GE
Sensing & Inspection Technologies

Ultrasonic

USM Go

Operator's Manual

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P/N 1254637 Rev. 1
July 2009

USM Go

Ultrasonic Flaw Detector

Operator's Manual

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Chapter 1. General Information

Chapter 2. Instrument Setup

Chapter 3. Making Measurements

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Safety Information

Before powering up or operating this instrument, the safety information in this section should be read carefully. This *Operator's Manual* should be stored in a safe place for reference.

IMPORTANT: *This instrument is to be used only for testing materials in an industrial environment. Any use for medical applications or any other purpose is not permitted.*

IMPORTANT: *This instrument is waterproof according to* **IP 67**. *It can be operated either with batteries or with the power supply unit. The power supply unit meets the requirements of* **Electrical Safety Class II**.

Batteries

For battery operation of this instrument, GEIT only recommends the use of a lithium-ion battery. You should only use the battery recommended by GEIT for operation of this instrument. You can charge the lithium-ion battery either within the instrument itself or with the external battery charger.

IMPORTANT: *See* "Battery Disposal" on page 147 *for instructions on proper battery disposal procedures.*

Important Ultrasonic Testing Guidelines

Please read the information in this section before using your instrument. It is important that you understand and observe this information to avoid any operator errors that might lead to false test results. Such false results could result in personal injuries or property damage.

Using Ultrasonic Test Equipment

This *Operator's Manual* contains essential information on how to operate your test equipment. In addition, there are a number of factors that affect the test results, but a description of all these factors is beyond the scope of this manual. The three most important factors for safe and reliable ultrasonic inspection are:

- Operator training
- Knowledge of special technical test requirements and limits
- Choice of appropriate test equipment

Operator Training

The operation of an ultrasonic test device requires proper training in ultrasonic testing methods. Proper training comprises adequate knowledge of:

- The theory of sound propagation
- The effects of sound velocity in the test material
- The behavior of the sound waves at interfaces between different materials
- The shape of the sound beam
- The influence of sound attenuation in the test object and the influence of the surface quality of the test object

Lack of such knowledge could lead to false test results with unforeseeable consequences. You can contact GEIT or NDT societies or organizations in your country (DGZfP in Germany; ASNT in the USA) for information on opportunities for training on ultrasonic instruments that use time-of-flight measurements.

Accurate measurement results require a constant sound velocity in the test object. Steel test objects have only slight variations in sound velocity, thus affecting only high precision measurements. Test objects made of other materials (e.g., nonferrous metals or plastics) may have larger sound velocity variations, which could adversely affect the accuracy of the measurements.

Test Object Material Effects

If the material of the test object is not homogeneous, the sound waves may propagate at different velocities in different parts of the test object. An average sound velocity should then be used for the range calibration. This is achieved by using a reference block with a sound velocity equal to the average sound velocity of the test object.

If substantial sound velocity variations are expected, then the instrument calibration should be adjusted to the actual sound velocity values at shorter time intervals. Failure to do so may lead to false readings.

Test Object Temperature Effects

The sound velocity also varies as a function of the temperature of the test object. This can cause appreciable errors in measurements if the instrument has been calibrated with a reference block at one temperature, and the instrument is then used on a test object at a different temperature. Such measurement errors can be avoided either by ensuring that the reference block and the test object are at the same temperature, or by using a correction factor obtained from published tables.

Limited Warranty

For a period of two (2) years from the date of purchase, we warrant that the instrument will be free of any claim of ownership by third parties, (ii) when new, be free from defects in material and workmanship and perform in accordance with the Product's specifications under normal use and service for the applicable warranty period following the date of sale. The second year of this warranty is valid only if the instrument is calibrated to within the provided specifications, by us or one of our certified service providers after month twelve of ownership but before month fourteen begins. The duration of the warranty may be extended or modified by explicit service contracts.

This limited warranty shall not apply to any problems arising from (i) failure to follow the product instructions or failure to perform preventive maintenance, (ii) service, repair or modification by someone other than us or one of our authorized service representatives; or (iii) external causes, such as accident, abuse, misuse, or problems with electrical power.

This warranty does not cover parts identified as wear-and-tear parts or lamps, transducers, tubes, accessories, or optional equipment not manufactured by us, which items may be covered by separate manufacturers' warranties.

Our obligation under this warranty is limited to the repair or replacement of components determined by us to be defective within the warranty period at no cost to the original purchaser. Customer shall arrange for delivery to us in approved packing material. This warranty extends to the original purchaser and cannot be assigned or transferred to any other party.

EXCEPT FOR THE WARRANTY SET ABOVE, WE EXPRESSLY DISCLAIM ALL WARRANTIES AND REPRESENTATIONS OF ANY KIND WITH RESPECT TO OUR PRODUCTS, WHETHER EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, TITLE AND ANY WARRANTIES ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.

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Chapter 1. General Information

The *USM Go* is a portable ultrasonic flaw detector. In addition to its light-weight design, the USM Go includes a clean and simple user interface and a large, easy-to-read color WVGA (800x480) display. When operating in *Acquire Mode*, the instrument provides ultrasonic flaw detection and thickness measurements. In this mode, it is capable of storing A-Scans, operating parameters, and reports. Prior to using the *Acquire Mode*, the instrument display and operating parameters must be configured by using the *Setup Mode*. The following specific topics are discussed in this chapter:

- Supplying power to the instrument
- Powering the instrument ON and OFF
- Using the keypad
- Using the display

1.1 Supplying Power to the Instrument

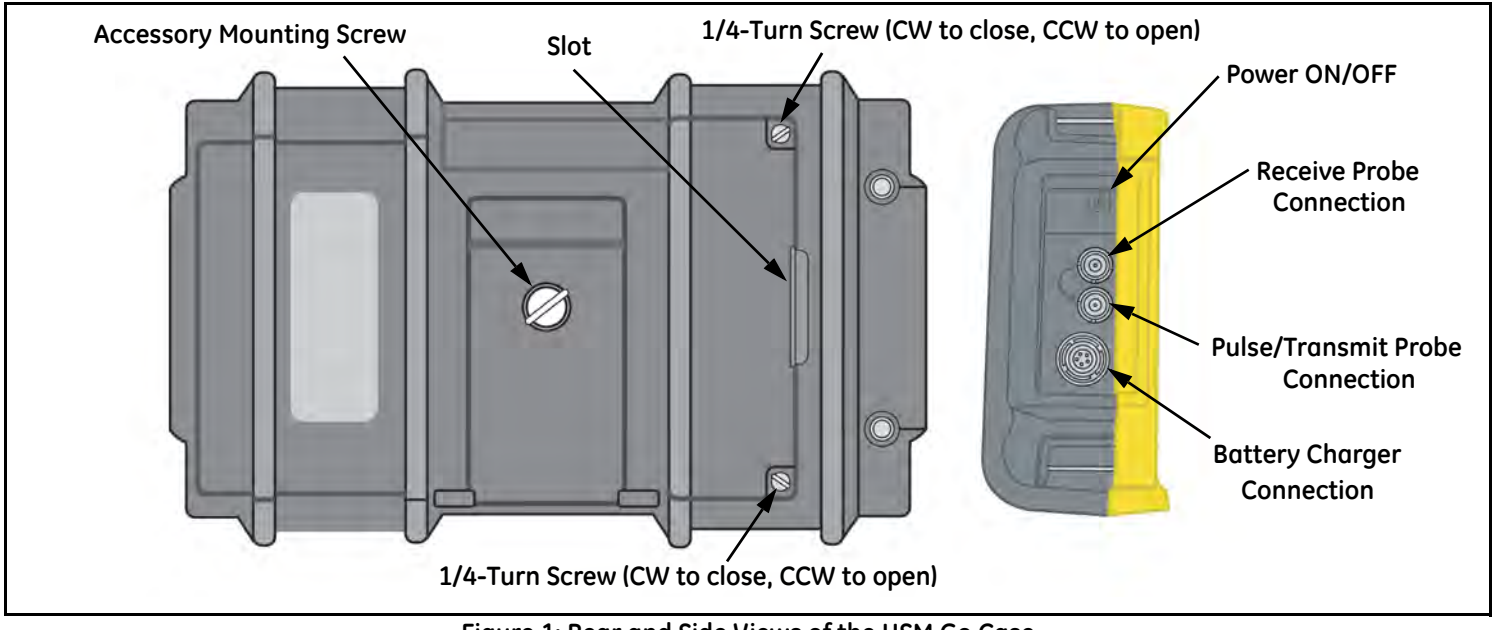


Figure 1: Rear and Side Views of the USM Go Case

1.1 Supplying Power to the Instrument (cont.)

The USM Go can be powered in either of two ways (see *Figure 1 on page 2*):

- A lithium battery pack that is installed in a compartment on the rear of the case, or
- An external power adapter plugged into the connector on the side of the case

CAUTION! Use only the GEIT Lithium battery pack in this instrument, and charge only this battery pack in the instrument or in the provided GEIT charger/adapter.

To remove the battery compartment cover, loosen the two 1/4-turn screws and then lift up on the slot between the screws. The standard GEIT Lithium battery pack is designed to provide maximum operating life between chargings.

The approximate level of remaining battery life is shown on the display (see *Figure 2 on page 5*) by the battery icon,  , and the approximate *"hours of charge"* indication below the icon. When a fully-charged battery pack is installed, the icon will appear as *"full,"* and the icon will begin to *"empty"* as the battery life is depleted. When the battery indicator is down to one-quarter full, charge the battery pack as soon as possible.

Note: *The instrument automatically shuts* OFF *when the batteries are too weak for reliable operation. However, your settings are saved and then restored when the instrument is turned back* ON. *When testing in remote locations, always carry a spare battery pack.*

1.1 Supplying Power to the Instrument (cont.)

When the AC adapter is connected to the instrument, the icon in the upper right corner of the display indicates the percentage of full-charge of the battery pack. When removing the battery pack to install a charged spare, the instrument will automatically turn OFF if the AC adapter is not connected to the instrument. However, if the adapter is connected, the instrument will remain ON while you change battery packs.

1.2 Powering the Instrument ON and OFF

To power the USM Go ON or OFF, simply press the power button,  , on the side of the case (see *Figure 1 on page 2*). As soon as the button press is recognized, you will hear the click of an internal relay. Then, after about 4 seconds, the display controller will be fully loaded and the display will become visible.

1.3 Using the Keypad

The USM Go is designed to provide the user quick access to all of the instrument's functions. Its easy-to-use menu system allows any function to be accessed with a minimum of effort. The functions typically used to collect ultrasonic data are located in the *Acquire Mode* menu, while those used to configure the instrument are found in the *Setup Mode* menu.

See *Figure 2 on page 5* for the locations of the front-panel components described in this chapter.

1.3 Using the Keypad (cont.)

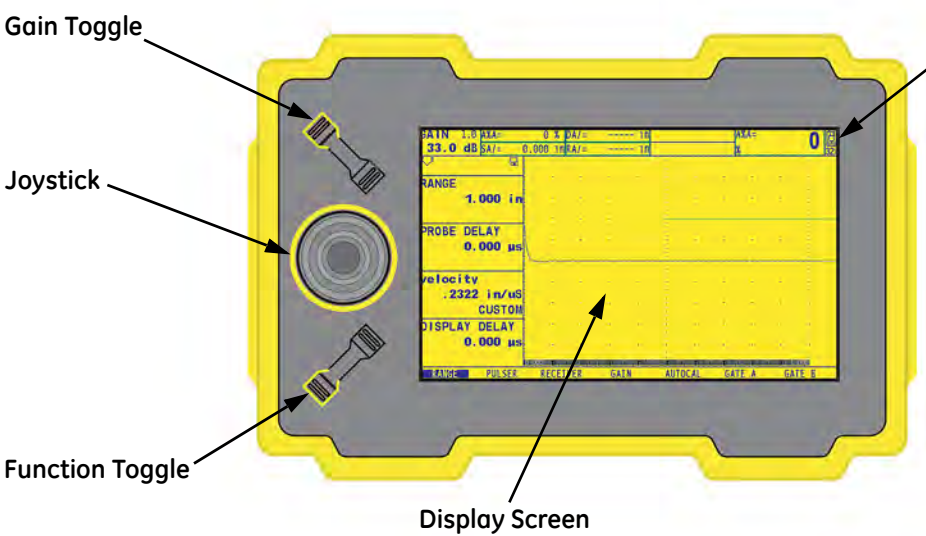


Figure 2: Front Panel of the USM Go

1.3.1 Instrument Orientation

One of the innovative features of the USM Go is the user option to quickly and easily rotate the instrument 180° to accommodate either right-hand or left-hand operation. During this process, the display image is also rotated to allow proper viewing. *Figure 3* below shows the instrument in both orientations.

Figure 3: USM Go in Left-Hand and Right-Hand Orientations

1.3.2 Keypad Components

The USM Go keypad includes the following items (see *Figure 2 on page 5*):

- ***Center-press joystick*** (): The joystick may be moved either *"left or right"* or *"up or down."* In addition, the center of the joystick may either be *"pressed"* or *"pressed and held."*
- ***Gain toggle*** (): The two ends of the gain toggle act as separate buttons. One end is the *"Gain DOWN"* button, while the other end is the *"Gain UP"* button. Either end of the gain toggle can either be *"pressed"* or *"pressed and held."*
- ***Function toggle*** (): The two ends of the function toggle act as separate buttons. One end is the *"Function 1"* button, while the other end is the *"Function 2"* button. Either end of the function toggle can either be *"pressed"* or *"pressed and held."*

Note: *The gain toggle is always at the top of the instrument, and the end of the function toggle closer to the display is always the "Function 1" button, regardless of the chosen instrument orientation.*

1.3.3 Joystick Functions

The effects of the joystick actions described on the previous page are as follows:

Joystick Center Press:

- When in *Acquire Mode*, a single press and release () toggles the A-Scan display between standard size and full screen mode.
- When in *Setup Mode*, a single press and release () activates or deactivates a parameter for adjustment.
- When in *Acquire or Setup Mode*, a 2-second press-and-hold () switches to the other mode.

Joystick Movement:

- When in *Acquire or Setup Mode*, moving up/down () scrolls between the available function options for the highlighted menu.
- When in *Acquire or Setup Mode*, moving left/right () highlights a menu option or adjusts the value of a selected parameter.

1.3.4 Multi-Key Functions

Note: *All multi-key functions are defined with the instrument in the left-hand orientation (see the left side of* Figure 3 on page 6*).*

- Power button + Function 2 button + Gain DOWN button

Pressing and holding these three buttons simultaneously causes the instrument to initiate a software upgrade.

Note: *A formatted SD card with a valid USM Go upgrade file in the root directory must be inserted prior to pressing these buttons.*

- Power button + Function 2 button + Gain UP button

Pressing and holding these three buttons simultaneously causes the instrument to ignore the last known setup and revert to the factory default settings.

Important: *The last known setup will be overwritten and lost during this process.*

- Gain UP button + Gain DOWN button

Pressing and holding the two *Gain Toggle* buttons simultaneously activates the AUTO80 function for the current *Evaluation Mode*.

1.4 Using the Display

Typical displays for the USM Go *Acquire Mode* and *Setup Mode* menus are illustrated in *Figure 4* below. See the following pages for step-by-step instructions on accessing these menus.

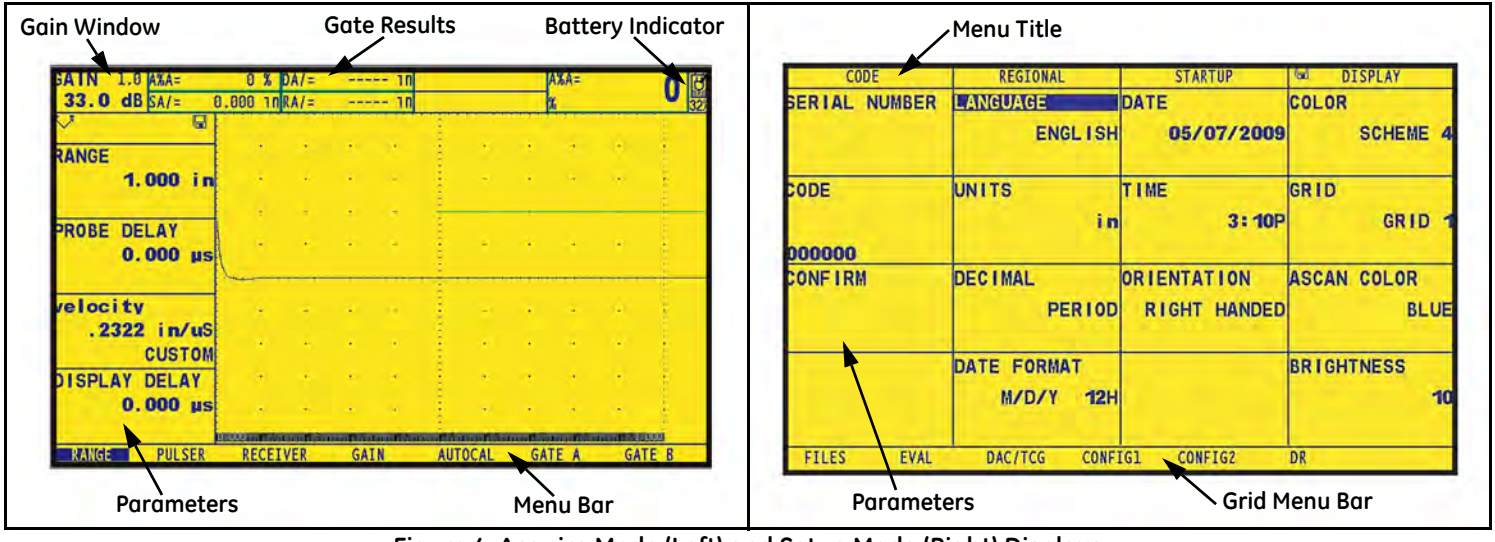


Figure 4: Acquire Mode (Left) and Setup Mode (Right) Displays

1.4.1 Accessing the Acquire Mode Menu

To access the *Acquire Mode* menu, refer to the left side of *Figure 4 on page 10* while completing the following steps:

1. Move the joystick left or right () until the desired menu is highlighted on the menu bar. The function bar automatically shows the parameters available in the highlighted menu.

2. Move the joystick up or down () to highlight the desired parameter.

3. While the desired parameter is highlighted, change its value by moving the joystick to the left or right () or by pressing either end of the function toggle (). For parameters with continuous values, the function toggle acts as a course adjustment, while the joystick acts as a fine adjustment. For selecting a parameter value from a list, either the joystick or the function toggle may be used to step through the list one item at a time.

Note: *Pressing both ends of the function toggle simultaneously resets a highlighted parameter to its default value.*

1.4.2 Accessing the Setup Mode Menu

To access the *Setup Mode* menu, refer to the right side of *Figure 4 on page 10* while completing the following steps:

1. Press and hold the center of the joystick () to toggle between *Acquire Mode* and S*etup Mode*.
2. Move the joystick left or right () until the desired menu is highlighted on the menu bar. The function bar automatically shows the parameters available in the highlighted menu.
3. Move the joystick as required () to highlight the desired parameter.
4. Press the center of the joystick () to activate the highlighted parameter. The parameter value can now be changed either by moving the joystick () as a fine adjustment or by pressing either end of the function toggle () as a coarse adjustment. Press the center of the joystick () again to deactivate the highlighted parameter.

Note: *Step 4 above applies to the setting of all parameters, except for specifying the actions associated with the function toggle keys. For instructions on configuring these keys, see* “Defining Function Toggle Actions” on page 35.

1.5 Using the SD Slot, USB Connector & I/O Connector

The USM Go uses a standard *SD memory card* for storing data set files and reports (see *"The FILES Menu" on page 114*) and for loading an instrument software upgrade (see *"Activating Instrument Upgrades" on page 60*). The SD card slot is located in a compartment on the top of the instrument, along with a USB connector and an I/O connector (see *Figure 5* below).

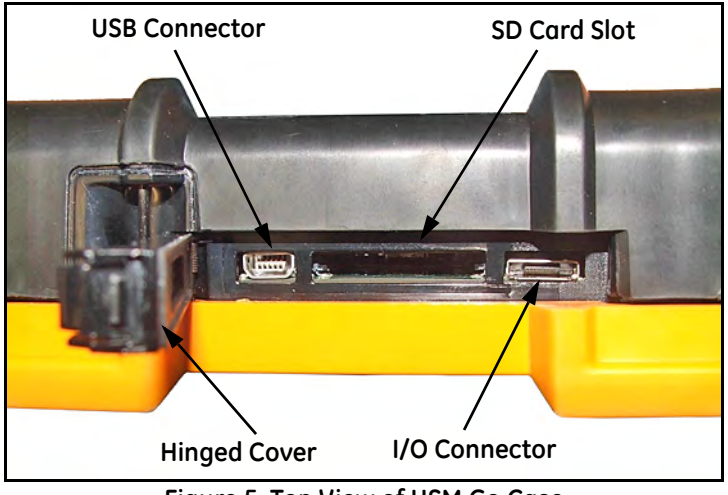


Figure 5: Top View of USM Go Case

1.5.1 Removing the SD Card

To remove the SD card from its slot, proceed as follows:

1. Access the SD card slot by pushing on the cover in the direction of the arrow and lifting the hinged cover.
2. Press down of the SD card with your finger and then remove your finger quickly. The SD card will be partially ejected, and you can then grasp it by the edge and slide it completely out of the slot.

1.5.2 Inserting the SD Card

To insert the SD card into its slot, proceed as follows:

CAUTION! Do not force the SD card into the slot if you feel significant resistance. If the card does not enter the slot freely, it is probably oriented incorrectly.

1. Access the SD card slot by pushing on the cover in the direction of the arrow and lifting the hinged cover.
2. Orient the SD card so that the label side faces the rear of the instrument and the blank side with the row of gold-colored electrical contacts faces the display side of the instrument. The edge of the card with the row of gold-colored electrical contacts must enter the slot first.
3. Slide the card fully into the slot and push gently until the card seats into its socket. Then, close the SD card slot cover.

1.5.3 Connecting the USB Port

The connector closest to the hinge of the top compartment cover (see *Figure 5 on page 13*) is a *Micro USB* port. If you use a standard USB cable to connect the USM Go to a PC (no special drivers are required), the installed SD card will be added to the list of active drives on the PC. You can then perform all normal drive activities, such as copying and deleting files, on the USM Go SD card.

Important: *While the USM Go is connected to a PC via the USB port, the instrument will not accept any user input from the keypad. Normal operation resumes as soon as the USB cable is disconnected.*

1.5.4 Connecting the I/O Port

The connector furthest from the hinge of the top compartment cover (see *Figure 5 on page 13*) is an *I/O* port. This port serves a dual role:

- *Serial port pins* - these are used strictly for factory service diagnostics.
- *Sync & Alarm pins* - these signals are accessible to the user via a special optional cable.

To use this connector you must order the optional USM Go cable, which is available as **P/N 022-510-032**. The pin designations for connecting the open end of this cable are listed in *Table 1* below:

Table 1: I/O Connector Pin Assignments

Pin #	Color	Signal
1	Brown	+5V
2	Red	SAP
3	Orange	Alarm
4	Yellow	RS232 CTS
5	Green	RS232 TX
6	Blue	RS232 RX
7	Purple	GND

Chapter 2. Instrument Setup

2.1 Display Screen and Keypad Features

The USM Go user interface has been designed for clarity and ease of use. *Figure 6* below show the complete set of icons that may appear in the icon area of the screen, and *Figure 7 on page 18* shows the major components of the display and the keypad.

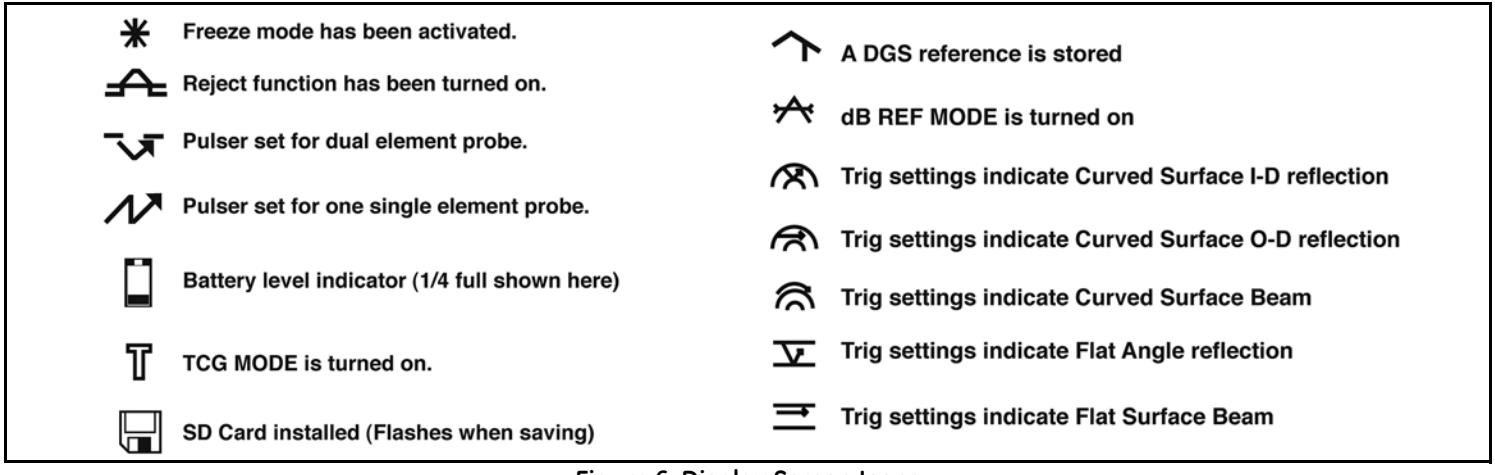


Figure 6: Display Screen Icons

2.1 Display Screen Features (cont.)

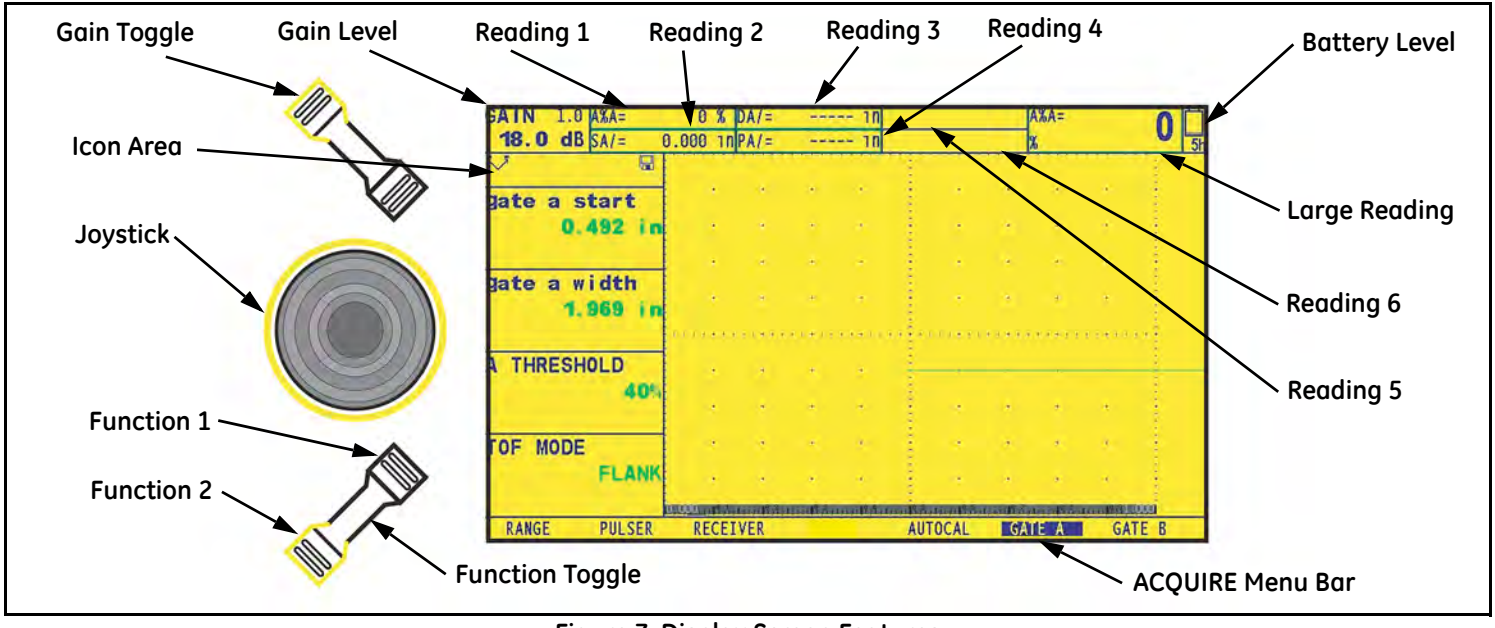


Figure 7: Display Screen Features

2.2 The Menu System

The USM Go menu system, as shown in *Figure 8 on page 20*, allows the operator to select and adjust various instrument features and settings. It includes:

- ***Acquire Menu:*** Consists of several submenus used to calibrate the instrument prior to a test, configure the instrument during a test, select the pulser and receiver characteristics, and configure the gates.
- ***SETUP Menu:*** Consists of several submenus used to configure the instrument prior to a test, including specifying the acquire mode and the screen appearance, adjusting the A-Scan display, setting the alarms, and controlling other significant measurement parameters.

The information provided in this chapter describes each menu function and shows how to access each function through the menu system.

The *EVALuation MODE Function*, which is located in the EVAL submenu of the SETUP menu, determines which submenu for evaluating results appears in the Acquire and SETUP menus (see the shaded cells in *Figure 8 on page 20*). See *Figure 9 on page 21* for the available *Evaluation Mode* options.

2.2 The Menu System (cont.)

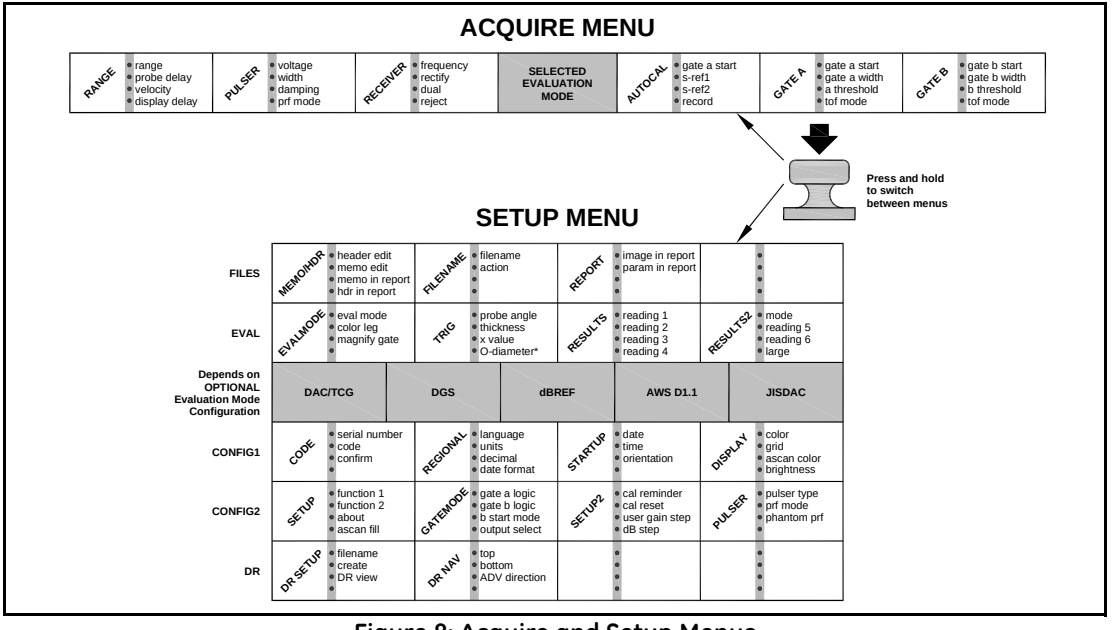


Figure 8: Acquire and Setup Menus

2.2 The Menu System (cont.)

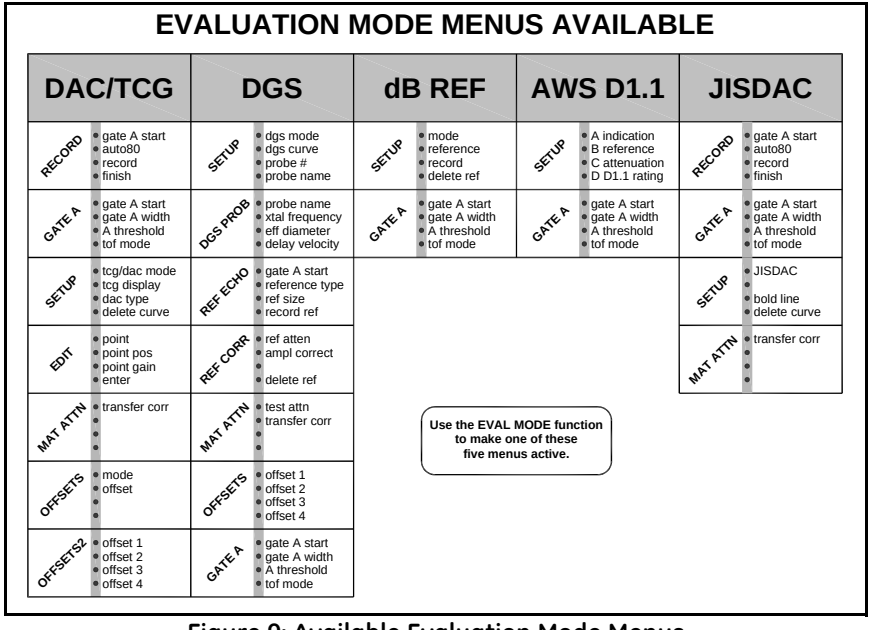


Figure 9: Available Evaluation Mode Menus

2.3 Initial Setup

In this section, you'll learn how to configure the USM Go display and operating features. Follow these procedures to turn the instrument ON and make initial adjustments to the control settings. Because the instrument can be set to save the control settings when it is turned OFF and restore them when it is turned back ON, you won't have to repeat these adjustments unless a change is required.

Power the instrument ON and note that the ACQUIRE menu is automatically activated. Activate the SETUP menu by pressing in and holding the center of the joystick ().

Note: *The entire menu structure is shown in* Figure 8 on page 20 *and* Figure 9 on page 21.

2.3.1 Language, Units of Measurement, Date, and Time

Use the procedures in this section to adjust the units of measurement, the date, the time, and the language that appears on the display screen and the data output. The adjustments require access to the REGIONAL and STARTUP function groups. These are accessed from the CONFIG1 submenu in the SETUP menu, as shown in *Figure 10 on page 23*.

2.3.1 Language, Units of Measurement, Date, and Time (cont.)

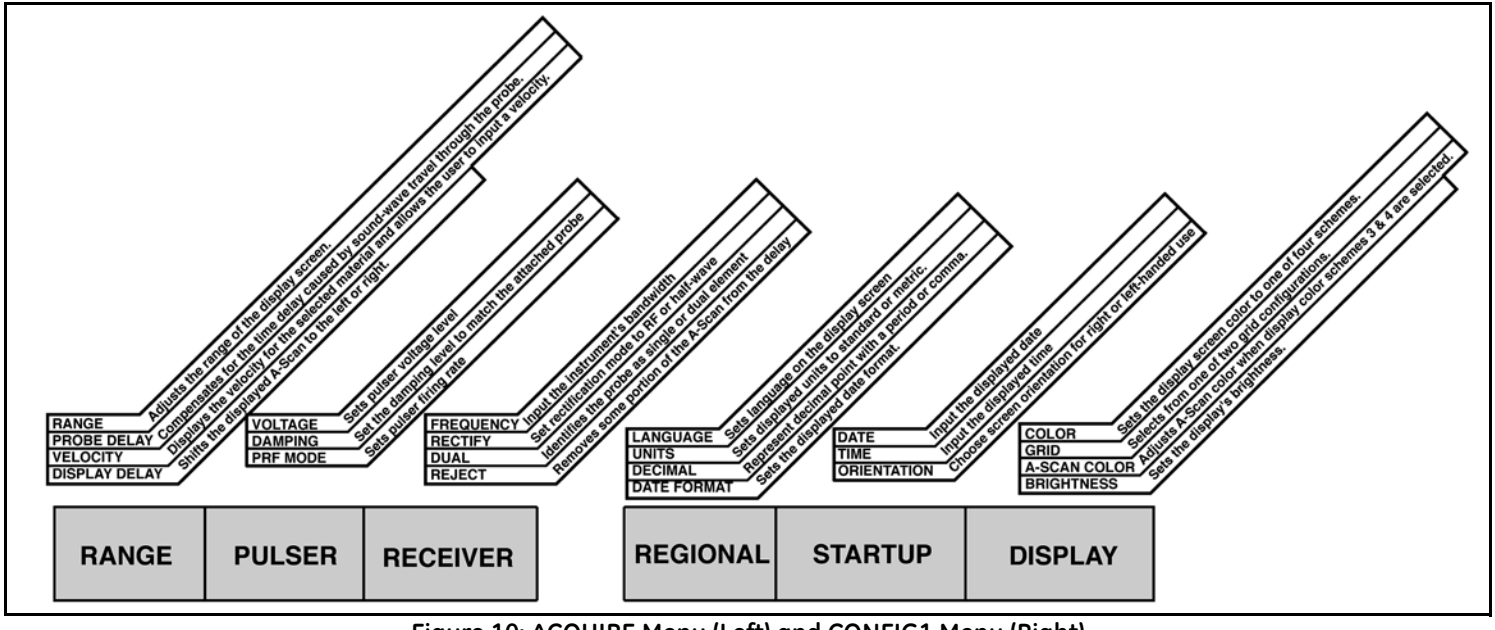


Figure 10: ACQUIRE Menu (Left) and CONFIG1 Menu (Right)

2.3.1a Setting the Acquire Mode Language (SETUP-CONFIG1-LANGUAGE)

1. In the SETUP menu, activate the CONFIG1 submenu using the joystick (). Several functions are displayed on the screen.

2. Use the joystick () to select the LANGUAGE function, then press the center of the joystick () to activate the function. To change the selected language, either move the joystick or press the function toggle. You'll note that the options available are English, German, French, Spanish, Italian, Romanian, Polish, Czech, Russian, Japanese and Chinese. The default language is English.

3. Press the center of the joystick () to deactivate the function when complete. The display screen and report language are now set to the choice last selected.

2.3.1b Setting the Units of Measurement (SETUP-CONFIG1-UNITS)

1. In the SETUP menu, activate the CONFIG1 submenu using the joystick (). Several functions are displayed on the screen.

2. Use the joystick () to select the function titled UNITS, then press the center of the joystick () to activate the function. The following options are available:

- **mm** - default setting which displays values in millimeters
- **INCH** - displays values in inches

3. To change the units of measurement, either move the joystick or press the function toggle.

4. After making your choice, press the center of the joystick () to deactivate the function.

2.3.1c Setting the Decimal Convention (SETUP-CONFIG1-DECIMAL)

1. In the SETUP menu, activate the CONFIG1 submenu using the joystick (). Several functions are displayed on the screen.

2. Use the joystick () to select the function titled DECIMAL, then press the center of the joystick () to activate the function. The following options are available:

- **PERIOD** - uses a period as a decimal point
- **COMMA** - uses a comma as a decimal point

3. To change the decimal convention, either move the joystick or press the function toggle.

4. After making your choice, press the center of the joystick () to deactivate the function.

2.3.1d Setting the Date and Time Formats (SETUP-CONFIG1-DATE FORMAT)

1. In the SETUP menu, activate the CONFIG1 submenu using the joystick (). Several functions are displayed on the screen.

2. Use the joystick () to select the function titled DATE FORMAT, then press the center of the joystick () to activate the function.

3. To change the selected date and time format, either move the joystick or press the function toggle. Choose from the following date and time formats:

- **Y-M-D** date format and **12 or 24 hour** time format
- **M/D/Y** date format and **12 or 24 hour** time format
- **D.M.Y** date format and **12 or 24 hour** time format

4. After making your choice, press the center of the joystick () to deactivate the function. The date and time format shown on the display screen and in the out reports are now set to the choice last selected.

2.3.1e Setting the Date (SETUP-CONFIG1-DATE)

1. In the SETUP menu, activate the CONFIG1 submenu using the joystick (). Several functions are displayed on the screen.

2. Use the joystick () to select the function titled DATE, then press the center of the joystick () to activate the function. Note that the first character is highlighted.

3. Move the joystick up or down () to change the highlighted character. Then, move the joystick left or right () to select the other characters to be modified.

4. After making your choice, press the center of the joystick () to deactivate the function.

2.3.1f Setting the Time (SETUP-CONFIG1-TIME)

1. In the SETUP menu, activate the CONFIG1 submenu using the joystick (). Several functions are displayed on the screen.

2. Use the joystick () to select the function titled TIME, then press the center of the joystick () to activate the function. Note that the first character is highlighted.

3. Move the joystick up or down () to change the highlighted character. Then, move the joystick left or right () to select the other characters to be modified.

4. After setting the correct time, press the center of the joystick () to deactivate the function.

Note: *Once set, the internal clock maintains the current date and time.*

2.3.1g Setting Left-Hand or Right-Hand Orientation (SETUP-CONFIG1-ORIENTATION)

1. In the SETUP menu, activate the CONFIG1 submenu using the joystick (). Several functions are displayed on the screen.

2. Use the joystick () to select the function titled ORIENTATION, then press the center of the joystick () to activate the function. Select either RIGHT hand or LEFT hand control.

3. To change the display screen orientation, either move the joystick or press the function toggle.

4. After making your choice, press the center of the joystick () to deactivate the function.

2.3.2 Display Appearance

Follow the procedures in this section to adjust the display appearance. The adjustments require access to the CONFIG1 submenu, which is accessed from the SETUP menu (see *Figure 10 on page 23*).

2.3.2a Setting the Display Color (SETUP-CONFIG1-COLOR)

1. In the SETUP menu, activate the CONFIG1 submenu using the joystick (). Several functions are displayed on the screen.
2. Use the joystick () to select the function titled COLOR, then press the center of the joystick () to activate the function. There are four preset color schemes.
3. To change the display color scheme, either move the joystick or press the function toggle.
4. After making your choice, press the center of the joystick () to deactivate the function.

2.3.2b Selecting a Display Grid (SETUP-CONFIG1-GRID)

1. In the SETUP menu, activate the CONFIG1 submenu using the joystick (). Several functions are displayed on the screen.

2. Use the joystick () to select the function titled GRID, then press the center of the joystick () to activate the function.

3. To change the display grid type, either move the joystick or press the function toggle. The selected grid style will be shown in the A-Scan window on the display screen, after you return to *Acquire Mode*.

4. After making your choice, press the center of the joystick () to deactivate the function.

2.3.2c Setting the A-Scan Color (SETUP-CONFIG1-ASCAN COLOR)

1. In the SETUP menu, activate the CONFIG1 submenu using the joystick (). Several functions are displayed on the screen.

2. Use the joystick () to select the function titled ASCAN COLOR, then press the center of the joystick () to activate the function. There are six A-Scan color options.

3. To change the A-Scan color, either move the joystick or press the function toggle.

4. After making your choice, press the center of the joystick () to deactivate the function.

2.3.2d Setting the Display Brightness (SETUP-CONFIG1-BRIGHTNES)

1. In the SETUP menu, activate the CONFIG1 submenu using the joystick (). Several functions are displayed on the screen.

2. Use the joystick () to select the function titled BRIGHTNESS, then press the center of the joystick () to activate the function. The available settings range from 1 to 10.

3. To change the brightness level, either move the joystick or press the function toggle.

4. After making your choice, press the center of the joystick () to deactivate the function.

2.3.3 Defining Function Toggle Actions

The user can specify a desired action to occur when either end of the *Function Toggle* () is pressed or pressed-and-held. The user-specified function action is ignored, however, whenever a parameter is selected and its value is being edited.

1. In the SETUP menu, activate the CONFIG2 submenu using the joystick (). Several functions are displayed on the screen.

2. Use the joystick () to select either the function titled FUNCTION1, for the end of the toggle closer to the display screen, or the function titled FUNCTION2, for the end of the toggle further from the display screen. Then, press the center of the joystick () to activate the function.

Note: *There are two values for each function. The* **upper** *parameter determines the action taken when then corresponding toggle end is momentarily pressed. The* **lower** *parameter defines the action taken when the toggle end is pressed and held.*

3. To change the ***upper*** parameter, move the joystick left or right ().

2.3.3 Defining Function Toggle Actions (cont.)

4. To change the ***lower*** parameter, press the function toggle to scroll through the options. The available options include:

- **NONE** – no action is assigned.
- **FREEZE** – Freezes the A-Scan and displays the *Freeze* icon (see *Figure 6 on page 17*) in the status bar.
- **JOYSTICK LOCK** – Prevents *up-down* and *left-right* adjustments using the joystick () and displays the *Lock* icon (see *Figure 6 on page 17*) on the display screen. However, *center-press* operations with the joystick are *not* disabled.
- **COPY** – Performs the task specified by the ACTION function, which is located in the FILE submenu.
- **AUTO80** – Adjusts the gain to place the Gate A triggering echo peak at 80% of full-screen height.
- **MAGNIFY GATE** – Zoom the A-Scan so that the displayed screen width matches the user-specified gate width.
- **HOME** – Selects the RANGE (i.e. HOME) menu in *Evaluation Mode*.

5. After making your choice, press the center of the joystick () to deactivate the function.

2.4 Installing a Probe

Follow the instructions in this section to install a probe on your USM Go.

2.4.1 Connecting the Probe

When connecting a probe to the instrument, the following steps must be taken:

- Properly complete the physical connection of the probe to the instrument.
- Properly configure the instrument to work with the connected probe.

The USM Go accepts either a *single-element* probe or a *dual-element* probe.

To install a *single-element* probe, connect the probe cable to either of the two ports on the side of the instrument (see *Figure 11* to the right). When a *dual-element* probe is connected to the instrument, the key between and below the ports ensures proper orientation of the transmit and receive connectors.

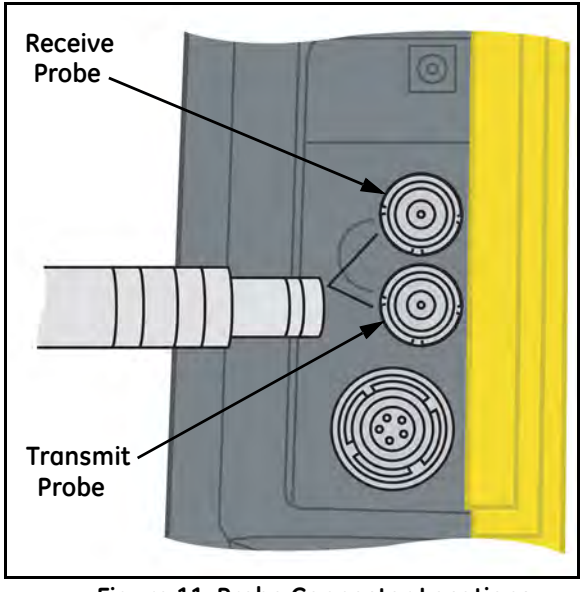


Figure 11: Probe Connector Locations

2.4.2 Configuring the Instrument

Three instrument settings are directly dependent on the type of probe installed. These settings must be adjusted any time a probe of a different type is installed, by following the instructions in the following sections.

2.4.2a Selecting the Probe Type (RECEIVER-DUAL)

1. In the ACQUIRE menu, activate the RECEIVER submenu using the joystick ().

2. Use the joystick () to select the function titled DUAL.

3. To change the probe type, move the joystick () or press the function toggle. Each available probe type is represented by an icon in the *Icon Bar*, near the upper left corner of the display, whenever that probe type is highlighted. The following options are available:

- **ON** - Use for *dual-element* probes. If this option is selected, the *Dual* icon (see *Figure 6 on page 17*) is displayed.
- **OFF** - Use for *single-element* probes. If this option is selected, the *Single* icon (see *Figure 6 on page 17*) is displayed.

4. After completing your selection, move the joystick up or down () to navigate away from this function.

*2.4.2b Specifying the Probe Frequency (*RECEIVER-FREQUENCY)

1. In the ACQUIRE menu, activate the RECEIVER submenu using the joystick ().

2. Use the joystick () to select the function titled FREQUENCY.

3. To change the specified frequency, move the joystick () or press the function toggle. The following options are available:

- **1, 2, 2.25, 4, 5, 10, 13 MHz** - Choose the frequency that matches the frequency of your probe.
- **BROADBAND** - Select this option to use the built-in broadband filter.

4. After completing your selection, move the joystick up or down () to navigate away from this function.

2.4.2c Changing Damping Level to modify the Signal to Noise Ratio (PULSER-DAMPING)

1. In the ACQUIRE menu, activate the PULSER submenu using the joystick ().

2. Use the joystick () to select the function titled DAMPING.

3. To change the specified damping level and optimize the A-Scan signal appearance, move the joystick () or press the function toggle. The following options are available:

- 50 Ω
- 1000 Ω

4. After completing your selection, move the joystick up or down () to navigate away from this function.

2.4.3 Adjusting the Pulser Repetition Frequency (PRF)

The *Pulser* fires at a frequency which can be set either ***automatically*** or ***manually***. To set the PRF mode and frequency level:

1. In the ACQUIRE menu, activate the PULSER submenu using the joystick ().
2. Use the joystick () to select the function titled PRF MODE.
3. Press the function toggle to see the three available options:
   - **AUTO HIGH** - The instrument calculates and sets the pulser firing rate at 75% of the maximum frequency possible, based on the range and the material velocity.
   - **AUTO MED** - The instrument calculates and sets the pulser firing rate at 50% of the maximum frequency possible, based on the range and the material velocity.
   - **AUTO LOW** - The instrument calculates and sets the pulser firing rate at 20% of the maximum frequency possible, based on the range and the material velocity.
   - **MANUAL** - Allows the user to set the pulser frequency. However, unacceptable PRF settings will cause a display prompt to appear.

Note: *The* MANUAL *option is available only if the* CUSTOM PRF *option is enabled.*

2.4.3 Adjusting the Pulser Repetition Frequency (PRF) (cont.)

4. If PRF MODE is set to AUTO HIGH, AUTO MED or AUTO LOW, the automatically calculated value is displayed in the function box. If you selected the MANUAL option, you may now adjust the PRF value by moving the joystick left or right ().

Note: *The PRF setting may be limited based on the user-selected pulser voltage setting. This feature acts to limit signal dissipation.*

2.4.4 Setting the Pulser Voltage

The relative energy with which the pulser fires is adjusted by changing the VOLTAGE setting. To set the pulser voltage level:

1. In the ACQUIRE menu, activate the PULSER submenu using the joystick ().

2. Use the joystick () to select the function titled VOLTAGE. Press the function toggle or move the joystick () to:

- Set the voltage level to HIGH or LOW, for a standard PULSER TYPE setting of SPIKE, or
- Specify the actual VOLTAGE value, for an optional PULSER TYPE setting of SQUARE

3. After completing your selection, move the joystick up or down () to navigate away from this function.

2.4.5 Selecting the Pulser Type (OPTIONAL)

The standard pulser shape is a spike, and there is also an optional square pulser shape available. If the PULSER TYPE option is activated, choose between the spike and square options as follows:

1. In the SETUP menu, activate the CONFIG2 submenu using the joystick ().
2. Use the joystick () to select the function titled PULSER TYPE. Then, press the center of the joystick () to activate the function.
3. Press the function toggle or move the joystick () to select SPIKE or SQUARE. Then, press the center of the joystick () to activate the function.

Note: *This selection influences the* VOLTAGE *settings available and the availability of a* PULSER WIDTH *function, which is only available when a* SQUARE *wave is specified.*

4. After making your choice, press the center of the joystick () to deactivate the function.

2.4.6 Selecting the Pulser Width (OPTIONAL)

The standard pulser shape is a spike, and there is also an optional square pulser shape available. If the PULSER TYPE option is activated and a SQUARE wave is chosen, the user may specify the time-based width of the pulser. The pulser width generally varies from 30 to 500 nanoseconds. The pulse width value is expressed as half of the bipolar square wave pulse width. A recommended starting point from which the width setting can be adjusted is found with the following equation:

$$\text{PULSE WIDTH (nanoseconds)} = \frac{1000}{2f} (\text{with f in MHz})$$

For example, if a 2 MHz probe is used, the equation becomes:

$$\text{PULSE WIDTH (nanoseconds)} = \frac{1000}{2 \bullet 2} = 250$$

2.4.6 Selecting the Pulser Width (OPTIONAL) (cont.)

To set a pulser width:

1. In the ACQUIRE menu, activate the PULSER submenu using the joystick ().
2. Use the joystick () to select the function titled WIDTH, which is only available if the PULSER TYPE function is set to square.

   Press the function toggle or move the joystick () to set the width of the pulser.
3. After completing your selection, move the joystick up or down () to navigate away from this function.

2.4.7 Using the Phantom PRF Feature

When activated, this diagnostic feature varies the PRF to identify any wrap-around signals, which are phantom echoes caused by a PRF setting that is too high. When this feature is activated, the time-based position of the phantom echoes varies while the true echoes remain stationary on the display screen.

1. In the SETUP menu, activate the CONFIG2 submenu using the joystick ().
2. Use the joystick () to select the function titled PHANTOM PRF. Press the joystick () to activate this function.
3. Press the function toggle or move the joystick () to choose either ON or OFF.
4. After making your choice, press the center of the joystick () to deactivate the function.

2.4.8 Selecting a Rectification Mode

Rectification effects the orientation of the A-scan on the display screen. The A-scan represents the sound pulse (i.e. echo) that is returned to the instrument from the material being tested. The series of echoes looks like the *Radio Frequency (RF)* signal shown in *Figure 12* below. Note that the RF signal has both a negative component below the axis and a positive component above the axis. In RF mode, Gate A and Gate B can be positioned either above or below the axis, to be triggered by either a positive-heading echo or a negative-heading echo.

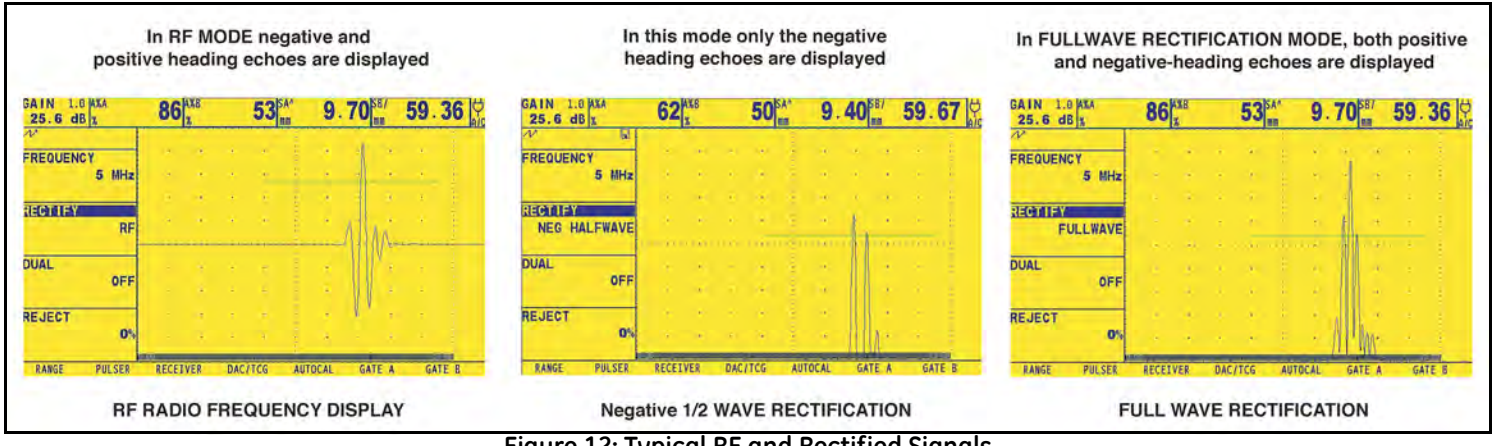


Figure 12: Typical RF and Rectified Signals

2.4.8 Selecting a Rectification Mode (cont.)

- *Positive Half Rectification* means that only the upper (i.e. positive) half of the RF signal is displayed.
- *Negative Half Rectification* means that only the bottom (i.e. negative) half of the RF signal is displayed (see *Figure 12 on page 47*). Note that although only the negative half of the RF signal is displayed, it is shown in the same orientation as a positive component to simplify viewing.
- *Full-Wave Rectification* combines the positive- and negative-rectified signals together, and displays both of them in a positive orientation (see *Figure 12 on page 47*).

Use the procedure on the next page to select a rectification mode.

2.4.8 Selecting a Rectification Mode (cont.)

1. In the ACQUIRE menu, activate the RECEIVER submenu using the joystick ().

2. Use the joystick () to select the function titled RECTIFY. The following options are available:

- **NEG HALFWAVE** - Shows the negative component of the RF signal but displays it in a positive orientation.
- **POS HALFWAVE** - Shows the positive component of the RF signal.
- **FULLWAVE** - Shows the positive and negative halves of the RF wave, but both are oriented in the positive direction.
- **RF** - Shows the echo with no rectification.

3. Press the function toggle or move the joystick () to select the desired rectification method.

4. After completing your selection, move the joystick up or down () to navigate away from this function.

2.4.9 Setting the A-Scan REJECT Level

A portion of the A-Scan can be omitted from the display screen, by defining the percentage of the full-screen height you wish to omit. To set a reject percentage:

1. In the ACQUIRE menu, activate the RECEIVER submenu using the joystick ().
2. Use the joystick () to select the function titled REJECT.
3. To change the amount of the A-Scan you wish to omit from the display, as a percentage of the full-screen height, either move the joystick () or press the *function toggle*. You may omit a portion of the A-Scan up to 80% of the full-screen height.

Note: *Whenever* REJECT *is set to a value greater then 0%, the reject icon (see* Figure 6 on page 17*) is displayed in the status bar.*

2.5 Adjusting the A-Scan

To configure the USM Go A-Scan, follow the instructions in this section.

2.5.1 Setting the A-Scan Range

Calibration of the USM Go requires the use of two calibrated standards. These standards must be of different thicknesses, and they must be made of the same material as the test piece. Prior to calibrating the instrument/probe combination, the the A-Scan display range, which is the material thickness value represented by the full horizontal width of the screen, is normally set to a value equal to or slightly larger than the thicker calibrated standard (see *Figure 13* below).

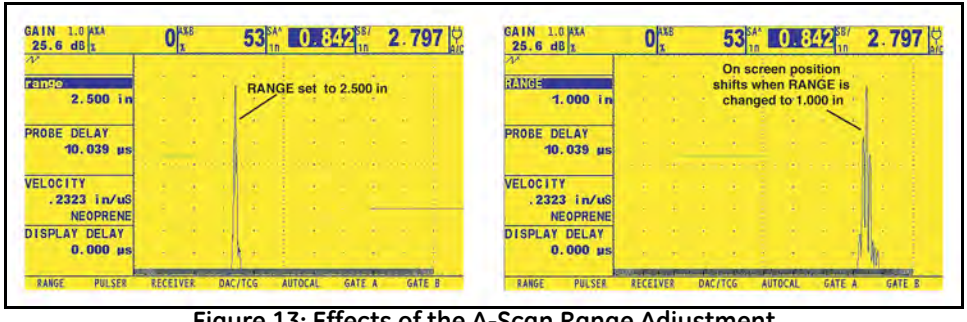


Figure 13: Effects of the A-Scan Range Adjustment

2.5.1 Setting the A-Scan Range (cont.)

To set the A-Scan range:

1. In the ACQUIRE menu, activate the RANGE submenu using the joystick ().

2. Use the joystick () to select the function titled RANGE, which has both coarse and fine adjustment modes. Coarse adjustments are made with the *function toggle*, while fine adjustments are made with the *joystick*. When "RANGE" appears in all capital letters, coarse adjustments are being made, while fine adjustments occur when "range" appears in all lower-case letters.

3. Press the function toggle or move the joystick () to change the range setting. Values from 0.040 to 1100 in. are allowed.

Note: *Pressing both buttons on the* Function Toggle *simultaneously resets the* RANGE *to the default value of* 10.000 in.

4. After completing your selection, move the joystick up or down () to navigate away from this function.

2.5.2 Setting the Display Delay

The display delay function shifts the displayed A-Scan to the left or the right in the viewing window. To set the display delay:

1. In the ACQUIRE menu, activate the RANGE submenu using the joystick ().
2. Use the joystick () to select the function titled DISPLAY DELAY.
3. Press the function toggle or move the joystick () to change the display delay. As you change the value, you should see the displayed echoes shift to the left or the right.

Note: *Pressing both buttons on the* Function Toggle *simultaneously resets the* DELAY *to the default value of* 0.

4. After completing your selection, move the joystick up or down () to navigate away from this function.

2.6 Calibrating the Instrument

To calibrate the USM Go, follow the instructions in this section.

2.6.1 Pre-Calibration Check List

To improve the accuracy and quality of your calibration, be sure that the following steps have been taken before beginning the calibration:

- Install the probe
- Adjust the DUAL (RECEIVER) setting to match probe
- Set the material type
- Set the DISPLAY DELAY to 0 (recommended)
- Set the PRF to AUTO LOW
- Set TCG to OFF
- Set REJECT to 0 (recommended).

2.6.2 Using AUTOCAL

Note: *While following the instructions in this section, refer to* Figure 14 on page 56.

1. In the ACQUIRE menu, activate the AUTOCAL submenu using the joystick ().
2. Use the joystick () to select the function titled S-REF1. Then, press the function toggle or move the joystick () to change the value to match the thickness of the ***thinner*** calibration standard. The S-REF1 function has both coarse and fine adjustment modes. Coarse adjustments are made with the function toggle, while fine adjustments are made with the joystick.
3. Use the joystick () to select the function titled S-REF2. Then, press the function toggle or move the joystick () to change the value to match the thickness of the ***thicker*** calibration standard. The S-REF2 function has both coarse and fine adjustment modes. Coarse adjustments are made with the function toggle, while fine adjustments are made with the joystick.
4. Apply couplant and couple the probe to the ***thinner*** calibration standard. With the A START function highlighted, press the function toggle or move the joystick () to shift the starting point of Gate A until Gate A lies over the echo corresponding to the thickness of the thinner standard (see *Figure 14 on page 56*). Coarse adjustments are made with the function toggle, while fine adjustments are made with the joystick.

2.6.2 Using AUTOCAL (cont.)

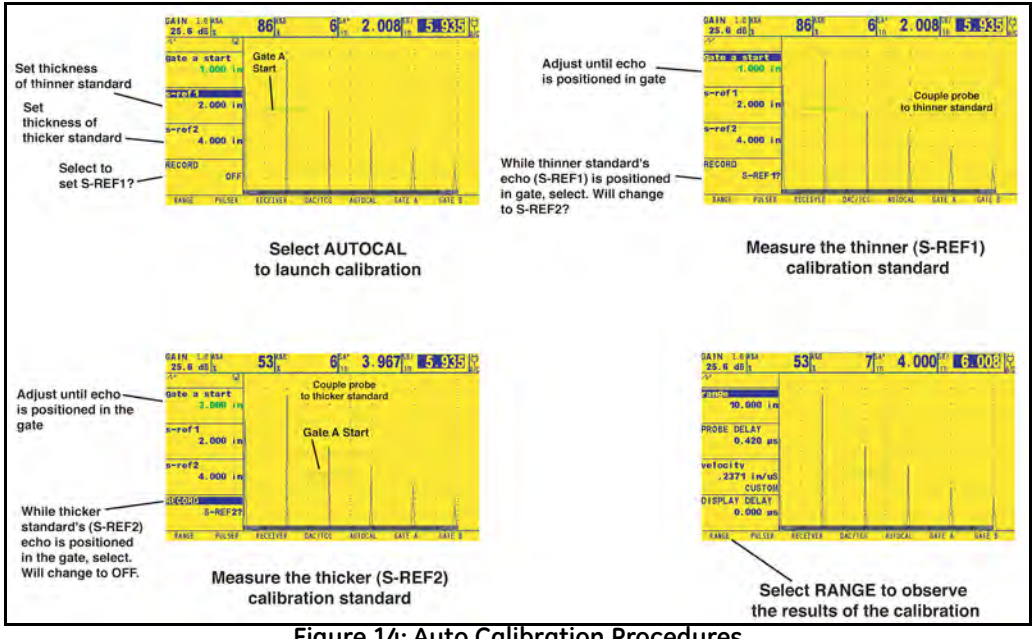


Figure 14: Auto Calibration Procedures

2.6.2 Using AUTOCAL (cont.)

Note: *During the following steps, pressing both buttons on the* Gain Toggle *simultaneously activates the* AUTO80 *function.*

5. Use the joystick () to select the function titled RECORD. The value in the function box changes from "OFF" to "S-REF1?".

While maintaining the signal in Gate A, move the joystick right or left () to record the reference echo. The value in the function box now reads "S-REF2?".

6. Apply couplant and couple the probe to the ***thicker*** calibration standard. Then, use the joystick () to select the function titled A START. Press the function toggle or move the joystick () to shift the starting point of Gate A until Gate A lies over the echo corresponding to the thickness of the thicker standard (see *Figure 14 on page 56*). Coarse adjustments are made with the function toggle, while fine adjustments are made with the joystick.

7. Use the joystick () to select the function titled RECORD. While maintaining the signal in Gate A, move the joystick right or left () to record the reference echo. The value in the function box now reads "OFF".

2.6.3 Checking the Calibration Results

Following the calibration procedure, the calculated acoustical velocity and probe delay are displayed. To view these calculated values:

1. In the ACQUIRE menu, activate the RANGE submenu using the joystick ().
2. Press the function toggle or move the joystick () to view the following selections:
   - **PROBE DELAY** - The adjustment made as a result of the AUTOCAL (zeroing) procedure is shown. This represents the time delay caused by sound-wave traveling through the probe membrane, wear plate, or delay line.
   - **VELOCITY** - The calculated velocity after the calibration is shown. The *material type* is listed as *"custom"*.

2.7 Using the Calibration Reminder Alarm

The USM Go incorporates a timed alarm feature that causes an icon to appear on user-defined input intervals between 0.5 and 4.0 hours. To use this alarm:

1. In the SETUP menu, activate the CONFIG2 submenu using the joystick ().
2. Use the joystick () to select the function titled CAL REMINDER, then press the center of the joystick () to activate the function. Input the intervals at which the reminder alarm will trigger (between 0.5 and 4.0 hours). Setting this value automatically resets the alarm to trigger on the specified intervals. This function also allows the alarm to be disabled.
3. Press the function toggle or move the joystick () to change the alarm interval.
4. Select and activate CAL RESET to acknowledge the triggered alarm and reset it to resume normal operation.

Note: *The selection of the* PROBE DELAY *or* VELOCITY *functions also resets the alarm.*

2.8 Activating Instrument Upgrades

When provided, activation codes matched to your USM Go serial number can be input via the CODE submenu, which is located in the CONFIG menu. This submenu also lists the serial number assigned to your instrument. To input an activation code:

[no content intended for this page - proceed to next page]

1. In the SETUP menu, activate the CONFIG1 submenu using the joystick ().
2. Use the joystick () to select the function titled CODE, and then press the center of the joystick () to activate the function. Note that the first character of the current code value is highlighted.
3. Use the joystick () to change the highlighted character to match the value provided by GEIT. Then, move the joystick () to select the next character, and continue modifying the values until they all match the code provided by GEIT.

Note: *Holding either end of the* Function Toggle *down for three seconds resets all values in the code to 0.*

2.8 Activating Instrument Upgrades (cont.)

4. After completing the code entry, press the center of the joystick () to deactivate the function.

5. Use the joystick () to select the function titled CONFIRM, and then press the center of the joystick () to acknowledge that the new code is correct.

6. Be sure to follow on-screen instructions to successfully complete the activation.

[no content intended for this page - proceed to next page]

Chapter 3. Making Measurements

This chapter explains how to configure the USM Go flaw detection and thickness measurement capabilities. It then explains how to make ultrasonic measurements.

3.1 Configuring Gate A and Gate B

Setting the position and the characteristics of Gate A and Gate B is the first step in configuring the instrument for flaw detection or material thickness measurements. The GATE A and GATE B submenus control the location of Gate A and Gate B, while the EVAL and CONFIG2 submenus in the SETUP menu control the operating characteristics for the gates.

1. In the ACQUIRE menu, activate the Gate A or Gate B submenu using the joystick ().
2. Choose the desired function from the available options.

3.1.1 Positioning the Gates

Use the procedures in this section to set the vertical and horizontal position of Gate A and Gate B. Remember that gate position has the following effects on instrument performance:

- A-Scan echoes on the right side of the display screen represent features that occur at a greater depth from the test-material surface than those on the left side of the display screen. Therefore, moving a gate to the right means that the gate is evaluating a deeper portion of the test material.
- A wider gate setting means that the gate is evaluating a thicker portion of the test material.
- Increasing the vertical height, called the threshold, of a gate means that only reflected signals of sufficiently large amplitude will cross the gate.

3.1.1a Setting the Gate Starting Point (GATE A or GATE B-GATE START)

1. In the ACQUIRE menu, activate the GATE A or GATE B submenu using the joystick ().

2. Use the joystick () to select the GATE A START (or GATE B START) function.

3. To change the gate starting point, either move the joystick () or press the function toggle.

Increasing and decreasing the value of the starting point moves the gate to the right and left, respectively. The gate starting point remains as set here, even when width adjustments are made.

Note: *The* GATE A START *and* GATE B START *functions have both coarse and fine adjustment modes. Coarse adjustments are made with the function toggle, while fine adjustments are made with the joystick. When the function name appears in all capital letters, coarse adjustments are being made, while fine adjustments occur when the function name appears in all lower-case letters.*

4. After completing your selection, move the joystick up or down () to navigate away from this function.

*3.1.1b Adjusting the Gate Width (*GATE A WIDTH or GATE B-GATE WIDTH)

1. In the ACQUIRE menu, activate the GATE A or GATE B submenu using the joystick ().

2. Use the joystick () to select the GATE A WIDTH (or GATE B WIDTH) function.

3. To change the gate width, either move the joystick () or press the function toggle.

Note: *This function has both coarse and fine adjustment modes. Coarse adjustments are made with the function toggle, while fine adjustments are made with the joystick.*

4. After completing your selection, move the joystick up or down () to navigate away from this function.

3.1.1c Setting the Gate Threshold (Vertical Position) (A THRESHOLD or B THRESHOLD)

1. In the ACQUIRE menu, activate the GATE A or GATE B submenu using the joystick ().

2. Use the joystick () to select the A THRESHOLD (or B THRESHOLD) function.

3. To change the gate height, either move the joystick () or press the function toggle. Increasing or decreasing the value of the threshold moves the gate up or down, respectively.

4. After completing your selection, move the joystick up or down () to navigate away from this function.

3.1.2 Selecting the TOF-Detection Method

A-Scan signals crossing either Gate A or Gate B are evaluated for the purposes of flaw detection and material thickness evaluation. When the signal crosses Gate A or Gate B, either the gate-crossing point (i.e. the flank) of the signal, or the maximum point (i.e. the peak) of the signal in that specific gate is used for evaluation purposes. The TOF MODE function allows the user to specify which A-Scan feature (FLANK or PEAK or JFLANK) is used to evaluate the signal in each gate.

1. In the ACQUIRE menu, activate the GATE A or GATE B submenu using the joystick ().

2. Use the joystick () to select the TOF MODE function.

3. To change the gate detection mode, either move the joystick () or press the function toggle. The following options are available:

- **PEAK -** All detection, whether time-based and peak height, is based on the HIGHEST triggering echo in the gate.
- **FLANK -** The time-based triggering point is the first flank to cross the gate, and amplitude-based results are based on the HIGHEST peak of any echo crossing the gate. This is not necessarily the peak of the same echo whose flank triggered the gate.
- **JFLANK -** The time-based triggering point is the first flank to cross the gate, and the amplitude-based results are based on the peak of this first echo to cross the gate. This is not necessarily the highest echo in the gate.

3.1.2 Selecting the TOF-Detection Method (cont.)

4. After completing your selection, move the joystick up or down () to navigate away from this function.

Note: *The detection method chosen is indicated by a small icon. This icon is displayed in the display box containing the measured reading, and in the options offered in the READING 1 through 6 and LARGE function boxes.*

3.1.3 Setting Gate Alarms and Outputs

An alarm can be set for either one or both of the gates. This is accomplished by configuring either *Reading Box 4* (in LARGE mode) or the single *Large Reading Box* (in SMALL mode) to act as a virtual LED that mimics an indicator light. When so configured, the virtual LED reading box is green when there is no fault condition and red when the alarm has been triggered.

3.1.3a Defining Gate-Alarm Logic (SETUP-CONFIG2-GATE A or B LOGIC)

Each gate alarm can be triggered by one of two circumstances: either when an A-Scan echo crosses the gate or when no A-Scan echo crosses the gate. Use the following procedure to specify the gate LOGIC settings:

1. In the SETUP menu, activate the CONFIG2 submenu using the joystick ().

2. Use the joystick () to select the function titled GATE A (or GATE B) LOGIC. Press the center of the joystick () to activate the function.

3. To choose the gate-alarm triggering logic, move the joystick up or down (). The following options are available:

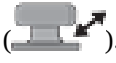
- **POSITIVE** - An A-Scan signal crosses the gate
- **NEGATIVE** - No A-Scan signal crosses the gate
- **OFF** - No alarm is connected to the selected gate

Note: *Gate A and Gate B can be configured so that either gate triggers the alarm.*

4. After making your choice, press the center of the joystick () to deactivate the function.

3.1.3b Assigning Alarm Output Indicator Lights (SETUP-CONFIG2-OUTPUT SELECT)

As an option, one reading box may be configured as a virtual LED (see *"Setting Gate Alarms and Outputs" on page 69*), which is green when there is no fault condition and red when the alarm has been triggered. This virtual LED corresponds to an OUTPUT, which is in-turn assigned to a gate alarm. When an alarm is triggered, the virtual LED is illuminated (except when the GATE LOGIC is set to OFF). Use the following procedure to indicate which gate activates the virtual LED:

1. In the SETUP menu, activate the CONFIG2 submenu using the joystick ().
2. Use the joystick () to select the function titled OUTPUT SELECT. Press the center of the joystick () to activate the function.
3. To configure the gate-alarm virtual LED operation, move the joystick up or down (). The following options are available:
   - **A(+), A(-)** - the virtual LED indicates the Gate A alarm is triggered (see previous page for description of **+** and **-** alarms)
   - **B(+), B(-)** - the virtual LED indicates the B Gate alarm is triggered (see previous page for description of **+** and **-** alarms)
   - **A or B(+), A or B (-)** - the virtual LED indicates either Gate alarm is triggered (see previous page for description of **+** and **-** alarms)
4. After making your choice, press the center of the joystick () to deactivate the function.

*3.1.3c Select Gate to Be Magnified When Function Toggle Is Pressed (*SETUP-EVAL-MAGNIFY GATE)

The user can indicate the action to be taken when either end of the *Function Toggle* is pressed. One option magnifies the A-Scan display, so the assigned gate spans the entire displayed range. To specify the gate that should be magnified on demand:

1. In the SETUP menu, activate the EVAL submenu using the joystick ().

2. Use the joystick () to select the function titled MAGNIFY GATE. Press the center of the joystick () to activate the function.

3. To select Gate A or the Gate B, move the joystick up or down ().

Note: *Pressing the assigned end of* Function Toggle, *when* FUNCTION1 *or* FUNCTION 2 *is set to* MAGNIFY GATE, *magnifies the display so the selected gate spans the entire displayed range.*

4. After making your choice, press the center of the joystick () to deactivate the function.

3.2 Using Angle Beam Probes

When connecting an angle beam probe to the instrument, adjustments must be made for probe characteristics as well as test piece geometry. These adjustments include:

- Probe angle
- Probe X value = the distance from the probe Beam Index Point (BIP) to the front edge of its wedge
- Test piece thickness
- O-Diameter

3.2.1 Setting the Angle Beam Probe Parameters

To configure the instrument for an angle-beam probe, follow this procedure:

1. In the SETUP menu, activate the EVAL submenu using the joystick ().
2. Use the joystick () to select the function titled PROBE ANGLE. Input the angle for the installed probe. Surface evaluation is performed by installing the correct probe/wedge and setting this value to > 89°.

Note: *This function has both coarse and fine adjustment modes. Coarse adjustments are made with the function toggle, while fine adjustments are made with the joystick.*

3.2.1 Setting the Angle Beam Probe Parameters (cont.)

3. Use the joystick () to select the THICKNESS function, and input the thickness of the test piece. The thickness of a solid rod should be input as 1/2 of its diameter.

4. Use the joystick () to select the X VALUE function, and input the user-determined X value for the probe. This compensates for the distance from the BIP to the front of the probe wedge.

5. Use the joystick () to select the O DIAMETER function, and input the outside diameter (from 50 to 2000 mm) of a curved test piece. When set to FLAT, curvature correction is not applied.

Note: *Based on the values input for the* PROBE ANGLE, THICKNESS, X VALUE, *and* O DIAMETER *parameters, the instrument operates in one of five modes. Each of these modes is represented by an icon in the* icon area *at the upper left corner of the screen. See* Figure 6 on page 17 *for an illustration of these icons.*

3.2.2 Indicating Leg with Color

The leg in which a reflector is encountered, can be visually indicated on the instrument display using color. Setting the COLOR LEG function, located in the EVAL submenu of the SETUP menu, to ON causes each ultrasonic time region to be displayed in a unique color.

3.3 Displaying Measured Results

The instrument is capable of displaying up to seven measured readings at one time. The displayed readings are selected using the EVAL submenu located in the SETUP menu. The parameters available for display, which depends on the instrument configuration and the evaluation mode, include the following:

- A%A - Amplitude, as a % of full-screen height, of the highest echo falling within the width of Gate A
- A%B - Amplitude, as a % of full-screen height, of the highest echo falling within the width of Gate B

Note: *When* S, D, P, *or* R *readings are displayed, the* Gate-Detection Mode *setting for the referenced gate (*A *or* B*) is indicated by a* ^ for Peak Mode *or a* / for Flank Mode.

- SA - Sound-Path distance or duration, represented by the highest echo or the first flank to cross Gate A
- SB - Sound-Path distance or duration, represented by the highest echo or the first flank to cross Gate B
- SBA - Sound-Path distance or duration, from the highest echo or the first flank in Gate A to the echo in Gate B. The reading is only available if Gate A and Gate B are set to ON.

3.3 Displaying Measured Results (cont.)

- DA - Material-thickness depth from the probe-contacted side of the test-piece surface to the reflector, represented by the Gate A echo.
- DB - Material-thickness depth from the probe-contacted side of the test-piece surface to the reflector, represented by the Gate B echo.
- LA - Leg number of the reflector, represented by the Gate A echo.
- LB - Leg number of the reflector, represented by the Gate B echo.
- PA - Projection distance from the probe BIP to the reflector, represented by the Gate A echo.
- PB - Projection distance from the probe BIP to the reflector, represented by the Gate B echo.
- RA - Projection distance from the probe BIP to the reflector, represented by the Gate A echo, minus the current X-VALUE.
- RB - Projection distance from the probe BIP to the reflector, represented by the Gate B echo, minus the current X-VALUE.
- A%rA - Amplitude of the signal crossing Gate A, as a percentage of the active EVAL MODE reference amplitude.
- A%rB - Amplitude of the signal crossing Gate B, as a percentage of the active EVAL MODE reference amplitude.
- dBrA - dB equivalent height difference between the signal crossing Gate A and the active EVAL MODE reference height.
- dBrB - dB equivalent height difference between the signal crossing Gate B and the active EVAL MODE reference height.

3.3 Displaying Measured Results (cont.)

Note: Reference results *(identified with "r") behavior based on* EVAL MODE *are as follows:*

- DAC - % Amplitude or dB compared to corresponding DAC curve point
- TCG - % Amplitude or dB compared to TCG reference level
- dB REF - % Amplitude or dB compared to reference level
- DGS - % Amplitude or dB compared to curve/size selected
- JISDAC - % Amplitude or dB compared to JIS LINE (H, M, or L) set to BOLD
- NONE - % Amplitude or dB compared to gate threshold height

- CLS - JIS CLASS (I, II, III, or IV). Available only when JISDAC evaluation mode is active.
- ERS - Evaluates the reflected echo in DGS Mode, and calculates the *Equivalent Reflector Size*
- GT - DGS test gain, which initializes the DGS curve maximum height at 80% FSH.
- GR - DGS reference gain, which represents the instrument gain at which the reference echo peak reaches 80% FSH.
- VIRTUAL LED - Reading box color changes from green to red when a gate alarm is triggered.
- OFF - No reading is displayed in the reading box.

3.3 Displaying Measured Results (cont.)

The measured readings can be displayed at the top of the display screen either in six small reading boxes and one large reading box or in four large reading boxes. To set the reading box configuration:

1. In the SETUP menu, activate the RESULTS2 submenu using the joystick ().
2. Determine the configuration of the reading boxes by setting the MODE function to either LARGE (four parameters displayed) or SMALL (six parameters displayed in small boxes and a seventh parameter displayed in a large box).
3. In the RESULTS and RESULTS2 submenus, access and set the READING 1 through READING 6 functions to select the desired result to be displayed. When time or thickness readings are displayed, the detection method selected for that gate is indicated with a ^ (representing PEAK) or / (representing FLANK or JFLANK).

Note: *Under certain conditions, while* TCG *reference points are being recorded, two measurement results boxes are automatically set (if not so configured already) to display* SA *and* A%A *values.*

3.4 Locking the Gain Toggle and the Joystick

The gain toggle can be locked so that pressing it has no effect on the instrument.

1. In the SETUP menu, activate the CONFIG2 submenu using the joystick ().
2. Use the joystick () to select the function titled dB STEP. Press the center of the joystick () to activate the function.
3. Move the joystick left or right () to change the value of dB STEP until the word LOCK appears as the dB STEP value. The gain toggle is now locked.
4. To unlock the gain toggle, change the setting of dB STEP to any value other than LOCK.
5. After making your choice, press the center of the joystick () to deactivate the function.

Joystick operation is disabled by assigning either FUNCTION1 or FUNCTION2 to a value of JOYSTICK LOCK, then pressing that end of the *Function Toggle*. When the joystick is locked, the *Lock* icon (see *Figure 6 on page 17*) appears on the display. To unlock the joystick, simply press the assigned end of the *Function Toggle* a second time.

IMPORTANT: *When the joystick is locked, the center-press function still works.*

3.5 Setting the Gain

Instrument gain, which increases and decreases the height of a displayed A-Scan, is adjusted with the *Gain Toggle*. The instrument gain can be adjusted while in any menu location, except when the dB STEP feature is set to LOCK.

Note: *Pressing both buttons on the* Gain Toggle *simultaneously activates the* AUTO80 *function.*

3.5.1 Changing the Gain-Adjustment Increment (dB STEP)

When adjusting the A-Scan gain, each press of the *Gain Toggle* increases or decreases the gain level by a dB increment equal to the dB STEP value. Several values can be specified for dB STEP, including: a user-specified value known as the USER GAIN STEP. There is also a *Gain Toggle* adjustment LOCK which prevents any gain adjustment by the user. To select one of the existing dB STEP values:

1. In the SETUP menu, activate the CONFIG2 submenu using the joystick ().

2. Use the joystick () to select the function titled dB STEP. Press the center of the joystick () to activate the function.

3. Move the joystick left or right () to change the value of dB STEP. Available increments include: 0.2 dB, 0.6 dB, 1.0 dB, 2.0 dB, 6 dB, a user-defined *Gain Step* (if one has been defined), and LOCK.

4. After making your choice, press the center of the joystick () to deactivate the function.

3.5.2 Setting the User-Defined Gain Step (SETUP-GAIN-USER GAIN STEP)

When adjusting the A-Scan gain, each press of the *Gain Toggle* increases or decreases the gain level by the amount of the dB STEP. To enter a user-specified gain step, known as USER GAIN STEP, complete the following steps:

1. In the SETUP menu, activate the CONFIG2 submenu using the joystick ().

2. Use the joystick () to select the function titled USER GAIN STEP. Press the center of the joystick () to activate the function.

3. Move the joystick left or right () to change the value of USER GAIN STEP. This value is now available as an option whenever the dB STEP function is activated.

4. After making your choice, press the center of the joystick () to deactivate the function.

3.6 Freezing the A-Scan Display

By using the FUNCTION1 or FUNCTION2 functions in the SETUP menu, you can program one end of the *Function Toggle* to FREEZE the display. Then, whenever an A-Scan is active, pressing that end of the *Function Toggle* freezes the A-Scan display. The active A-Scan will remain as it appeared when the toggle was pressed and the display will remain frozen until it is pressed again. While the display is frozen, the displayed readings are based on the frozen echoes.

3.7 DAC/TCG Evaluation Mode (Optional)

Note: *Optional evaluation features, such as* DAC/TCG*, are selected via the* EVAL MODE *function in the* EVAL *menu. The functions for the selected evaluation mode then appears in the* ACQUIRE *menu.*

Conventional measurements can be made using the *Time Corrected Gain* (**TCG**) and *Distance Amplitude Correction* (**DAC**) modes. The functions for these modes are accessed through the DAC/TCG menu on the ACQUIRE menu bar. The DAC and TCG modes operate based on a set of user-recorded data points. These points are recorded from the DAC/TCG menu as described below.

The TCG mode displays reflectors of equal size at equal A-Scan amplitudes, regardless of the depth of the reflector in the test material. This is accomplished by adjusting the gain at different locations in the A-scan display, corresponding to different material depths, to compensate for signal loss (or variation) due to attenuation, beam spread, or other factors.

The DAC mode displays all echoes at their true amplitude, without depth compensation. However, when operating in DAC mode, a *Distance Amplitude Correction* curve is superimposed on the A-Scan display. The curve represents the constant reflector size at varying material depth.

3.8 Using DAC Mode (Optional)

When displayed, the DAC curve visually represents a line of constant reflector peaks over a range of material depths. Remember that in DAC mode, the only deviation from traditional display and operation is the appearance of the DAC curve. All A-Scan echoes are displayed at their non-compensated height. A DAC curve can be based on up to 16 data points (material depths).

A DAC curve is programmed using a series of same-reflector echoes at various depths, covering the range of depths to be inspected in the test material. Because near field and beam spread vary according to transducer size and frequency, and materials vary in attenuation and velocity, DAC must be programmed differently for different applications.

The minimum time difference between successive points is 60 ns. This corresponds to a distance of 0.18 mm (0.007 in.) at a velocity of 5900 m/s (.2323 in./µs). Successive data points do not have to progressively decrease in amplitude. That is, the DAC/TCG curve does not have to have a constantly descending slope.

3.8.1 Recording the DAC Curve

DAC Curve points are typically recorded from a standard with equally-sized reflectors (holes) located at various material depths. The primary echo from each of these points, for a total of up to 16 echoes, are recorded. When DAC mode is active, the instrument displays a line that represents echo peaks for constant reflectors at varying material depth. This line is drawn as either a curved, linear in gain, line based on a series of collected DAC points or a series of straight line segments that join these DAC points. Only one DAC curve can be stored at a time. To program the DAC curve proceed as follows:

1. In the ACQUIRE menu, activate the DAC/TCG submenu using the joystick ().

2. Couple the probe to the first reference point and use the GATE A START function to adjust Gate A so that it is broken by the primary echo. If necessary, use the *Gain Toggle* to adjust the gain so that the echo crosses Gate A, and the highest peak in Gate A is at approximately 80% of full-screen height. The highest peak must not be higher than 100% full-screen height.

Note: *The* AUTO 80 *function allows for automatic application of gain to set the Gate A triggering echo to 80% of full screen height.*

3. While Gate A is lined up over the first reference echo, use the joystick () to select the function titled RECORD. Press the center of the joystick () to activate the function. When the value of the RECORD function changes from 0 to 1, you have recorded the first *DAC Curve* point, which is then treated as the reference echo. The amplitude value at which this point is recorded becomes the *"reference amplitude"* value. However, the *"reference amplitude"* is updated if a new point is recorded with an earlier TOF.

3.8.1 Recording the DAC Curve (cont.)

Note: *If the* Gate Detection Mode *is set to* PEAK*, after the first* DAC *reference point is stored, two measurement result boxes are automatically set, if not already configured, to display* SA *and* A%A *values.*

4. Repeat steps 2 and 3 to record additional *DAC Curve* points, up to a maximum of 16 points. A minimum of two *DAC Curve* points are required to define the curve.

5. After entering all of your points, press the center of the joystick () to deactivate the function. The TCG/DAC data is stored, using the amplitude of the earliest TOF as the reference amplitude.

6. In the SETUP menu, activate the DAC TYPE function using the joystick (). Then, select one of the following options:

- **STRAIGHT:** The DAC curve is displayed as a series of straight line segments that join the stored DAC points.
- **CURVED:** The DAC curve is displayed as a curved line that is linear in gain, based on the stored DAC points.

Note: *DAC curve points and status are stored with a data set. When recalled, the curve status is the same as when it was stored.*

3.8.1 Working with DAC Mode

In DAC mode the instrument uses the user-input reference points to create a curve representing the amplitudes of echoes representing same-size reflectors at varying material depth. The recorded point data is stored until replaced or edited. To create a DAC curve and operate in **DAC** mode:

1. With the DAC/TCG menu accessed, select the SETUP submenu.
2. Use the TCG/DAC MODE menu to activate the DAC function. The DAC Curve appears whenever operating in DAC mode.
3. The DAC curve can appear either as a series of straight line segments joining the stored DAC points or as a curved (linear in gain) line based on these points. Access the DAC TYPE function in the SETUP submenu to display the desired DAC curve type.

Note: *To operate in* TCG/DAC *mode, a* DAC *curve must first be generated. After the* DAC *curve has been generated, the* TCG *mode can be accessed by setting the* TCG/DAC *function value to* TCG.

Note: *When rectification is set to* RF, *reference lines are not displayed.*

3.9 Using TCG Mode (Optional)

When the optional TCG mode is in use, echoes from equally sized reflectors are shown at the same height on the A-Scan display. Before using the TCG mode do the following:

1. Make sure that the instrument/probe combination has been properly calibrated and that all instrument settings (PULSER, RECEIVER, etc.) have been properly configured. Changing these settings after the TCG reference points have been entered will affect the accuracy of your measurements.
2. Up to 16 TCG points may be recorded, but a minimum of two points are required to define the curve. This process allows the instrument to calculate and compensate for the effect of material depth on reflector echo height. Successive data points do not have to progressively decrease in amplitude. That is, the DAC/TCG curve does not have to have a constantly descending slope.

3.9.1 Generating the TCG Reference Curve

TCG reference points are derived from the points used to create the DAC curve. Points are typically taken from a standard with equally sized reflectors (holes) located at various material depths. The primary echo from each of these points, for a total of up to 16 echoes, are recorded. When TCG is active, the instrument compensates for different material thickness by applying a varying gain level to echoes at material depths other than the baseline depth.

Note: TCG *reference points, curve, and status are stored with a data set. When recalled, curve status is the same as when it was stored.*

3.9.2 Working with TCG

In TCG mode the instrument uses the recorded reference points to calculate an amount of gain correction required to display each echo from same-size reflectors at the same amplitude. The recorded reference point data is stored until replaced or edited. To use the stored reference points and operate in TCG mode:

1. Enter the SETUP menu, and then select the TCG/DAC MODE function.
2. Activate the TCG/DAC MODE function, and select the TCG option.
3. Select the TCG DISPLAY function, and turn this feature ON or OFF.

Note: *The TCG curve begins at the first reference point recorded. It then proceeds horizontally from the amplitude of this first reference point to the depth (i.e. time position) of the last reference point recorded.*

Note: *When rectification is set to* RF*, reference lines are not displayed.*

3.10 Adjusting DAC or TCG Display and Adding Offsets

After the DAC or TCG curves are displayed, the addition of guidelines offset from the reference line by a fixed or variable dB value provides enhanced evaluating capabilities. Similarly, the TRANSFER CORR function applies dB compensation for the difference in coupling conditions between the known standard and the test piece.

3.10.1 Defining DAC or TCG Curve Offsets (DAC/TCG-OFFSETS-MODE)

To add a series of guidelines, offset from the DAC or TCG curve by a definable dB increment (but not exceeding ± 24 dB from the reference curve):

1. Access the OFFSETS submenu in the DAC/TCG menu.
2. Set the MODE function to FIXED for evenly spaced offset lines or to CUSTOM for user-controlled offset line placement. Set this function to OFF to remove offset lines from the display.
3. If FIXED offset MODE is selected, set the OFFSET function to the dB increment at which offset lines are drawn above and below the DAC or TCG line.
4. If CUSTOM offset MODE is selected, access the OFFFSETS2 submenu and input the positive or negative offset at which each of up to four guidelines are drawn.

3.10.2 Setting Transfer Correction (DAC/TCG-MAT ATTN-TRANSFER CORR)

To adjust the dB compensation for differences in ultrasonic coupling between the standard and the test piece:

1. Access the MAT ATTN submenu in the DAC/TCG menu.
2. Adjust the TRANSFER CORR function as required to compensate for coupling differences.

Note: *When* TRANSFER CORR *is set to any value other than 0, the displayed gain value appears in a contrasting color, indicating that the amount of applied gain differs from the listed* "instrument" *gain.*

3.11 Editing and Deleting DAC and TCG Reference Points

After your reference points are recorded, they may be individually deleted, their values may be manually adjusted, or new points may be manually entered (as long as the total number does not exceed 16 points). To edit points or input additional points:

1. With the DAC/TCG menu accessed, select the EDIT submenu.
2. Activate the POINT function and select the desired point number (or NEW if adding a new point).
3. Activate the POINT POS. function and adjust (or input for NEW points) the horizontal position of the point.
4. Activate the POINT GAIN function to adjust (or input for NEW points) the applied gain (i.e. the vertical position) of the point. Note that this adjustment applies regardless of whether the point is used for TCG reference or a DAC curve.
5. Activate the ENTER function to confirm the adjusted point values (or the position of a new point). The DAC curve or the TCG reference function is adjusted to match the edited input.
6. To delete any single DAC point, press and hold the center of the joystick for the POINT, POINT POS, or POINT GAIN function while the point to be deleted is active. When prompted, confirm the deletion. Note that the first point cannot be deleted, and that all DAC curves must contain at least two points. Therefore, if a curve has only two points stored, neither can be deleted.

3.12 Deleting a DAC Curve or TCG Reference Points

To delete a stored DAC curve or stored TCG reference points:

1. With the DAC/TCG menu activated, select the SETUP submenu.
2. Activate the DELETE CURVE function.
3. Activate the DELETE CURVE function a second time, then confirm your selection.
4. The statement in the function box changes to TCG/DAC MODE OFF.

3.13 DGS Evaluation Mode

Note: *Evaluation features, such as* DGS *mode, are first selected by the user via the* EVAL MODE *function in the* EVAL *menu. The menu for the selected evaluation mode is then available in the* ACQUIRE *menu bar.*

The USM Go *Distance Gain Sizing* (DGS) feature is accessed through the DGS menu, which is located in the ACQUIRE menu bar. DGS mode allows the user to use a particular probe to compare a reflector in a test piece with a known standard reflector. The DGS mode relies on a reference curve based on a recorded reference point. The procedure for recording a reference point using the DGS Menu is described on the next page.

3.13 DGS Evaluation Mode (cont.)

Using the DGS mode (*Distance Gain Size*), you can compare the reflecting power of a natural flaw in the test object with that of a theoretical flaw (e.g. a circular, disk-shaped equivalent reflector) at the same depth.

CAUTION! You are comparing the reflecting power of a natural flaw with that of a theoretical flaw. No definitive conclusions may be drawn about the natural flaw (roughness, inclined position, etc.).

The DGS diagram forms the basis for this comparison of the reflecting power. This diagram consists of a set of curves showing the connection of three influencing variables:

- Distance (**D**) between the probe and circular, disk-shaped equivalent reflector
- Difference in gain (**G**) between various large circular, disk-shaped equivalent reflectors and an infinitely large backwall
- Size (**S**) of the circular, disk-shaped equivalent reflector. The influencing variable **S** remains constant for one curve in a set

The advantage of the DGS method lies in the fact that you can carry out reproducible evaluations of small discontinuities. This reproducibility is most important whenever you carry out an acceptance test.

3.13 DGS Evaluation Mode (cont.)

In addition to the influencing variables already mentioned, these other factors affect the curve shape:

- sound attenuation
- transfer losses
- amplitude correction value
- probe

Also, the following probe parameters affect the curve shape:

- element or crystal diameter
- frequency
- delay length
- delay velocity

You can adjust these parameters in such a way that you can use the DGS method with many different probes and on various materials.

3.13 DGS Evaluation Mode (cont.)

When the DGS mode is in use, echoes from equally-sized reflectors located at varying depths appear to lie along the DGS *Reference Curve*. When operating in DGS mode, the DGS *Reference Curve* is shown on the display screen. Before using the DGS mode, do the following:

- Calibrate the instrument/probe combination
- Make all required instrument settings related to the pulser, receiver, and material velocity functions

The instrument prevents changes to certain settings after the DGS *Reference Echo* has been recorded and DGS is turned ON.

3.13.1 Specifying a Probe and Preparing to Record the Reference Echo

Before using the DGS mode to evaluate reflectors in test pieces, the characteristics of the attached probe must be specified, certain characteristics of the reference standard must be input, and a reference echo must be stored. To specify the probe characteristics:

1. Select the DGS menu on the ACQUIRE menu bar.
2. Select the SETUP submenu, then the PROBE # function. Once activated, this function allows you to choose from a list of available probe types . These are probes for which probe characteristics are already stored in the instrument, with the exception of the user-defined probe (PROBE # 0).

3.13.1 Specifying a Probe and Preparing to Record the Reference Echo (cont.)

3. If the user-defined probe type (PROBE #0) is selected, you can then select the PROBE NAME function. Then use the *Gain Toggle* and the *Function Toggle* to input a new name. Note that selecting any PROBE # value other than 0 will prevent you from modifying the PROBE NAME or any of the other settings described in this section.

4. If the user-defined probe type (PROBE #0) is selected, you must then select the DGS PROBE submenu and input the characteristics for the connected probe:

- **XTAL FREQUENCY -** The frequency rating of the probe
- **EFF. DIAMETER -** The effective diameter rating of the probe element
- **DELAY VELOCITY -** User-determined delay-line velocity

Note: *These characteristics cannot be changed for any probes other than* PROBE #0.

3.13.2 Record the Reference Echo that Defines the DGS Curve

Prior to generating the DGS curve, a test standard with a known reflector must be used to define a reference point. Acceptable test standards include these reference types:

- **BW** - Backwall echo with reference defect size defined as infinity
- **SDH** - Side-drilled hole with a reference defect size defined as the diameter of the hole
- **FBH** - Flat-bottom hole with a reference defect size equal to the facial diameter of the hole

Follow these steps to record a reference echo:

1. Select the REF ECHO submenu, then the REFERENCE TYPE function. Once activated, this function allows you to select one of the three reference types described above, and to specify the size of the known standard reference flaw.
2. Couple the probe to the known standard, capture the reference flaw so that it's reflected echo is displayed on the instrument A-Scan, and adjust the Gate A starting point to ensure that the resulting echo triggers the gate.
3. Adjust the *Gain Toggle* until the reference flaw A-Scan peak measures 80% of FSH (A%A = 80%).
4. With the probe coupled to the standard, and the reference flaw echo captured by Gate A, use the RECORD REF function to store a DGS reference echo.

3.13.2 Record the Reference Echo that Defines the DGS Curve (cont.)

Note: *The* AUTO 80 *function automatically sets the Gate A triggering echo to 80% of full screen height.*

Note: *Only one* DGS *reference echo can be stored at a time. To delete the currently stored reference, access the* REF CORR *submenu, select* DELETE REF*, and follow the on-screen prompts.*

Note: *When a* DGS *reference echo is stored, two measurement result boxes are automatically set, if not already configured, to display* SA *and* A%A *values.*

IMPORTANT: *The following two adjustments should be made prior to recording a reference echo. Changing these values after the* DGS *curve is generated will cause the curve to be deleted.*

- **REF ATTEN** (found in the REF CORR submenu) - Specify a sound attenuation value, in dB per inch or mm of material thickness, for the material from which the known standard is made.
- **AMPL CORRECT** (found in the REF CORR submenu) - Correction required when using an angle-beam type probe. This value is specified on the probe data sheet.

3.13.3 Display and Adjust the DGS Curve

After a reference echo has been recorded, the DGS curve is displayed simply by selecting the SETUP submenu in the DGS menu, then setting the DGS MODE function to ON. Note that switching this value to OFF does not delete the curve - it simply removes the curve from the display and disables the DGS mode. After the DGS curve is displayed, it can be adjusted using one of these three functions:

- **TEST ATTEN** (found in the MAT ATTN submenu) - Specify a sound attenuation value, in dB per inch or mm of material thickness, for the material from which the test piece is made.
- **TRANSFER CORR.** (found in the MAT ATTN Submenu) - dB compensation for difference in coupling conditions between the known standard and the test piece. Setting this to values other than zero causes a "T" to be added to the DGS icon and the displayed gain value to appear in a contrasting color, indicating that the amount of applied gain differs from the listed instrument gain.
- **DGS CURVE** (found in the SETUP submenu) - Positions the probe DGS curve based on the size of the reflector (flaw) being tested. The setting usually depends on the largest acceptable flaw size.

3.13.4 Evaluating Results in DGS Mode

After the DGS curve is recorded and displayed, by turning DGS mode ON, echoes are automatically compared to the recorded reference. There are three ways this comparison can be made and two additional DGS-related results that can be displayed:

- **A%rA -** Amplitude of the signal crossing Gate A as a percentage of the corresponding DGS curve amplitude.
- **dBrA -** dB equivalent height difference between the signal crossing Gate A and the corresponding DGS curve height.
- **ERS -** Evaluates the reflected echo and calculates the *Equivalent Reflector Size*.
- **Gt -** DGS test gain, which initializes the DGS curve maximum height at 80% FSH.
- **Gr -** DGS reference gain, which represents the instrument gain at which the reference echo peak reaches 80% FSH.

To aid in interpreting the DGS mode display, the instrument displays up to four curves representing fixed-gain offsets from the DGS curve. These curves are enabled and positioned, by specifying the dB-equivalent amount they are offset above or below the DGS curve, by accessing the OFFSETS submenu in the DGS menu.

3.13.5 Locks and Error Messages

As long as a valid reference echo is stored, no functions can be changed which could cause an incorrect DGS evaluation. If an attempt is made to change such a function, the following error message appears:

- "Function Locked - DGS Reference has been recorded"

Likewise, the DGS evaluation must be switched OFF and the reference echo deleted when selecting a new probe (e.g. for a new test application).

3.13.6 Validity of the DGS Method

Echo amplitude evaluations according to the DGS method are only reliable and reproducible in cases when:

- The reference echo is received from the test object if possible. If this is not possible, it should be verified that the reference block is made of the same material as the test object.
- The evaluation is carried out using the same probe which was also used for recording the reference echo. Another probe of the same type can be used only after recording a new reference echo.
- Echo amplitudes for reflector distances smaller than half of the probe near-field length are subject to extreme variation, for physical reasons due to interference phenomena effecting the area. Thus, evaluation results may fluctuate more than the usually permissible ±2 dB. An evaluation according to the DGS method is possible, but it is not recommended in such a case.

3.14 dB REF Evaluation Mode

Note: *Evaluation modes, such as* dB REF*, are selected via the* EVAL MODE *function in the* EVAL *menu. The selected evaluation mode menu then appears in the* ACQUIRE *menu bar.*

When dB REF is activated, the amplitude of the highest echo in A-Gate becomes the reference echo against which subsequent echo amplitudes are evaluated. At the time of the dB REF activation, the gain setting also becomes a reference against which subsequent gain values are compared.

1. Access the SETUP submenu in the dB REF menu.
2. Locate the reference echo in Gate A and adjust the gain as required. Then, use the RECORD function to record the reference echo. The function box now indicates that a reference has been stored. Also note the following:
   - The instrument gain and the reference echo amplitude are now shown in the function box titled REFERENCE.
   - The instrument automatically switches the dB REF MODE function to ON, as indicated on the display.
   - Setting MODE to OFF allows you to disable the dB REF mode without deleting the reference echo.
   - Use DELETE REF function to delete the current reference.

3.14 dB REF Evaluation Mode (cont.)

IMPORTANT: *Remember that the highest echo in Gate A and the* GAIN *setting, when* dB REF *is selected, become the reference amplitude and gain values for as long as* dB REF *is activated.*

Note: *The reference echo amplitude must not exceed 100% of full-screen height.*

After dB REF has been activated, the *Gain-Display Window* lists both the *Reference Gain* and *Incremental Gain* levels.

The *Reference Gain* remains constant throughout the dB REF session while the *Incremental Gain* value changes with the *Gain Toggle*.

After dB REF has been activated, any amplitude measurements are stated in relation to the reference echo amplitude. Available amplitude readings when operating in dB REF mode are:

- dBrA - dB difference between the reference echo and the highest echo to cross Gate A.
- A%rA - Amplitude of the signal crossing Gate A, as a percentage of the reference amplitude.
- dBrB - dB difference between the reference echo and the highest echo to cross Gate B.
- A%rB - Amplitude of the signal crossing Gate B, as a percentage of the reference amplitude.

3.15 AWS D1.1 Weld Rating Evaluation Mode

Note: *Evaluating modes, such as* AWS D1.1 / D1.5*, are selected in the* EVAL MODE *function in the* EVAL *menu. The selected evaluation mode menu then appears in the* ACQUIRE *menu bar.*

This mode allows the analysis of welds according to AWS specifications D1.1 or D1.5 and provides a D1.1 or D1.5 rating. The AWS D1.1 mode is accessed via the ACQUIRE menu. The mode utilizes four AWS-specified variables, including:

- **A INDICATION -** Gain (in dB) required to position an A-Scan echoes peak from the measured reflector) at an amplitude equal to the reference amplitude (between 10 and 90% of full-screen height)
- **B REFERENCE -** Gain (in dB) required to position an A-Scan echo peak from the reference reflector at the user-selected amplitude (between 10 and 90% of FSH).
- **C ATTENUATION -** Determined by subtracting 1 inch from the sound-path distance to the discontinuity, using the equation (inch units): C = (SA–1) × 2. This compensates for sound loss from material attenuation along the sound path to the discontinuity.
- **D D1.1 RATING -** Calculated based on the AWS formula: D = A-B-C.

Note: *The dB value of A-Indication is automatically adjusted to match the amplitude of the B-Ref upon performing the dB rating calculation.*

3.15 AWS D1.1 Weld Rating Evaluation Mode (cont.)

Before activating the AWS D1.1/D1.5 weld rating mode, be sure that all instrument settings are properly adjusted for the specific measurement application. Then access the AWS D1.1 submenu in the ACQUIRE menu, and follow this procedure:

1. Apply couplant and couple the probe to a suitable reference test standard.

2. Ensure that Gate A is positioned over the desired echo. Then, adjust the gain until the peak of the desired reference echo reaches the desired amplitude. Note that if the echo peak amplitude (A%A) does not fall between 10% and 90% of FSH, the point will not be accepted.

3. Use the B REFERENCE function to define the reference dB level.

4. To evaluate a reflector in a test piece, couple the probe to the test piece. Now adjust the Gate A position, if required, so that it is over the desired echo.

5. Adjust the gain until the peak of the test-piece echo reaches the desired screen height.

Note: *The dB value recorded for A-Indication is automatically adjusted based on the amplitude difference between it and the value recorded for* B-REF. *It will usually not match the instrument dB gain setting.*

6. With the AWS D1.1 SETUP submenu displayed, note that the A, C, and D parameters automatically update to match the Gate A triggering echo. Use the A INDICATION function to HOLD the current parameters. Note that the displayed RESULTS continue to update while the A, C, and D parameters are held.

3.16 JISDAC Evaluation Mode

Note: *Evaluation modes, such as* JISDAC*, are selected in the* EVAL MODE *function in the* EVAL *menu. The selected evaluation mode menu then appears in the* ACQUIRE *menu bar. While operating in* JISDAC *mode, the Gate A* TOF MODE *must be set to* PEAK *or* JFLANK.

Conventional measurements can be made using the *JIS Distance Amplitude Correction* (JISDAC) mode. This mode operates based on a set of user-recorded data points. These points are recorded from the JIS/DAC menu, as described below.

The JISDAC mode displays all echoes at their true amplitude. However, when operating in JISDAC mode, a *Distance Amplitude Correction* curve is superimposed on the A-Scan display. The curve represents constant reflector size at varying material depth.

When displayed, the JISDAC curve visually represents a line of constant reflector peaks over a range of material depths. Remember that in JISDAC mode, the only deviation from traditional display and operation is the appearance of the JISDAC curve and a series of OFFSET curves. All A-Scan echoes are displayed at their non-compensated height. A JISDAC curve can be based on up to 15 data points (i.e. material depths). A JISDAC curve is programmed using a series of same-reflector echoes at various depths, covering the range of depths to be inspected in the test material. Because near field and beam spread vary according to transducer size and frequency, and materials vary in attenuation and velocity, JISDAC must be programmed differently for different applications.

The dynamic range of the JISDAC function is 60 dB, and the maximum curve slope is 12 dB per microsecond. Successive data points do not have to progressively decrease in amplitude. That is, the JISDAC curve does not have to have a constantly descending slope.

3.16.1 Recording the JISDAC Curve

JISDAC Curve points are typically taken from a standard with equally-sized reflectors (holes) located at various material depths. The primary echo from each of these points, for a total of up to 15 echoes, are recorded. When JISDAC is active, the instrument displays a line that represents echo peaks for constant reflectors at varying material depth. This line is drawn as either a curved (linear in gain) line based on a series of collected JISDAC points or a series of straight line segments that join these JISDAC points. Only one JISDAC curve can be stored at a time. To program the JISDAC Curve:

1. Access the JISDAC menu, and select the RECORD submenu .
2. Couple the probe to the first reference point and adjust Gate A so that it is broken by the primary echo. If necessary, use the *Gain Toggle* to adjust the gain so that the echo crosses Gate A and the highest peak in Gate A is at approximately 80% of full-screen height. The highest peak must not be higher than 100% full-screen height.

Note: *The* AUTO 80 *function automatically adjusts the gain to set the Gate A triggering echo to 80% of full screen height. If desired, select the* AUTO 80 *function in the* RECORD *submenu.*

3. While the Gate is lined up over the first reference echo, activate the RECORD function. When the value of the RECORD function changes from 0 to 1, you have recorded the first JISDAC Curve point. Note that the first JISDAC point is treated as the reference echo. The amplitude value at which this point is recorded becomes the *"reference amplitude"* value.

3.16.1 Recording the JISDAC Curve (cont.)

Note: *When the first JISDAC reference point is stored, two measurement result boxes will be automatically set (if not already configured) to display SA and A%A values.*

4. Continue to record additional curve points, up to a maximum of 15 points (note that at least two JISDAC Curve points are required).

5. When all of your points have been entered, select the FINISH function.

3.16.2 Working with JISDAC

In JISDAC mode, the instrument uses the user-input reference points to create a curve representing the amplitudes of echoes representing same-size reflectors at varying material depth. To turn JISDAC evaluation mode ON or OFF:

1. With the JISDAC menu accessed, select the SETUP submenu.

2. Use the JISDAC function to select ON or OFF. The JISDAC Curve is displayed whenever the feature is turned ON.

3.16.2a Interpreting JISDAC Lines and Classes

The JISDAC display contains a recorded reference line and five fixed offset lines. Three of the lines are labeled as follows:

- **H Line** – Connects the recorded reference points
- **M Line** – Fixed offset positioned 6 dB below the H line
- **L Line** – Fixed offset positioned 12 dB below the H line

Any one of these three lines can be identified as the reference from which measurements are based (see the BOLD LINE function below). In addition, the remaining three offset lines are drawn at 6, 12, and 18 dB above the H line.

The regions of the A-Scan display bordered by the H, M, and L lines are identified with JIS Class numbers. These identifying numbers can also be displayed as results. CLS reports the region that contains the peak of the Gate A triggering echo.

3.16.2b Defining a BOLD LINE Measurement Reference (JISDAC-SETUP-BOLD LINE)

The user-defined measurement reference is selected as follows:

1. Access the SETUP submenu in the JISDAC menu.
2. Use the BOLD LINE function to select the H, M, or L line.
3. Note that the selected line is now shown in bold on the A-Scan display. This line now serves as the reference level from which all reference measurements (such as A%rA or dBrB) are made.

3.16.2c Setting TRANSFER CORRection (JISDAC-MAT ATTN-TRANSFER CORR)

The TRANSFER CORR function applies dB compensation for the difference in coupling conditions between the known standard and the test piece.

1. Access the MAT ATTN submenu in the JISDAC menu.
2. Adjust the TRANSFER CORR function as required to compensate for coupling differences.

Note: *When* TRANSFER CORR *is set to any value other than 0, the displayed gain value appears in a contrasting color, indicating that the amount of applied gain differs from the listed* "instrument" *gain.*

3.16.3 Deleting a JISDAC Curve

To delete a stored JISDAC curve:

1. With the JISDAC menu activated, select the SETUP submenu.
2. Activate the DELETE CURVE function, and then confirm your selection.
3. The entry in the JISDAC function box changes to OFF.

[no content intended for this page - proceed to next page]

Chapter 4. Data Sets & Reports

The USM Go can store data set files and generate reports. To perform these functions, see *Figure 15* below and proceed with this chapter.

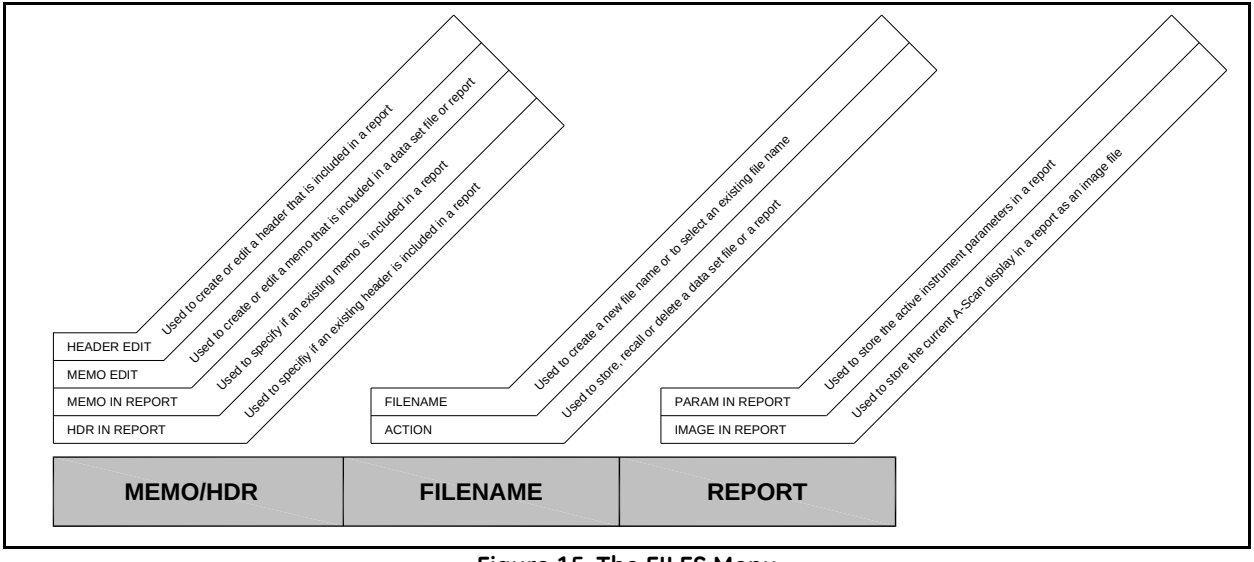


Figure 15: The FILES Menu

4.1 The FILES Menu

To access the FILES menu and select the desired function, refer to *Figure 15 on page 113* and complete the following steps:

1. In the SETUP menu, activate the FILES submenu using the joystick ().

2. Use the joystick () to select the function titled ACTION. Press the center of the joystick () to activate the function.

3. Move the joystick left or right () to select one of the following actions:

- **STORE DATASET** - see *"Storing a New Data Set File" on page 115*
- **RECALL DATASET** - see *"Recalling a Data Set File" on page 117*
- **DELETE DATASET** - see *"Deleting a Data Set File" on page 118*
- **STORE REPORT** - see *"Storing a Report" on page 125*
- **FAST REPORT** - see *"Fast Report" on page 126*

4. After making your choice, press the center of the joystick () to deactivate the function.

4.1 The FILES Menu (cont.)

4.2 Working With Data Set Files

The current instrument settings, which includes most of the functional settings, can be stored as a *data set file*. When a stored data set file is later recalled, all active function settings are modified to match those contained in the data set file. Also, if the A-Scan was stored in the data set file, it is displayed and frozen on the display screen. After a data set is recalled, the newly active functional settings may then be modified if desired. To perform data set operations:

After a data set file is recalled, the instrument settings may then be modified, but these changes only affect the stored data set file if the new setting are stored with the same file name as the original data set file.

4.2.1 Storing a New Data Set File

After selecting the STORE DATASET action (see *"The FILES Menu" on page 114*), proceed to the appropriate section on the following page to either create a new file name or select an existing file name.

4.2.1a File Selection Mode

1. Use the joystick () to select the function titled FILENAME. Press the center of the joystick once () to activate the function in *File Selection* mode.

2. Move the joystick up or down () to select the desired file name from the list of SD card files.

3. Press the center of the joystick () to store the data set with the selected file name and deactivate the function.

4.2.1b File Naming Mode

1. Use the joystick () to select the function titled FILENAME. Press the center of the joystick twice () to activate the function in *File Naming* mode.

2. Move the joystick up or down () to choose the first character in the desired file name. Then, move the joystick left or right () to move the cursor to another character position in the text string. Repeat the process until you have entered the entire file name.

3. Press the center of the joystick () to deactivate the function.

4.2.2 Recalling a Data Set File

After selecting the RECALL DATASET action (see *"The FILES Menu" on page 114*), continue as follows:

1. Use the joystick () to select the function titled FILENAME. Press the center of the joystick () to activate the function in *File Selection* mode.

2. After the list of data set files available on the SD card is displayed, move the joystick up or down () to select the desired data set file name from the list.

3. After selecting the desired data set file, press the center of the joystick () to deactivate the function.

4.2.3 Deleting a Data Set File

After selecting the DELETE DATASET action (see *"The FILES Menu" on page 114*), continue as follows:

1. Use the joystick () to select the function titled FILENAME. Press the center of the joystick () to activate the function.
2. Move the joystick up or down () to choose the first character in the desired filename. Then, move the joystick left or right () to move the cursor to a different character position in the text string.
3. Repeat step 2 until you have entered the entire file name. Then, press the center of the joystick () to deactivate the function.

4.2.4 Editing a Data Set File

Editing an existing data set file, requires a simple combination of the procedures described in the previous sections:

1. Recall the data set file that you wish to edit (see *"Recalling a Data Set File" on page 117*).
2. Using the methods described in previous chapters, modify the active functional settings as desired.
3. Store the modified settings as a data set file (see *"Storing a New Data Set File" on page 115*). When choosing a filename, overwrite the original data set file by choosing the same filename for the modified settings.

4.3 Creating a Memo

Memos may be attached to *Data Set Files* at the time the files are stored or to *Reports* at the time they are generated. After a file is stored, the attached memo may be modified. To create or edit a memo:

1. In the SETUP menu, activate the FILES submenu using the joystick ().
2. Use the joystick () to select the function titled MEMO EDIT. Press the center of the joystick () to activate the function.
3. A text area for the memo is now available on the display, with the cursor positioned for the first character. Move the joystick up or down () to enter the first character in the memo. Then, move the joystick left or right () to move the cursor to a different character position in the text string.
4. Repeat step 3 until you have entered the entire memo. Then, press the center of the joystick () to deactivate the function.

4.4 Including a Memo in a Report

After creating a memo, you can specify whether that memo is included in a report. To add or remove a memo from a report:

1. In the SETUP menu, activate the FILES submenu using the joystick ().
2. Use the joystick () to select the function titled MEMO IN REPORT. Press the center of the joystick () to activate the function.
3. Move the joystick left or right () to select one of the following options:
   - **YES** - the memo is included with a report
   - **NO** - the memo is not included with a report
4. After making your choice, press the center of the joystick () to deactivate the function.

4.5 Creating a Report Header

Report Headers are attached to data set files at the time the files are stored. After a file is stored, the attached *Report Header* may be edited. To create or edit a *Report Header*:

1. In the SETUP menu, activate the FILES submenu using the joystick ().
2. Use the joystick () to select the function titled HEADER EDIT. Press the center of the joystick () to activate the function.
3. A text area for the header is now available on the display, with the cursor positioned for the first character. Move the joystick up or down () to enter the first character in the header. Then, move the joystick left or right () to move the cursor to a different character position in the text string.
4. Repeat step 3 until you have entered the entire header (nine characters maximum). Then, press the center of the joystick () to deactivate the function.

4.6 Including a Header in a Report

After creating a header, you can specify whether that header is included in a report. To add or remove a header from a report:

1. In the SETUP menu, activate the FILES submenu using the joystick ().
2. Use the joystick () to select the function titled HDR IN REPORT. Press the center of the joystick () to activate the function.
3. Move the joystick left or right () to select one of the following options:
   - **YES** - the header is included with a report
   - **NO** - the header is not included with a report
4. After making your choice, press the center of the joystick () to deactivate the function.

4.7 Creating a Report

IMPORTANT: *Before proceeding be sure an SD card is installed in the instrument (see* "Using the SD Slot, USB Connector & I/O Connector" on page 13*).*

A report, with contents specified by the user, can be generated and stored on the USM Go SD card. The following features of the active data set file can either be omitted from or included in the report:

- Header (use the HDR IN REPORT function)
- Memo (use the MEMO IN REPORT function)
- A-Scan Image (use the IMAGE IN REPORT function)
- Instrument parameters (use the PARAM IN REPORT function)

After configuring the report as desired, proceed to the next page to store the report.

4.8 Storing a Report

To store the report specified in the previous section:

Note: *If you have chosen to store the A-Scan image with the report, the image will be saved as a JPG file.*

1. Use the joystick () to select the function titled FILENAME. Press the center of the joystick () to activate the function.
2. Move the joystick up or down () to choose the first character in the desired filename. Then, move the joystick left or right () to move the cursor to a different character position in the text string.
3. Repeat step 2 until you have entered the entire file name. Then, press the center of the joystick () to deactivate the function.
4. If you have not already done so, assign the COPY function to one of the *Function Toggle* buttons (see *"Defining Function Toggle Actions" on page 35*). Your report can now be saved by pressing the assigned toggle button, whenever you are in *Acquisition Mode* and the cursor is in the menu bar or the full-screen display is active.

4.9 Fast Report

The *Fast Report* option performs the same basic function as the *Store Report* option. The difference is that, if you save the A-Scan screen image along with the report, the image is saved as a bitmap file. This permits the save operation to be completed significantly faster, but you should be aware that some SD card printers may not recognize the bitmap file. To use the Fast Report option:

1. Use the joystick () to select the function titled FILENAME. Press the center of the joystick () to activate the function.
2. Move the joystick up or down () to choose the first character in the desired filename. Then, move the joystick left or right () to move the cursor to a different character position in the text string.
3. Repeat step 2 until you have entered the entire file name. Then, press the center of the joystick () to deactivate the function.
4. If you have not already done so, assign the COPY function to one of the *Function Toggle* buttons (see *"Defining Function Toggle Actions" on page 35*). Your report can now be saved by pressing the assigned toggle button, whenever you are in *Acquisition Mode* and the cursor is in the menu bar or the full-screen display is active.

Chapter 5. Data Recorder Files

The *Data Recorder* (**DR**) menu functions are shown in *Figure 16* below.

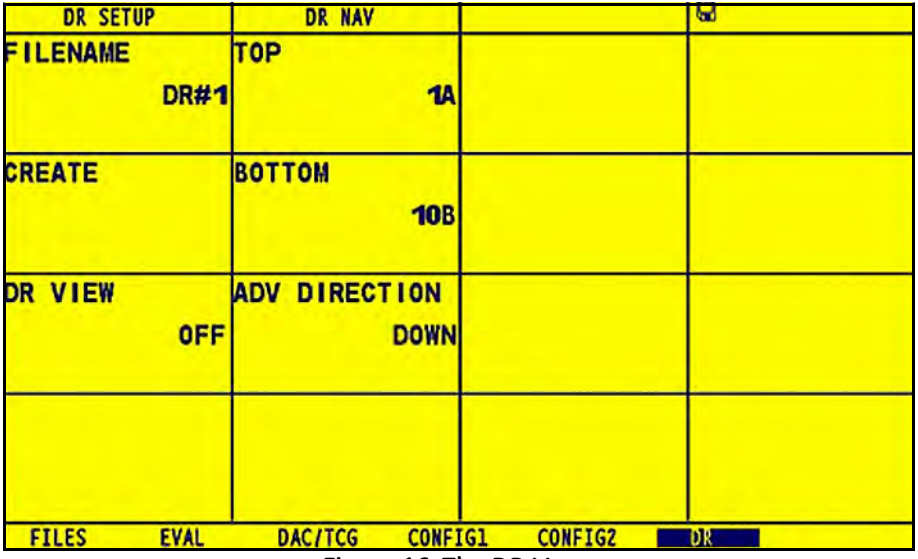


Figure 16: The DR Menu

5.1 Naming the Data Recorder File

In the SETUP menu, use the joystick () to activate the DR menu (see *Figure 16 on page 127*). Then, proceed to the appropriate section below to either create a new file name or select an existing file name.

5.1.1 File Selection Mode

1. Use the joystick () to select the function titled FILENAME in the DR SETUP submenu. Press the center of the joystick once () to activate the function in *File Selection* mode.
2. Move the joystick up or down () to select the desired file name from the list of SD card files.
3. Press the center of the joystick () to deactivate the function.

5.1.2 File Naming Mode

1. Use the joystick () to select the function titled FILENAME in the DR SETUP submenu. Press the center of the joystick twice () to activate the function in *File Naming* mode.

2. Move the joystick up or down () to choose the first character in the desired file name. Then, move the joystick left or right () to move the cursor to another character position in the text string. Repeat the process until you have entered the entire file name.

3. Press the center of the joystick () to deactivate the function.

5.2 Configuring the Data Recorder File

After entering a name for the data recorder file, the following parameters must be specified:

- **TOP** - the coordinates of the first cell in the file, using a row number and an column letter (e.g. 1A).
- **BOTTOM** - the coordinates of the last cell in the file, using a row number and an column letter (e.g. 10B).
- **ADV DIRECTION** - specifies the direction (**DOWN** or **RIGHT**) in which the DR advances after each thickness reading is recorded.

Use the usual joystick methods to select each of the above functions and program the desired values.

5.3 Creating the Data Recorder File

1. After naming and configuring the DR file, use the joystick () to select the function titled CREATE.

2. Press the center of the joystick () to create and activate a DR file that uses your previous selections.

IMPORTANT: *After the DR file is created, the* **TOP** *and* **BOTTOM** *parameters cannot be changed. In fact, these functions are replaced on the menu with listings of the* **NUM OF COLS** *and* **NUM OF ROWS**, *respectively.*

5.4 Viewing the Data Recorder File

To view the DR file that you have just activated, you must complete the following steps:

1. In the SETUP menu, activate the DR submenu using the joystick ().

2. Use the joystick () to select the function titled DR VIEW. Then, press the center of the joystick () to activate the function.

3. Move the joystick left or right () to select the **ON** option. Then, press the center of the joystick () to deactivate the function.

4. Press and hold the center of the joystick () to switch to the *Acquire Menu*.

5. When in *Acquire Mode*, press the center of the joystick () to enter the full-screen display mode.

As shown in *Figure 17 on page 132*, the DR file is displayed on the right side of the display screen.

5.4 Viewing the Data Recorder File (cont.)

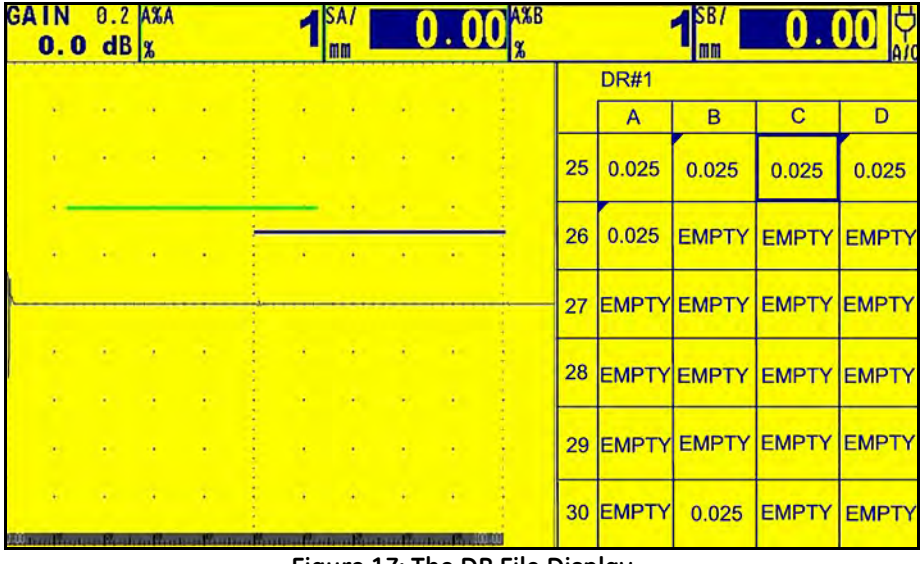


Figure 17: The DR File Display

5.5 Using the Data Recorder File

When the DR file is displayed (see *Figure 17 on page 132*), the name of the DR file is displayed at the top of the grid, and the currently selected cell is highlighted. At this point, the following actions may be taken:

IMPORTANT: *The two* **SEND** *functions described below will not work if the highlighted cell already contains data. You must delete the existing data first.*

- Move the joystick as required () to highlight any desired cell in the grid.
- Use the *Function 1* end of the function toggle () to send the current thickness data to the highlighted cell.
- Use the *Function 2* end of the function toggle () to send the current thickness data and the A-Scan image to the highlighted cell.

Note: *A flag in the upper left corner of a cell indicates that an A-Scan image is attached to the date in that cell.*

- Press both ends of the function toggle () simultaneously to delete the contents of the highlighted cell.

Note: *In DR mode, the function keys behave as described above, regardless of any previous user-defined actions. However, if the user-defined* **HOLD** *functions have been assigned to these keys, those functions are still available.*

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Appendix A. Specifications

Note: *All instrument specifications listed in this appendix are subject to change without prior notice. Also, see* "EN 12668 Specifications" on page 149.

A.1 LCD Display

Active Area:	108.0 mm (W) x 64.8 mm (H), 5.0" Diagonal
Size:	5.0"
Resolution:	800 (W) x 480 (H) pixel
Contrast Ratio:	≥300
Brightness:	≥200 cd/m^2

A.2 Connectors

Probe Connectors:	2, LEMO-00
UT Output Connector:	SAP output, with an added ALARM pin
USB Interface:	Micro USB connector
SD-Card Connector:	Full-size SD card slot, accommodates all standard SD cards
Range:	14,016 mm (552”) for longitudinal wave in steel
Display Delay:	-15 µµs to 3500 µs
Probe Delay:	0 to 1000 µs
Sound Velocity:	1000 to 16,000 m/s
PRF:	Automatically optimized from 5 to 2000 Hz, *3 automatic adjustment modes:* Auto Low, Auto Med, Auto High

A.3 Pulser

Note: *All pulser measurements were taken according to EN12668 specifications.*

Pulser Mode:	*Standard:* simulated spike *Optional:* uni-polar square wave via software control
Pulser Voltage (SQ Mode):	20 V to 300 V, with a 10 V step and tolerance of 10%
Pulser Falling/Rising Time:	10 ns maximum
Pulser Width (SQ Mode):	30 ns to 500 ns, with a 20 ns step and a tolerance of 10%
Pulser Amplitude (Spike Mode):	*Low:* 120 V *High:* 300 V
Damping:	50 ohms or 1000 ohms

A.4 Receiver

Digital Gain:	Dynamic range of 110 dB, with a 0.2 dB step
Analog Bandwidth:	0.2 to 20 MHz
Equivalent Input Noise:	30 µV, across the full bandwidth
Recovery Time:	Target of <1 µs (no EN12668 specification is given for this parameter)
Input Linearity:	2% by method E317, for output data on all 4 ADCs
Filters:	*Broad Band:* 0.5 to 15 MHz *1 MHz:* 0.5 to 1 MHz *2 MHz:* 1 to 3 MHz (2.25 MHz in German language mode) *5 MHz:* 2.5 to 7.5 MHz (4 MHz in German language mode) *10 MHz:* 5 to 15 MHz *Low Pass:* 0.2 to 2.5 MHz *High Pass:* 8.0 to 15 MHz

A.5 Gates

Independent Gates:	2 Gates (A and B), Gate B supports triggering by Gate A
Rectification:	POS (positive) NEG (negative) FW (full wave) RF
Measurement:	Peak Flank J-Flank

A.6 Memory

Capacity:	2 GB, SD card
Data Sets:	
Reports:	jpg or bmp A-Scan images

A.7 Environmental

Battery:	*Life:* 6 hr per full charge *Charging (standard):* Internal *Charging (optional):* External adapter *Level:* proportional battery gauge
Battery Charger:	Universal AC input (100 to 240 VAC, 50-60 Hz); meets CCC, CE, UL, CSA and PSE requirements
Size:	175 mm (W) x 111 mm (H) x 50 mm (D)
Weight:	1 kg with battery
Languages:	English, German, French, Spanish, Chinese, Japanese

A.8 Protection

Damp Heat & Humidity (Storage):	*10 Cycles:* 10 hr at +60°C down to +30°C, 10 hr at +30°C up to +60°C, Transition within 2 hr (507.4)
Temperature Shock (Storage):	*3 Cycles:* 4 hr at -20°C up to +60°C, 4 hr at +60°C, Transition within 5 minutes (503.4 Procedure II)
Vibration:	*General Exposure:* 1 hr each axis, 514.5-5 Procedure I, Annex C, Figure 6
Shock:	*6 Cycles each axis*, 15 g, 11 ms, half-sine (516.5 Procedure I)
Loose Cargo (in Shipping Container):	514.5 Procedure II
Transit Drop (Packaged for Shipment):	*26 Drops*, 516.5 Procedure IV
Dust Proof/Dripping Water Proof:	As per the IEC 529 specification for IP67 classification
Operating Temperature Range:	0 to 55°C
Storage Temperature Range:	-20 to +60°C, 24 hr with battery

A.8 Protection (cont.)

Compliance:	*EMC/EMI:*	EN 55011
		EN 61000-6-2:2001
	Ultrasound:	EN 12668
		ASTM E1324
		E317
		ANSI/NCSL Z 540-1-1994
		MIL STD 45662A
		MIL STD 2154

A.9 USM Go Options

AWS Option:	AWS sizing tool, according to AWS D1.1 structural welding code	
DAC Option:	DAC sizing tool, 16 points,	
	Complaint with:	EN 1712 - EN 1713 - EN1714
		ASTM E164
		ASME & ASME III
		JIS Z3060
		TCG: 120 dB Dynamic
		110 dB/µs slope

A.9 USM Go Options (cont.)

DGS Option:	DGS sizing tool, *Complaint with:* EN 1712 - EN 1713 - EN1714 ASTM E164
Embedded Data Logger Option:	Grid file creation
Square Wave Pulser Option:	Allows fine-tuning of pulser parameters, Voltage adjustment from 120 to 300 V per 10 V steps, pulse width adjustment from 30 to 500 ns per 10 ns steps
Manual PRF & Phantom Option:	Allows manual PRF optimization between 15 Hz and 2000 Hz per 5 Hz step. Phantom PRF will help to identify a ghost echo caused by multiple reflections in low-attenuation materials

[no content intended for this page - proceed to next page]

Appendix B. Environmental Compliance

This appendix contains information on the following topics:

- WEEE Directive (see *Section B.1 on page 146*)
- Battery disposal (see *Section B.2 on page 147*)

B.1 Waste Electrical and Electronic Equipment (WEEE) Directive

GE Sensing & Inspection Technologies is an active participant in Europe's Waste Electrical and Electronic Equipment (WEEE) take-back initiative, directive 2002/96/EC.

The equipment that you bought has required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment.

In order to avoid the dissemination of those substances in our environment and to diminish the pressure on the natural resources, we encourage you to use the appropriate take-back systems. Those systems will reuse or recycle most of the materials of your end life equipment in a sound way.

The crossed-out wheeled bin symbol invites you to use those systems.

If you need more information on the collection, reuse and recycling systems, please contact your local or regional waste administration.

Visit **www.ge.com/inspectiontechnologies** for take-back instructions and more information about this initiative.

B.2 Battery Disposal

This product contains a battery that cannot be disposed of as unsorted municipal waste in the European Union. See the product documentation for specific battery information. The battery is marked with this symbol, which may include lettering to indicate cadmium (Cd), lead (Pb), or mercury (Hg). For proper recycling return the battery to your supplier or to a designated collection point.

B.2.1 What do the Markings Mean?

Batteries and accumulators must be marked (either on the battery or accumulator or on its packaging, depending on size) with the separate collection symbol. In addition, the marking must include the chemical symbols of specific levels of toxic metals as follows:

- Cadmium (Cd) over 0.002%
- Lead (Pb) over 0.004%
- Mercury (Hg) over 0.0005%

B.2.2 The Risks and Your Role in Reducing Them

Your participation is an important part of the effort to minimize the impact of batteries and accumulators on the environment and on human health. For proper recycling you can return this product or the batteries or accumulators it contains to your supplier or to a designated collection point.

Some batteries or accumulators contain toxic metals that pose serious risks to human health and to the environment. When required, the product marking includes chemical symbols that indicate the presence toxic metals: Pb for lead, Hg for mercury, and Cd for cadmium.

- **Cadmium** poisoning can result in cancer of the lungs and prostate gland. Chronic effects include kidney damage, pulmonary emphysema, and bone diseases such as osteomalcia and osteoporosis. Cadmium may also cause anemia, discoloration of the teeth, and loss of smell (anosmia).
- **Lead** is poisonous in all forms. It accumulates in the body, so each exposure is significant. Ingestion and inhalation of lead can cause severe damage to human health. Risks include brain damage, convulsions, malnutrition, and sterility.
- **Mercury** creates hazardous vapors at room temperature. Exposure to high concentrations of mercury vapor can cause a variety of severe symptoms. Risks include chronic inflammation of mouth and gums, personality change, nervousness, fever, and rashes.

Appendix C. EN 12668 Specifications

The EN 12668 specifications for the USM Go are listed in *Table 2* below.

Table 2: EN 12668-1:2000 Specifications

Paragraph	Parameter	LSL	Typ.	USL	Units	Test Conditions
8.2	Timebase Stability Against Temperature	-1	0	1	%FS/C	After 30 minute warm-up
	Amplitude Stability Against Temperature	-5	0	5	%FS/C	After 30 minute warm-up
9.3.2	Timebase Stability After Warm Up	-1	0	1	%FS	After 30 minute warm-up
	Amplitude Stability After Warm Up	-2	1	2	%FS	After 30 minute warm-up
9.3.3	Timebase Display Jitter	-1	0	1	%FS	After 30 minute warm-up
	Amplitude Display Jitter	-2	1	2	%FS	After 30 minute warm-up
9.3.4	Timebase Stability Against Voltage Variation	-1	0	1	%FS	
	Amplitude Stability Against Voltage Variation	-2	0	2	%FS	
8.3.2	Pulse Repetition Frequency Error	-20	0	20	% Err	
8.3.3	Pulser Output Impedance		<50		Ohm	
8.3.4	*Pulser Spectrum		See Chart			

Table 2: EN 12668-1:2000 Specifications (cont.)

Paragraph	Parameter	LSL	Typ.	USL	Units	Test Conditions
9.4.2	Loaded Pulse Voltage	-140	-156	-172	V	Damping = 50, Voltage = Low, Energy = Low, RepRate = 15
		-139	-154	-169	V	Damping = 50, Voltage = Low, Energy = Low, RepRate = 2000
		-171	-190	-209	V	Damping = 1000, Voltage = Low, Energy = Low, RepRate = 15
		-171	-190	-209	V	Damping = 1000, Voltage = Low, Energy = Low, RepRate = 2000
		-103	-114	-125	V	Damping = 50, Voltage = Low, Energy = High, RepRate = 15
		-102	-113	-124	V	Damping = 50, Voltage = Low, Energy = High, RepRate = 2000
		-115	-128	-141	V	Damping =1000, Voltage = Low, Energy = High, RepRate =15
		-115	-128	-141	V	Damping =1000, Voltage = Low, Energy = High, RepRate =2000
		-167	-186	-205	V	Damping =50, Voltage = High, Energy = Low, RepRate =15
		-167	-185	-204	V	Damping =50, Voltage = High, Energy = Low, RepRate =200
		-209	-232	-255	V	Damping =1000, Voltage = High, Energy = Low, RepRate =15
		-209	-232	-255	V	Damping =1000, Voltage = High, Energy = Low, RepRate =2000
		-185	-206	-227	V	Damping =50, Voltage = High, Energy = High, RepRate =1
		-185	-205	-226	V	Damping =50, Voltage = High, Energy = High, RepRate =2000
		-211	-234	-257	V	Damping =1000, Voltage = High, Energy = High, RepRate =15
		-211	-234	-257	V	Damping =1000, Voltage = High, Energy = High, RepRate =2000

Table 2: EN 12668-1:2000 Specifications (cont.)

Paragraph	Parameter	LSL	Typ.	USL	Units	Test Conditions
9.4.2	Pulse Rise Time		3	10	nSec	Damping = 50, Voltage = Low, Energy = Low, RepRate = 15
			3	10	nSec	Damping = 50, Voltage = Low, Energy = Low, RepRate = 2000
			3	10	nSe	Damping = 1000, Voltage = Low, Energy = Low, RepRate = 15
			3	10	nSec	Damping = 1000, Voltage = Low, Energy = Low, RepRate = 2000
			4	10	nSec	Damping = 50, Voltage = Low, Energy = High, RepRate = 1
			4	10	nSec	Damping = 50, Voltage = Low, Energy = High, RepRate = 2000
			4	10	nSec	Damping =1000, Voltage = Low, Energy = High, RepRate =15
			4	10	nSec	Damping =1000, Voltage = Low, Energy = High, RepRate =2000
			3	10	nSec	Damping =50, Voltage = High, Energy = Low, RepRate =15
			3	10	nSec	Damping =50, Voltage = High, Energy = Low, RepRate =2000
			3	10	nSec	Damping =1000, Voltage = High, Energy = Low, RepRate =15
			3	10	nSec	Damping =1000, Voltage = High, Energy = Low, RepRate =2000
			3	10	nSec	Damping =50, Voltage = High, Energy = High, RepRate =15
			3	10	nSec	Damping =50, Voltage = High, Energy = High, RepRate =2000
			3	10	nSec	Damping =1000, Voltage = High, Energy = High, RepRate =15
			3	10	nSec	Damping =1000, Voltage = High, Energy = High, RepRate =2000

Table 2: EN 12668-1:2000 Specifications (cont.)

Paragraph	Parameter	LSL	Typ.	USL	Units	Test Conditions
9.4.2	Pulse Duration	16	18	20	nSec	Damping = 50, Voltage = Low, Energy = Low, RepRate = 15
		16	18	20	nSec	Damping = 50, Voltage = Low, Energy = Low, RepRate = 2000
		27	30	33	nSec	Damping = 1000, Voltage = Low, Energy = Low, RepRate = 15
		28	31	34	nSec	Damping = 1000, Voltage = Low, Energy = Low, RepRate = 2000
		57	63	69	nSec	Damping = 50, Voltage = Low, Energy = High, RepRate = 15
		57	63	69	nSec	Damping = 50, Voltage = Low, Energy = High, RepRate = 2000
		93	103	113	nSec	Damping =1000, Voltage = Low, Energy = High, RepRate =1
		94	104	114	nSec	Damping =1000, Voltage = Low, Energy = High, RepRate =2000
		16	18	20	nSec	Damping =50, Voltage = High, Energy = Low, RepRate =1
		16	18	20	nSec	Damping =50, Voltage = High, Energy = Low, RepRate =200
		28	31	34	nSec	Damping =1000, Voltage = High, Energy = Low, RepRate =15
		28	31	34	nSec	Damping =1000, Voltage = High, Energy = Low, RepRate =2000
		57	63	69	nSec	Damping =50, Voltage = High, Energy = High, RepRate =1
		57	63	69	nSec	Damping =50, Voltage = High, Energy = High, RepRate =2000
		94	104	114	nSec	Damping =1000, Voltage = High, Energy = High, RepRate =15
		94	104	114	nSec	Damping =1000, Voltage = High, Energy = High, RepRate =2000

Table 2: EN 12668-1:2000 Specifications (cont.)

Paragraph	Parameter	LSL	Typ.	USL	Units	Test Conditions
9.4.2	Pulse Reverberation		0	4	nSec	Damping = 50, Voltage = Low, Energy = Low, RepRate = 15
			0	4	nSec	Damping = 50, Voltage = Low, Energy = Low, RepRate = 2000
			0	4	nSec	Damping = 1000, Voltage = Low, Energy = Low, RepRate = 15
			0	4	nSec	Damping = 1000, Voltage = Low, Energy = Low, RepRate = 2000
			0	4	nSec	Damping = 50, Voltage = Low, Energy = High, RepRate = 15
			0	4	nSec	Damping = 50, Voltage = Low, Energy = High, RepRate = 2000
			0	4	nSec	Damping =1000, Voltage = Low, Energy = High, RepRate =15
			0	4	nSec	Damping =1000, Voltage = Low, Energy = High, RepRate =2000
			0	4	nSec	Damping =50, Voltage = High, Energy = Low, RepRate =15
			0	4	nSec	Damping =50, Voltage = High, Energy = Low, RepRate =2000
			0	4	nSec	Damping =1000, Voltage = High, Energy = Low, RepRate =15
			0	4	nSec	Damping =1000, Voltage = High, Energy = Low, RepRate =2000
			0	4	nSec	Damping =50, Voltage = High, Energy = High, RepRate =15

Table 2: EN 12668-1:2000 Specifications (cont.)

Paragraph	Parameter	LSL	Typ.	USL	Units	Test Conditions
9.4.2	Pulse Reverberation		0	4	nSec	Damping =50, Voltage = High, Energy = High, RepRate =2000
			0	4	nSec	Damping =1000, Voltage = High, Energy = High, RepRate =15
			0	4	nSec	Damping =1000, Voltage = High, Energy = High, RepRate =2000
8.4.2	Crosstalk Pulser to Receiver	80	80	-	dB	
8.4.3	Dead Time After Transmitter Pulse			10	uSec	Measured in worst case frequency setting
8.4.4	Dynamic Range	100	100	-	dB	Measured in worst case frequency setting
8.4.5	Receiver Input Impedance		950		Ohm	Real Impedance at 4MHz
			0	0.1		$(R_{max\ gain} - R_{min\ gain})/R_{max\ gain}$
			40		Ohm	Imaginary Impedance at 4MHz
			1.03		nF	Input Capacitance
			0	0.15		$(C_{max\ gain} - C_{min\ gain})/C_{max\ gain}$
8.4.6	Distance Amplitude Correction	-1.5	0	1.5	dB	Maximum error between TCG curve and actual TCG correction

Table 2: EN 12668-1:2000 Specifications (cont.)

Paragraph	Parameter	LSL	Typ.	USL	Units	Test Conditions
9.5.2	Amplifier Frequency Response	0.72	0.76	0.80	MHz	Center Frequency (Geometric Mean), 1MHz selected
		1.78	1.87	2.06	MHz	Bandwidth, 1MHz selected
		1.66	1.75	1.83	MHz	Center Frequency (Geometric Mean), 2 to 2.25MHz selected
		2.75	3.06	3.37	MHz	Bandwidth, 2 to 2.25MHz selected
		4.51	4.75	4.99	MHz	Center Frequency (Geometric Mean), 4 to 5MHz selected
		4.56	5.07	5.58	MHz	Bandwidth, 4 to 5MHz selected
		8.79	9.25	9.71	MHz	Center Frequency (Geometric Mean), 10MHz selected
		6.17	6.85	7.54	MHz	Bandwidth, 10MHz selected
		12.25	12.89	13.53	MHz	Center Frequency (Geometric Mean), 13MHz selected
		5.02	5.58	6.14	MHz	Bandwidth, 13MHz selected
		2.00	2.10	2.21	MHz	Center Frequency (Geometric Mean), BroadBand selected
		13.37	14.86	16.35	MHz	Bandwidth, BroadBand selected

Table 2: EN 12668-1:2000 Specifications (cont.)

Paragraph	Parameter	LSL	Typ.	USL	Units	Test Conditions
9.5.3	Equivalent Input Noise	-	50	80	nV/ sqrt Hz	1MHz Selected
		-	48	80	nV/ sqrt Hz	2 to 2.25MHz Selected
		-	37	80	nV/ sqrt Hz	4 to 5MHz Selected
		-	33	80	nV/ sqrt Hz	10MHz Selected
		-	40	80	nV/ sqrt Hz	13MHz Selected
		-	45	80	nV/ sqrt Hz	BroadBand Selected
9.5.4	Accuracy of Calibrated Attenuator	-1	0.7	1	dB	Cumulative Error over 20dB Range
		-2	0.7	2	dB	Cumulative Error over 60dB Range

Table 2: EN 12668-1:2000 Specifications (cont.)

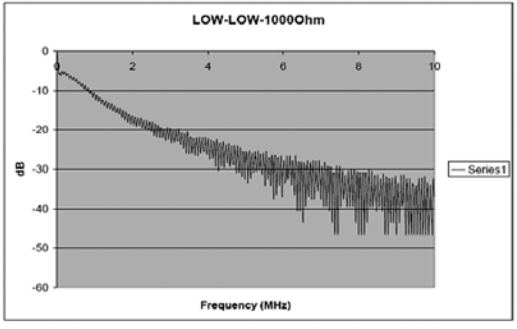
Paragraph	Parameter	LSL	Typ.	USL	Units	Test Conditions
9.5.5	Linearity of Vertical Display	-2	0.6	2	%FSH	1MHz Selected
		-2	0.5	2	%FSH	2 to 2.25MHz Selected
		-2	0.6	2	%FSH	4 to 5MHz Selected
		-2	-0.9	2	%FSH	10MHz Selected
		-2	-1.25	2	%FSH	13MHz Selected
		-2	0.18	2	%FSH	BroadBand Selected
8.7.2	Linearity of Timebase	-	0.03	0.5	%FSW	
8.7.3	Digitization Sampling Error	-5	-4	5	%FSH	
	Dimensions		17.1		CM	Height
			28.2		CM	Width
			15.9		CM	Depth
			3.8		KG	Weight (With Battery)

Table 2: EN 12668-1:2000 Specifications (cont.)

Paragraph	Parameter	LSL	Typ.	USL	Units	Test Conditions
8.7.3	Battery Life		6		Hr	Instrument will automatically shut down when batteries are too low for reliable operation
	Operating Temperature Range	0	-	50	DegC	
	Rectification Modes		FW			
			HWP			
			HWN			
			RF			
	Pulse Repetition Frequency	15		2000	Hz	Continuously Variable
	Display Dimensions		16.5		CM	Diagonal
			640 x 480			Pixels
	Number of Pixels to Display an A-Scan		512			
	A-Scan Graticule Major Divisions		None, 5 or 10			Vertical and Horizontal, User selectable
	A-Scan Graticule Minor Horizontal Divisions		50			Displayed along the baseline
	A-Scan Graticule Minor Vertical Divisions		50			Displayed on the center vertical

Table 2: EN 12668-1:2000 Specifications (cont.)

Paragraph	Parameter	LSL	Typ.	USL	Units	Test Conditions
8.7.3	Velocity Range	0.0098	-	0.6299	in/uS	
		250	-	16000	M/S	
	Display Delay Range	-15	-	3500	uS	
	TCG Range	40			dB	
	TCG Maximum Slope	6			dB/uS	
	TCG Maximum Number of Points	15				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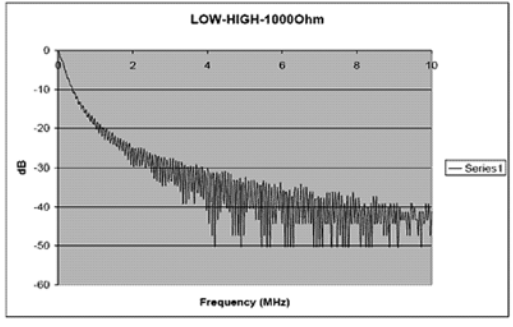
-20
-30
-40
-50
-60
dB
0
2
4
6
8
10
Frequency (MHz)
Series1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dB
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8
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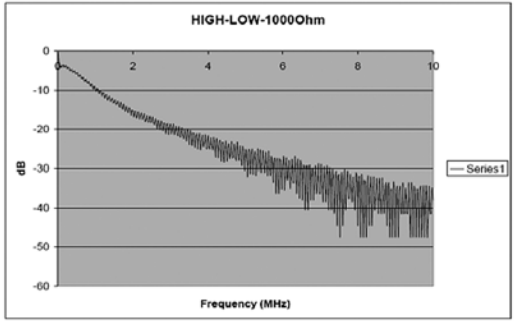
Frequency (MHz)
Series1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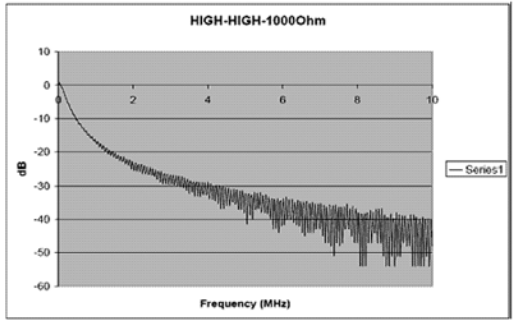
Frequency (MHz)
Series1


HIGH-HIGH-1000Ohm
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dB
0
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4
6
8
10
Frequency (MHz)
Series1

A

B

E

F

R

S

V

W

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