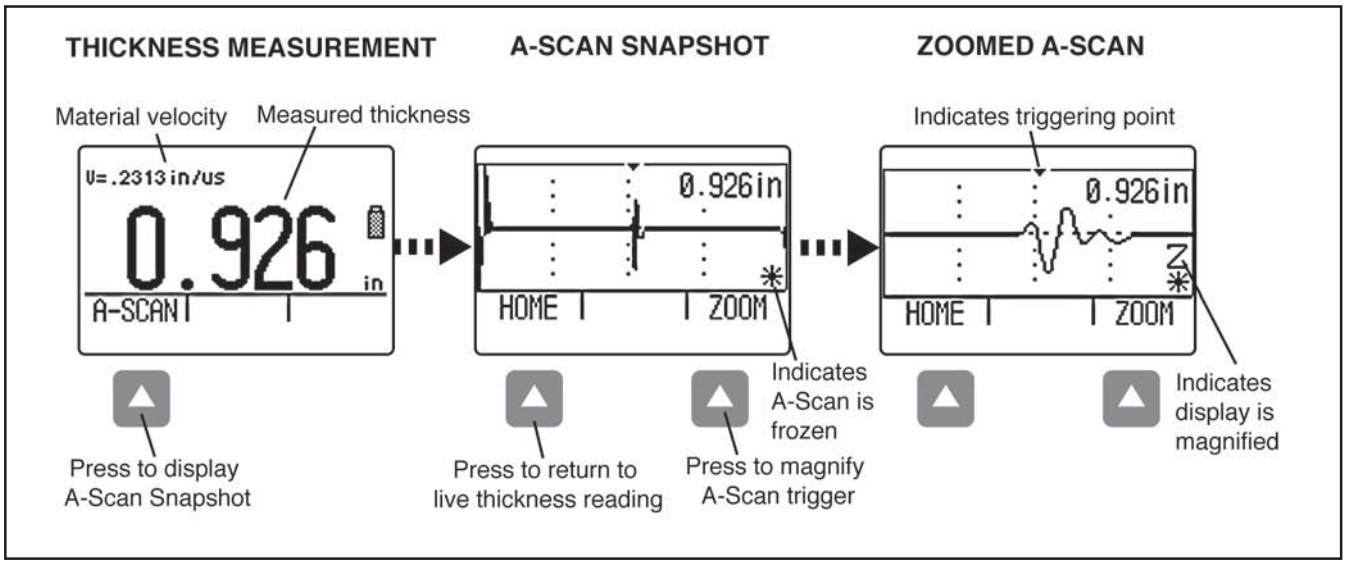

FIGURE 4-1—NORMAL view mode displays only the thickness reading. Selecting the A-SCAN function bar option allows you to view a Snapshot of the A-Scan echo that is represented by the thickness reading. This A-Scan is frozen. No live A-Scan echo is available in this view mode.

4.3 Min Scan and Max Scan Measurement Modes

These modes allow the user to continuously evaluate material thickness then, when the evaluation period is complete, display the extreme (minimum or maximum) material thickness observed. During the evaluation period, thickness is displayed along with the minimum and maximum observed thickness values (Figure 4-2). ***See Section 4.1 to select view mode.***

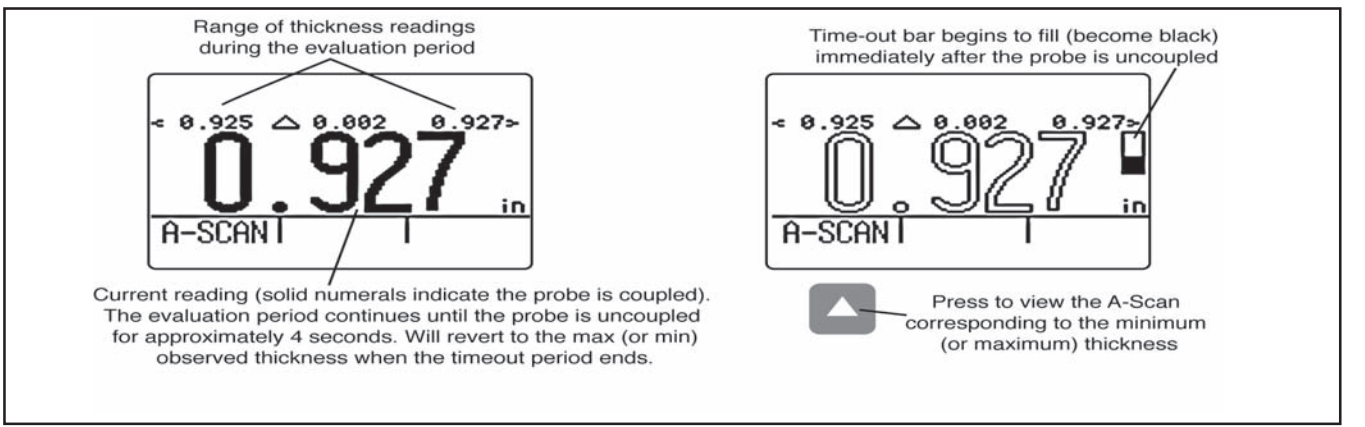

FIGURE 4-2—MIN SCAN and MAX SCAN views allow the user to observe thickness measurements over an area, and display the maximum and minimum thickness encountered during the evaluation period. The time-out feature (represented by the bar shown here) allows the user to momentarily uncouple during the evaluation period, and then recouple to continue the same period. In these modes the instrument will continue to collect and compare thickness readings for as long as the probe remains coupled.

4.4 Differential / Rate-of-Reduction Measurement Mode

This view mode displays the currently measured and user-inputted nominal thickness, along with the difference between these two values (measured minus nominal) expressed in percentage and dimensional terms. Note that the displayed differences can have positive or negative values (Figure 4-3). ***See Section 4.1 to select view mode and 3.2.3 to specify nominal thickness.***

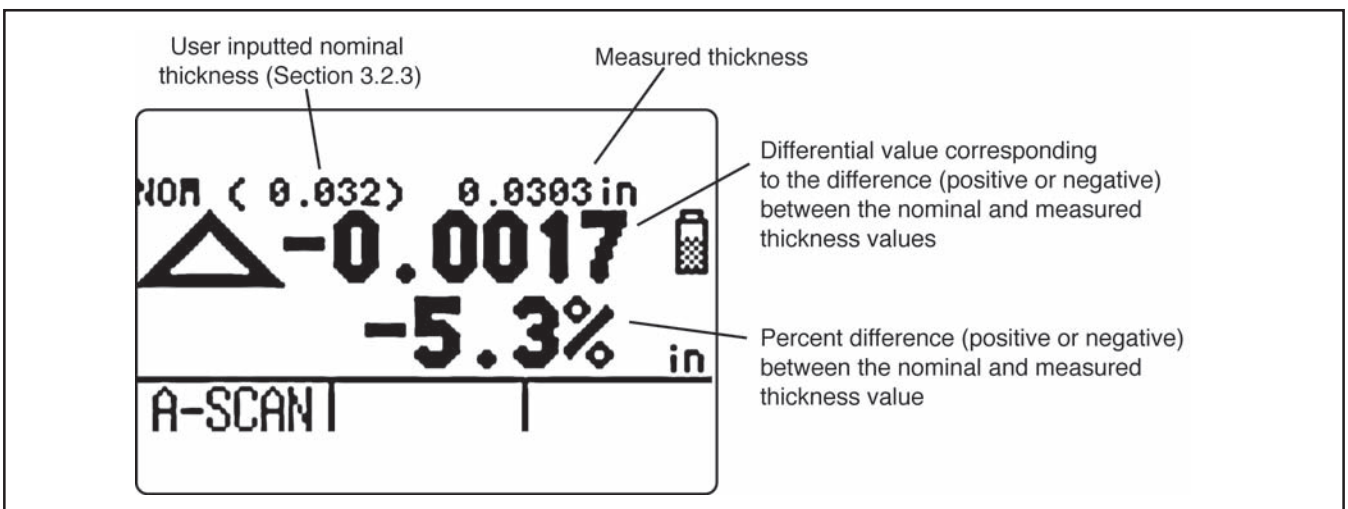

FIGURE 4-3—The DIFF / RR% view compares the live measurement with a user-inputted nominal material thickness. This comparison is then expressed as a differential measurement and a percentage of the nominal thickness.

4.5 Thickness + A-Scan Measurement Mode (Optional)

This *optional* view mode displays both a live A-Scan reading and corresponding thickness value. Selecting FIND moves the triggering echo to the center of the display while FREEZE captures the live A-Scan. After the display is frozen, select ZOOM to magnify the triggering echo (Figure 4-4). ***See Section 4.1 to select view mode.***

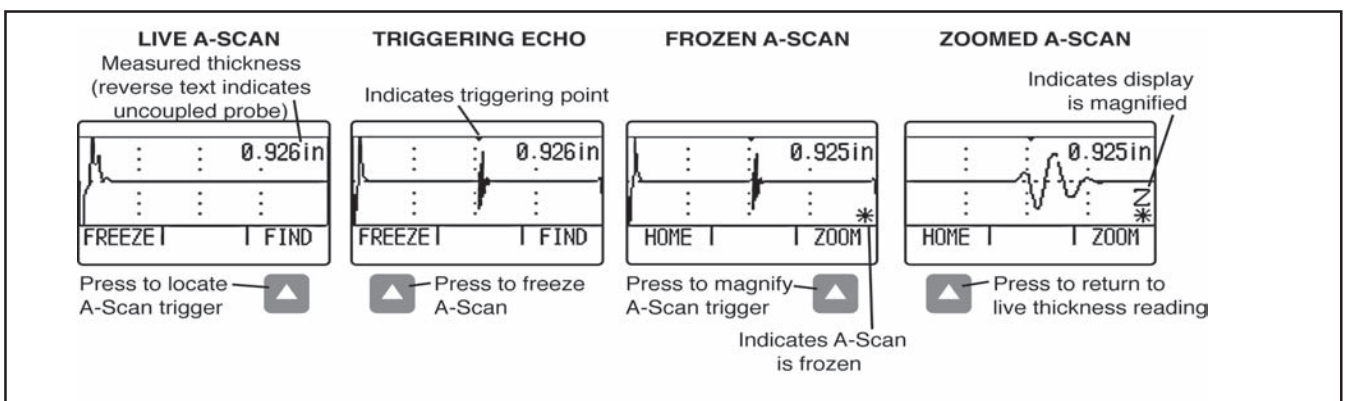

FIGURE 4-4—THK + A-SCAN view mode displays, freezes, and magnifies a live A-Scan.

4.6 Velocity Measurement Mode (Optional)

This *optional* view mode displays measured material velocity (see Section 4.1 to select view mode). The material velocity calculation depends on the value inputted for the test material's nominal thickness. This nominal thickness value can be manually inputted (Section 3.2.3) or by using the digital caliper supplied with all instruments that incorporate the Velocity option. (Figures 4-5 and 4-6). Note that when operating in VELOCITY view mode, material velocity values may be entered for MINIMUM and MAXIMUM ALARMs (Section 3.4).

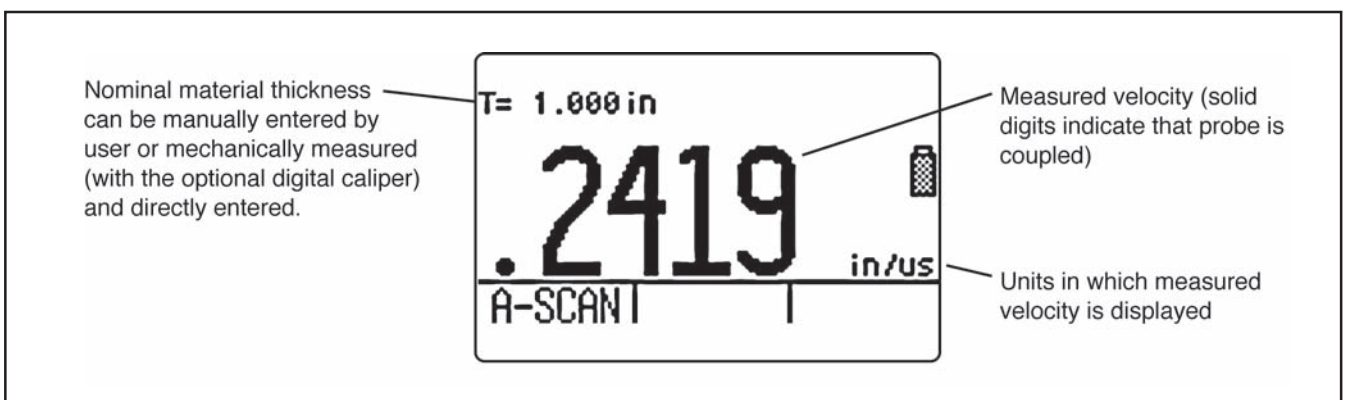

FIGURE 4-5—VELOCITY view mode allows measurement of acoustic velocity based on a user inputted (or manually measured) mechanical thickness.

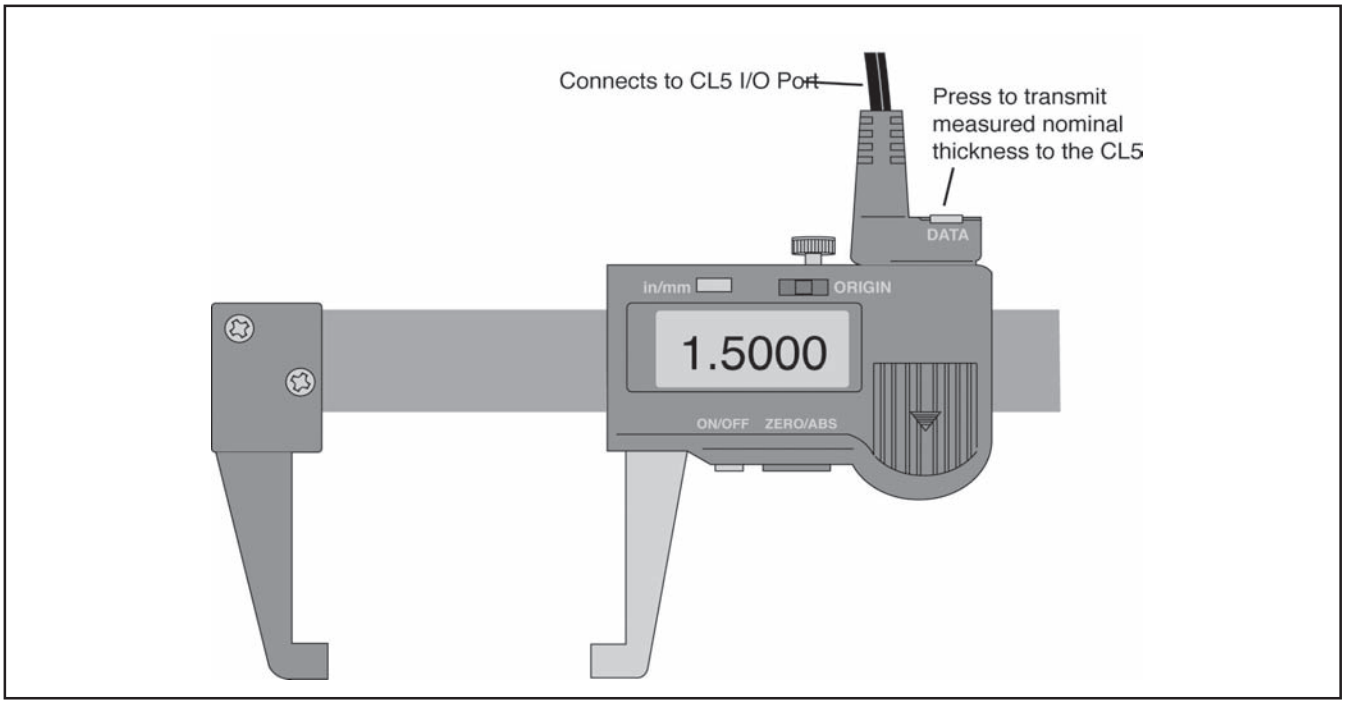

FIGURE 4-6—Direct input of nominal thickness in VELOCITY mode.

Using the Optional Data Recorder 5

☞ **Note:**

The instructions here apply only to instruments equipped with a Data Recorder.

When installed and activated, the data recorder option allows users to create Data Recorder files, store thickness readings (and accompanying A-Scans when desired), and navigate through file contents. In this chapter you'll learn how to

- Create Data Recorder files (Section 5.1)
- Recall and erase Data Recorder files (Section 5.2)
- Store thickness readings in Data Recorder files (Section 5.3)
- Store A-Scans in Data Recorder files (Section 5.3.1)
- Navigate Data Recorder file locations to store or delete readings (Section 5.3.2)
- Print reports (Section 5.4)

5.1 Creating a New Data Recorder File

To create a new Data Recorder file, you need only specify a file name. In most cases, however, you'll wish to enter additional information. Parameters that can be adjusted during the file-naming process include:

- The first (TOP) and last (BOTTOM) positions in the Data Recorder file (Figure 5-2 describes how these define the number of locations in the new file)
- The ADVANCE DIRECTION (described in Figure 5-2)
- NOTES related to the data file

Follow *Steps* 1 through 5 in Figure 5-1 to create a new Data Recorder file.

☞ **Note:**

Once created, the file name and size parameters can NOT be edited. Only the ADVANCE DIRECTION parameter and NOTES contents can be modified. To accomplish this, first select the file then activate and modify the parameter.

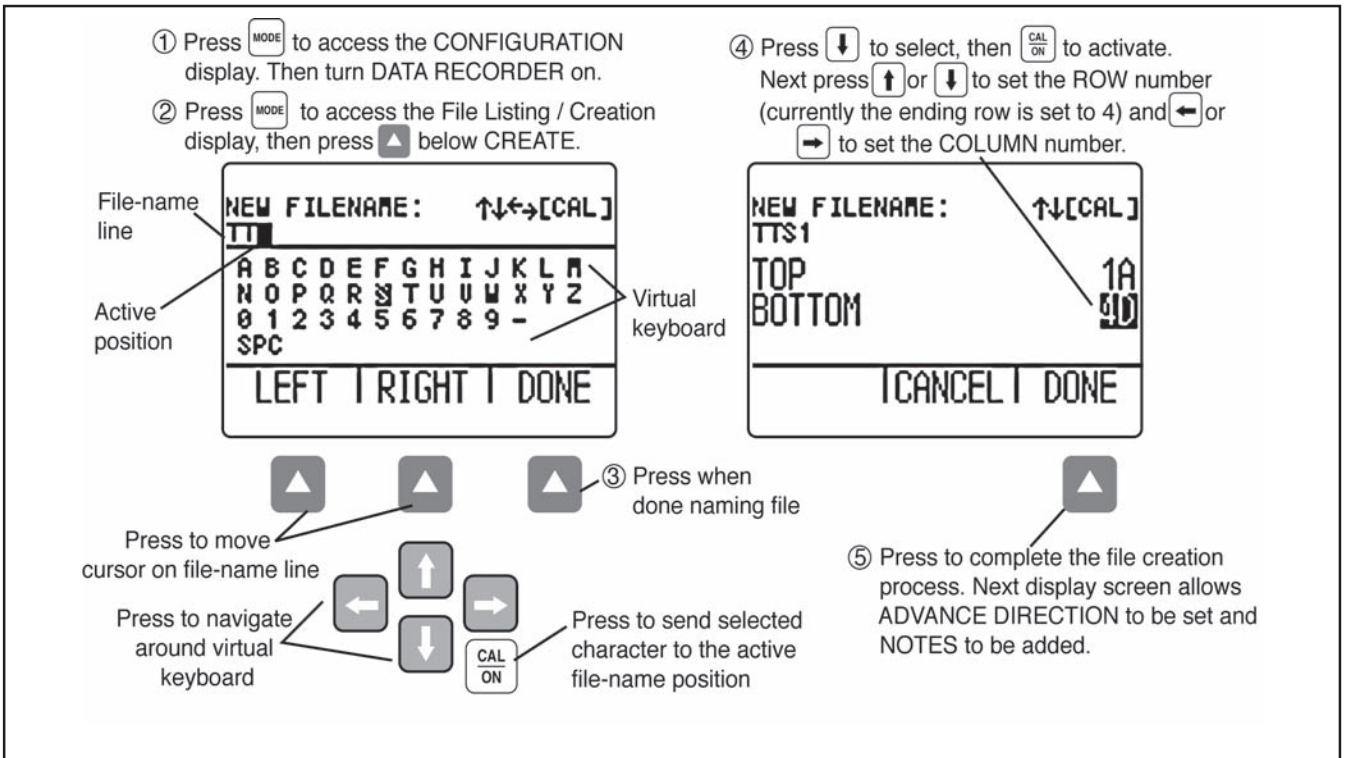

FIGURE 5-1—Creating a New Data Recorder File

5.2 Recalling and Erasing Stored Data Recorder Files

Stored files can be recalled or erased at any time. Once recalled, thickness measurements can be stored in empty file locations, existing measurements can be deleted and the advance direction can be changed. To recall a Data Recorder file:

Step 1: Press MODE to access the CONFIGURATION display, then set DATA RECORDER to ON.

Step 2: Press MODE again to launch the File Display mode

Step 3: Activate the file selection function by pressing ▲ below FILES. A file list will appear on the display.

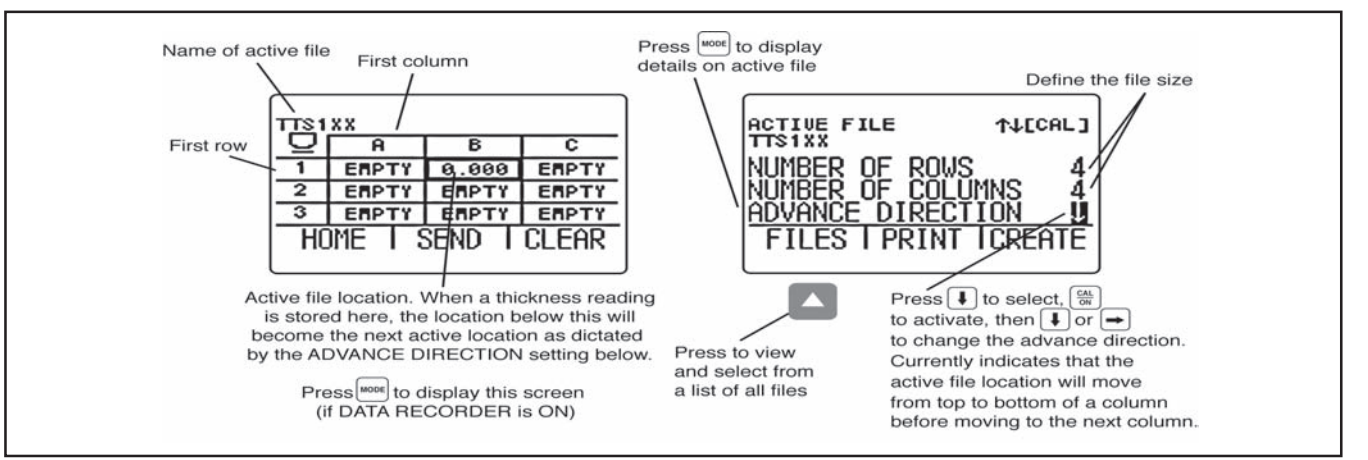

FIGURE 5-2—Defining the Size and Advance Direction of a Data Recorder File

Step 4: Press ↑ or ↓ to select the stored file you wish to recall, and then press CAL ON.

To erase a Data Recorder file:

Step 1: Press MODE to launch the File Display mode

Step 2: If required, press ▲ below FILES to obtain a list of stored files.

Step 3: Press ↑ or ↓ to select the stored file you wish to erase, and then press and hold ▲ below ERASE.

☞ **Note:**

Once erased, the Data Recorder file and any stored thickness measurements can not be retrieved.

5.3 Recording Thickness and Velocity Measurements in Data Recorder Files

The Data Recorder must be enabled (turned ON) via the CONFIGURATION display. Once the Data Recorder is turned on, the contents of the active Data Recorder file are displayed in the File Navigation Grid shown in Figure 5-2.

To store a thickness reading in the selected file position, press ▲ below SEND. Remember that the units of the thickness value, and the number of decimal places to which the thickness is recorded, are determined by the UNITS and RESOLUTION settings as described in Section 3.2.

☞ **Note:**

Pressing and holding ▲ below SEND for three seconds will cause the thickness and displayed A-Scan to be stored in the selected position as described in Section 5.3.1.

☞ **Note:**

Pressing ▲ below SEND with the instrument connected to a PC that has the applicable software installed and running will result in the thickness reading being sent out the I/O port as described in Section 6.1.

5.3.1 Recording A-Scans in Data Recorder Files

An A-Scan can be stored in that active position of the Data Recorder by pressing and holding (for three seconds) ▲ below SEND.

5.3.2 Navigating Through Data Recorder Files

When the Data Recorder is turned on, the contents of the active Data Recorder file are displayed in the File Navigation Grid shown in Figure 5-2. Once the navigation grid is activated, ↑, ↓, ←, and → can be used to select any file position. Note that a heavier grid box appears around the selected file position. Once a file position is selected:

- The current thickness reading can be sent to an EMPTY file position
- A measurement value can be stored by pressing ▲ below SEND
- An already stored value can be deleted by pressing ▲ below CLEAR

5.4 Printing a Report

☞ **Note:**

The following procedure explains how to print the contents of a stored Data Recorder file.

Once the instrument is configured for the connected PC (see Section 6.2), you can proceed with the report printing process. A printed report will include:

- A file header listing Data Recorder file name
- A description of the file's structure including number of rows, columns, and a listing of NOTES
- All thickness measurements stored in the Data Recorder file, along with an indication if the file has an A-Scan attached or resulted from a Minimum or Maximum thickness scanning session.
- Attached A-Scans are NOT printed as part of the report

Step 1: Press MODE to access the Data Recorder file display as shown in Figure 5-2.

Step 2: Follow the regular procedure to select the file to be printed.

Step 3: Press ▲ below PRINT to launch the report printing process. All features listed above will be included in the printed report.

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I/O Features 6

☞ **Note:**

The instructions in this chapter apply to all instruments.

The instrument can communicate with external devices in several ways. All of these communication methods rely on the instrument's I/O port. The following cables are available for connection to this RS-232 port (see Figure 3-1 for location):

- USB PC Cable
- Serial PC Cable
- Digital Caliper—Velocity Option
- Li Battery Pack's Charging cable

The instrument determines if the cable is connected to a device provided the device is not "off line" or "busy".

Individual thickness readings and A-Scans can be transmitted to an attached device. With the use of remote codes, a PC can control the instrument.

In this chapter you will find:

- The byte structure used when thickness readings are transmitted through the I/O port (Section 6.1)
- Remote commands (Section 6.2)

6.1 Transmitting Data to an External Device

When ▲ below SEND is pressed to transmit a thickness or velocity value through the I/O port, data will be transmitted at 8 data bits, 1 stop bit, no parity, and at the user-specified baud rate. The transmitted data will be in a 13-byte message format, structured as shown in Table 6-1. Note that data can be transmitted (and SEND appears) only when the PC cable is connected to a device that can receive data.

Table 6-1	
Format of Transmitted Thickness Measurements	
Byte 1	"+" or "-" for displayed differential thickness values "?" for displayed high resolution metric velocity values " " (space) for all other displayed values
Byte 2,3,4,5,6	Display value (4 digits and decimal point) .0000 0.000 00.00 000.0 0000.
Byte 7	" " (space)
Byte 8,9,10,11	"IN " for displayed inch thickness values "MM " for displayed metric thickness values
Byte 12	Carriage Return (ASCII 13)

6.2 Setting Communication Speed (Baud Rate) and Connecting to a PC

Using the proper cable, the instrument's I/O port can be connected to a PC. Before connecting to a PC do the following:

Step 1: Press MODE to display the CONFIGURATION menu

Step 2: Select the COMM (communication) control

Step 3: Press CAL ON to activate the control, then ↑ or ↓ to adjust the selected baud rate to match that of the connected device. Data transfer will not occur if the selected baud rate does not match the device.

Step 4: Press CAL ON when the desired value is selected.

6.3 Remote Commands

The CL 5 can receive coded instructions from a personal computer or terminal connected to the RS-232 I/O port. Queries, key presses and adjusting instrument settings can be done remotely by using a user written program or a commercially available serial communications program such as Windows™ HyperTerminal. After starting and configuring the program, commands are inputted using the computer keyboard.

Two types of command structures are possible:

- To request the status or value of a function the following sequence is used:

  <ESC><COMMAND><RETURN>

- To execute a keypad operation or adjust a setting the following sequence is used:

  <ESC><COMMAND><SPACE><VALUE><RETURN>

  Examples:

  <ESC><8J><RETURN>

  The CL 5 will now return the version of instrument operating software.

<ESC><7K><SPACE><11><RETURN>

The CL 5 now displays the Setup Screen listing all stored default and custom probe setups.

Remote Control Codes:

The following is a partial listing of remote commands. Additional remote commands are available upon request.

Strings inside [ ] are values / parameters

Codes supporting queries are indicated with *

Code	Query	Parameter	Range	Resolution	Function
ID*	Yes (not req.)				Identification: INSTRUMENT returns "CL 5".
DP*	Yes (not req.)				Directory of Parameter Sets: INSTRUMENT will return a list of parameter sets (custom setups) in the same format as the file directory structure: 0001 XXXXXXXXXXXXXXX 0002 XXXXXXXXXXXXXXX 0003 XXXXXXXXXXXXXXX 0004 XXXXXXXXXXXXXXX
DR*	Yes (not req.)				Directory: INSTRUMENT will return a list of data recorder files with file type information (file name field indicated by X's is 24 characters) : (only supported when Data Recorder option is enabled.) 0001 XXXXXXXXXXXXXXX GRID 0002 XXXXXXXXXXXXXXX CLIIN
FX (n)	NO	file number on dir list	1 to Number of files	1	INSTRUMENT will transmit the file indicated by (n). (n) should be the file number as displayed on the directory list. (only supported when Data Recorder option is enabled.)
FU					File Upload: INSTRUMENT will go into file receive mode. This should not be used for parameter sets. (only supported when Data Recorder option is enabled.)
PU [n]		Parameter set number	1 to 11 (1 to 7 on CL5P)	1	Parameter Set Upload: INSTRUMENT will go into parameter set receive mode. The parameter [n] indicates which parameter set to replace with the one uploaded.

(Continued)

Code	Query	Parameter	Range	Resolution	Function
PD [n]	NO	Parameter set number	0 to 11 (0 to 7 on CL5P)		Parameter Set Download: INSTRUMENT will go into parameter set download mode sending the requested parameter set. [n] indicates the parameter set number that is requested. 0 sends the presently active instrument parameters.
AM					Available Memory: INSTRUMENT will return memory available on SD card in bytes.
AP [str]	NO	Setup Name			Loads the setup indicated by the parameter string name specified.
AF [n]	YES	file number on dir list	1 to number of files	1	Active File: Set / Query the active data recorder file.
7K [n]	NO	key press code		1	Key Press: [n] = value indicated what key press to execute. #define KCODE_NO_KEY 0 #define KCODE_F1 1 #define KCODE_F2 2 #define KCODE_F3 3 #define KCODE_UP_ARROW 4 #define KCODE_DOWN_ARROW 5 #define KCODE_LEFT_ARROW 6 #define KCODE_RIGHT_ARROW 7 #define KCODE_MODE 8 #define KCODE_ON_OFF 9
7H	NO				HOME: Sets instrument to TG measurement view mode.

(Continued)

Code	Query	Parameter	Range	Resolution	Function
7R	NO				Soft parameter reset. Resets the following parameters to their defaults: View Mode:Thickness Radix: PERIOD Backlight: OFF Language: English Batteries: Alkaline (unless Li battery is detected) Power Down: Auto Units: INCH Resolution: X.XXX Lock Outs : OFF (all lockout parameters) Nominal Thickness: 0.000 Min / Max Alarms: 0.000 (OFF) Baudrate (not-affected)
8J	YES(not req)				Query for Operating System version number
8K	YES(not req)				Query for Instrument Serial Number
8M					Query for Boot code revision string.
8N					Query for FPGA design revision string.
8T	YES(not req)				Query for internal instrument temperature.
8Y	NO	LCD Memory Dump			Will dump data containing the bitmap of the LCD display memory in one of several formats. This is the binary dump. This dumps the video memory byte for byte.

(Continued)

Code	Query	Parameter	Range	Resolution	Function
9C	NO	none			Places instrument into factory calibration / configuration mode
9D	NO	none			Active only while in factory calibration / configuration mode. Download the presently active calibration data from the instrument. The instrument will respond by sending 256 bytes of the calibration space in decimal number format with a CR after each one.
9U	NO	none			Active only while in factory calibration / configuration mode. Upload the calibration space to the instrument. The instrument will expect to receive 256 bytes of configuration space with a CR after each. The instrument will respond with a CR after each byte is processed.
9P	NO	Pulser disable			Active only while in factory calibration / configuration mode. Disables pulser for gain calbrations. 0 - enable 1 - disable
9A	NO	none			Program updated calibration space back into EEPROM
MS	YES				Query for the present instrument thickness, velocity, couple status: Output Format: (comma delimited fields) Thickness , Velocity , couple status Thickness will always be a whole number in .001 mm resolution. Velocity will be in 0.1 m/s. Couple flag will be "C" for coupled, "U" for uncoupled

(Continued)

Code	Query	Parameter	Range	Resolution	Function
8W	NO	Streaming Data Mode	1		Turning this mode on(x) or off(0) will put the instrument in a mode where the thickness value and TOF will be send over the UART after each acquisition. This may slow the instrument down at slow baud rates or when running in Min-Cap mode. Output Format: (comma delimited fields)
			2		THICKNESS , VELOCITY , COUPLE STATUS Thickness will always be a whole number in .001 mm resolution. Velocity displayed in 1 m/s resolution Couple flag will be "C" for coupled, "U" for uncoupled
			3		THICKNESS , ALARM STATUS , COUPLE STATUS Alarm is displayed as: < : thickness is less than min alarm (if on)Ñ : no alarm > : thickness is greater than max alarm (if on)
			4		TOF , COUPLE STATUS Time of flight resolution in nano-seconds THICKNESS , DIFFERENCE , RR% , COUPLE STATUS Difference is calculated from nominal thickness RR% is the percentage difference from nominal thickness
			5		THICKNESS , MIN THICK , MAX THICK , COUPLE STATUS Min and max thickness are the thickness values, in .001 mm resolution for the capture session. Min and Max will be displayed as the - sign when a new capture session is started and no new min or max has been captured.
TR	NO	Thickness Display Resolution	0 - x.xxxx 1 - x.xxx 2 - x.xx 3 - x.x		Sets thickness display resolution
PR	NO	Lockout Password Reset			Resets the lockout password to CL5 and sets all lockout parameters to unlocked.

Specifications 7

This chapter lists the features and specifications of your CL 5 including:

- Instrument Specifications (Section 7.1)
- Features of the Optional A-Scan (Section 7.2)
- Features of the Velocity Measurement Option (Section 7.3)
- Features of the Optional Data Recorder (Section 7.4)
- Probe Specifications (Section 7.5)

7.1 Instrument Specifications

Operating Principle:	Ultrasonic, pulse echo measurement method
Measuring Range:	0.006 to 20.00 inch depending on probe and material 0.16 to 500 mm
Measuring Resolution:	inch 0.001 default (selectable 0 .0001, 0.001, 0.01 inch) mm 0.01 default (selectable 0.001, 0.01, 0.1 mm)
Material Velocity Range:	0.03937 to 0.78736 in/µs 1000 to 19999 m/s
Material Velocity Resolution:	0.00001 in/µs 0.1 m/s

Units:	Inch or millimeter
Calibration:	Enter velocity or thickness Contact: One point or Two point calibration Delay: One point
Pulser:	
Excitation Pulse:	Spike Pulser
Voltage:	100 V into 50 ohm load, using 20 MHz Scope
Receiver	
Bandwidth:	1.0 to 10 MHz @ -3 dB
Gain:	Automatic Gain Control
Display Type:	High Resolution: Graphical LCD 64 x 128 Pixels, 2.25" × 2.56" (40 × 57 mm) with backlight and adjustable contrast.
Update Rate:	4 Hz or 8 Hz (User Selectable)
Thickness Value Display:	5 digit 0.75" (19 mm) high NORMAL MODE 5 digit 0.25" (6 mm) high with display of A-SCAN)

Display of Last Reading:	Solid filled or hollow digits indicate coupled or uncoupled condition.
Setups:	6 Standard Setups for Contact and Delay probes 5 Custom Setups with up to 16 character alphanumeric name
Alarm Settings:	Minimum and Maximum Alarms Range of 0.005-20 in. (0.1-508 mm) Red LED illuminates and < or > displayed when alarms are enabled and violated.
Power Requirements:	Standard Li Battery Pack with on-board charger. Batteries 3 each, “AA” size Alkaline, NiCad or NiMH
Battery Life/Operating Time:	Approximately 24 hours
Instrument Shut-0ff:	Selectable ALWAYS ON or AUTO OFF after 3 minutes of inactivity
Language:	Selectable English, German, French, Spanish, and Italian
Baud Rate:	Selectable 115200, 57600, 9600, 1200

I/O Connectors	
Transducer:	00 Lemo (coax)
RS-232, Battery Charger:	Micro—D9 (Female), Charger 100–240 V, 50–60 Hz
Temperature	
Operating:	+10°F to +140°F (-10°C to +60°C)
Storage:	-10°F to +160°F (-20°C to +70°C)
Weight:	0.92 lbs. (420 g) including batteries
Size:	7.1” H x 3.7” W x 1.8” D (180 mm x 94 mm x 46 mm)

Instrument specifications subject to change without prior notice.

7.2 A-Scan Option Parameter Adjustments

Display View	Thickness + A-Scan

Instrument specifications subject to change without prior notice.

7.3 Velocity Measurement Option Features

Display View	VELOCITY Measurement

7.4 Data Recorder Option Features

Capacity: attachments	120 files each containing 10,000 readings with or without A-Scan (May vary based on size of SD card used.)
File Structures	Grid created from instrument keypad and Custom Linear created with UltraMATE
File Naming:	Up to 24 character alphanumeric name
Optional Software:	UltraMATE and UltraMATE Lite

Instrument specifications subject to change without prior notice.

7.5 CL 5 Probe/Transducer Specifications

Model	Probe Type	Nominal Freq.	Contact Diameter	Measuring Range
A-2 DFR & CLF4	Standard Delay Line	15 MHz	0.30 in. 7.6 mm	0.007 to 1.0 in. 0.18 to 25.4 mm Steel

Model	Probe Type	Nominal Freq.	Contact Diameter	Measuring Range
Alpha 2F & CLF5	Fingertip Contact	10 MHz	0.38 in. 9.5 mm	0.060 to 10.0 in. 1.52 to 254 mm Steel
Alpha DFR-P	Plastics, Delay Line	22 MHz	0.30 in. 7.6 mm	0.005 to 0.15 in. 0.13 to 3.8 mm Plastic
Mini-DFR	Thin Range Delay Line	20 MHz	0.19 in. 4.8 mm	0.005 to 0.200 in. 0.13 to 5.1 mm Steel
CL1P1	Pencil Probe	15 MHz	0.065 or 0.090 in. 1.7 or 2.3 mm	0.008 to 0.175 in. 0.20 to 4.4 mm Steel
CA211A	Standard Contact	5 MHz	0.75 in. 19.1 mm	0.060 to 20.0 in. 1.52 to 508 mm Steel

Note: Other Probe Models Available upon request

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Maintenance 8

Care of the Instrument

Clean the instrument housing and display using a soft cloth lightly dampened with water or a mild window-cleaning product. Never use harsh solvents as they could cause the plastic to become brittle or damaged.

Care of Delay Line Probes

Replace delays showing signs of excessive wear or those embedded with metal turnings. Delays in good condition should periodically have the couplant between the probe face and delay refreshed as follows:

- Remove the delay by unthreading the knurled ring
- Wipe clean the mating surfaces of the delay and transducer face
- Apply a fresh drop of lightweight oil (recommend XD-740 couplant) and replace the delay line

Proper Cable Handling

- Avoid twisting or knotting of the cable
- Grasp the cable only by the connectors when connecting or disconnecting from the instrument

Batteries

Periodically inspect the batteries for signs of leakage or corrosion. If either occurs, remove and replace ALL the batteries. Take care to properly dispose of the defective batteries.

Appendix 9

This section contains supplementary information including instructions on:

- Resetting the Instrument's Operating Software
- Upgrading the Instrument's Software
- EMC Documentation
- Manufacturing and Service Center Locations

9.1 Resetting the Operating Software

WARNING: The following procedure deletes all Custom Setup files stored in the instrument. Any files you wish to retain should be downloaded using the UltraMATE PC software before resetting the operating software. Data recorder files (if so equipped) stored on the installed SD card will not be deleted.

To reset the instrument's operating software:

Step 1: Turn off the instrument.

Step 2: Press and hold down MODE then press and hold down CAL ON. Continue to press both keys for approximately three (3) seconds until the power-on sequence is initiated.

Step 3: A successful reset is acknowledged when the RESET COMPLETE message briefly appears in the display screen's bottom center.

9.2 Upgrading the Operating Software

The CL 5 operating software can be upgraded using an internet connection and an upgrade utility program. Each instrument is shipped with a CD containing the CL 5 Upgrade Utility Program.

Step 1: Install the Upgrade Utility Program on your Internet connected PC.

Step 2: Run the program by clicking on the program icon, located on your Program Menu. (Click the START and then RUN buttons, select PROGRAMS, and select CL 5 Upgrade Utility.)

Step 3: Select the Download New File button.

The program will connect to the GE Inspection Technologies, FTP site (you may need to be connected to the Internet prior to this operation). The program checks the version you have on your machine against the version that is on the FTP site. If the version on the FTP site is newer, it will download the CL 5 operation code. If they are the same, it will not download the program, but exit the download routine.

Step 4: Turn off the CL 5 and connect it to the PC.

Step 5: Click on the Upgrade The Instrument button.

Step 6: WHEN PROMPTED, press and hold the ↑ and CAL/ON for 3 seconds. The CL 5 will go into the re-programming mode. When finished, the CL 5 will automatically shut off.

Step 7: Reset the operating software to clean out the instrument's memory (**WARNING:** All stored Custom Setup Files will be lost!!! However, stored Data Recorder files will not be affected).

Information available on the GE Inspection Technolgies, web site. GEInspectionTechnologies.com

- Up to date information on operating software
- Latest upgrade utility program
- Specifications
- New features
- Literature
- And much more!

9.3 EMC Documentation

The following page displays the CL 5's Declaration of EMC Compliance.

Engineering Declaration of EMC Compliance

CL 5 Ultrasonic Precision Thickness Gauge

References: Radiation Sciences, Incorporated EMC Test Report No. RSI-2703E, GE Inspection Technologies Model CL 5, 21 March 2005.

Instrument Description: The CL 5 is a precision ultrasonic thickness gauge capable of measuring materials using ultrasonic transducers operating in frequency from .6 to 28 MHz. This instrument displayed a thickness calculated by the measured time of flight in the material at the velocity specified to the instrument. The instrument is intended for use as a portable thickness gauge in an industrial environment. The instrument is not intended to be part of a closed control loop in an automated process control system.

Compliance Statement: The CL 5 complies with the following EN standards:

- EN 55011: 1998 Radiated and conducted emissions, Class A
- EN 61000-3-2: 2001 Harmonic current emissions, Class A
- EN 61000-3-3: 1995 Voltage fluctuations and flicker
- EN 61000-4-2: 1995 Electrostatic Discharge 2, 4, 8kV
- EN 61000-4-3: 1998 Radiated Fields at 10 V/m from 80-1000 MHz including 1.4 to 2.0 GHz
- EN 61000-4-4: 1995 Fast Transient/Burst at 2 kV
- EN 61000-4-5: 1995 Surge Immunity 0.5 , 1, 2 kV
- EN 61000-4-6: 1996 Conducted RF Disturbances 10 V/rms
- EN 61000-4-11: Voltage Dips/Interruptions

9.4 Manufacturer/Service Addresses

The CL 5 is manufactured by:

GE Inspection Technologies, LP
50 Industrial Park Road
Lewistown, PA 17044

Telephone: (717) 242-0327
(717) 242-0331

Telefax: (717) 242-2606

The CL 5 is manufactured according to state-of-the-art methods using high-quality components. In-process testing and a quality management system certified to ISO 9001 ensure optimum quality of instrument conformance. Nevertheless should you experience a problem or require technical assistance, visit the product service page accessible from www.GEInspectionTechnologies.com to locate your local GE Inspection Technologies representative, or contact one of the following addresses:

Germany

GE Inspection Technologies, GmbH
Service-Center
Robert-Bosch-StraBe 3
D-50354 Huerth

or:

Postfach 1363
D-50330 Huerth

Telephone +49 (0) 22 33 - 601 111
Fax +49 (0) 22 33 - 601 402

France

GE Inspection Technologies Scs
68, Chemin des Ormeaux
69760 Limonest
France

Telephone +33 4 72 - 17 92 20
Fax +33 4 78 - 47 56 98

Great Britain

GE Inspection Technologies
892 Charter Avenue
Canley
Coventry CV4 8AF/West Midlands

Telephone +44 845-601-5771
Fax +44 845-130-5775

USA

GE Inspection Technologies, LP
50 Industrial Park Road
USA - Lewistown, PA 17044

Telephone 1 717-242-0327
Fax 1 717-242-2606

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