

OPERATION MANUAL

A1525 SOLO

TFM ULTRASONIC
FLAW DETECTOR



Acoustic Control Systems – ACS Group
Saarbrücken, Germany 2020



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This operation manual contains specifications, device, and operating principle descriptions for the correct use of the A1525 SOLO ultrasonic flaw detector.

Before operating this device, please carefully review this manual. Only properly trained and qualified personnel should operate this device. Please check local codes and regulations regarding any required certifications needed before use.

The manufacturer continually upgrades this device, thereby increasing reliability and operational convenience. Consequently, these new features may result in significant changes not mentioned in this manual version. Consult with your local agent or the factory if there are questions regarding operational characteristics not found within this manual.

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DEVICE DESCRIPTION AND OPERATION

1.1 DEVICE PURPOSE

1.1.1 TFM flaw detector purpose and field of use

The A1525 SOLO TFM flaw detector is the world's lightest and smallest TFM phased array instrument. It can also be operated as a conventional pulse-echo handheld ultrasonic devices used for general-purpose testing. This unique device utilizes phased array transducers and the Total Focusing Method (TFM) of signal processing to generate a tomographic image (or frame) instead of the traditional S-Scan display seen on conventional phased array flaw detectors. This image is much easier to interpret and provides non-technical users with the ability to understand the information presented on screen and how it relates to the part being inspected.

When the instrument is purchased with the optional single-axis encoder, D-Scan and C-Scan data can be collected for accurate location mapping and sizing. A D-Scan shows a cross-section view of the indication through the weld, and a C-Scan shows the corresponding top (plan) view of the indication. This information can be recorded for later review and analysis.

The A1525 SOLO is an excellent transition instrument for conventional UT inspectors to learn the benefits of phased array imaging. It is also ideal as a light and portable screening tool providing initial imaging scans for more in-depth investigations with AUT or other NDT methods as required.

1.1.2 Operating conditions

The A1525 SOLO is designed for operation under the following environmental conditions:

- at temperatures from -10 to + 55 °C; 14.0 °F to 131 °F
- at relative air humidity to 95 % at a maximum + 35 °C (95 °F).

SAFETY SYMBOLS USED IN THIS MANUAL:

Symbol	Description
	Indicates a potential threat. Failure to avoid it can result in death or serious injury.
	Indicates a potential threat. Failure to avoid it may result in minor injury.
NOTICE	Indicates a potentially harmful situation. If it is not avoided, the device or something in its vicinity may be damaged.

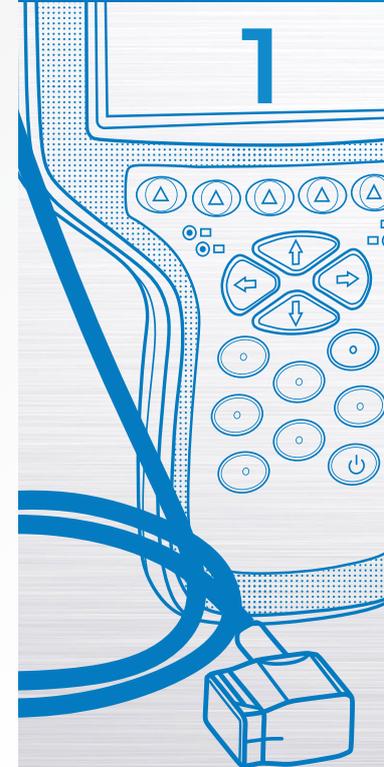
1.2 SPECIFICATIONS

1.2.1 Main device parameters

The main device parameters are given in Table 1.

Table 1

Parameter name	Value
Velocity value range, m/sec	1,000-10,000
Operating transducer frequencies, MHz	1.0 – 10.0
Operating frequencies deviation from rated, %	± 10
Thickness range (in steel) with a longitudinal transducer, mm	4-900
Permissible basic absolute error limits for thickness T calibration with a longitudinal transducer, mm	±(0.01·T+0.2)
Defect depth calibration range (in steel) with a longitudinal transducer, mm	7-180
Permissible basic absolute error limits for defect depth D with a longitudinal transducer, mm	±(0.01·D+0.2)
Defect coordinate ranges (in steel) with a shear wave transducer 60°, mm:	
Depths D	3 - 40
Surface Distance SD	5 - 75
Permissible basic absolute error limits for defect coordinates with a shear wave transducer 60°, mm:	
Depths D	±(0.03·D+1)
Surface Distance SD	±(0.03·SD+1)
Defect coordinate ranges (in steel) with a shear wave transducer 70°, mm:	
Depths D	3 - 40
Surface Distance SD	7 - 100





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Operation Manual

Table 1

Parameter	Value
Permissible basic absolute error limits for defect coordinate with a shear wave transducer 70°, mm: Depths D Surface ranges SD	$\pm(0.03 \cdot D + 1)$ $\pm(0.03 \cdot SD + 1)$
Defect coordinate ranges (in steel) with a phased array of longitudinal waves, mm	10 - 90
Permissible basic absolute error limits for defect depth D with a phased array of longitudinal waves, mm	$\pm(0.03 \cdot D + 1)$
Defect coordinates ranges (in steel) with a phased array of shear waves, mm: Depths D Surface Distance SD	6 - 80 6 - 80
Permissible basic absolute error limits for defect coordinates with a phased array of shear waves, mm: Depths D Surface Distance SD	$\pm(0.03 \cdot H + 1)$ $\pm(0.03 \cdot L + 1)$
Amplifier adjustment range, dB	0 - 80
Permissible basic absolute error limits for signal amplitude ratio on receiver input, dB	± 0.5
Power supply	Lithium Battery
Rated power value of a battery, V	11.2
Operation time with battery, hours	6
Overall dimensions of an electronic unit, mm	260x157x43
Weight of an electronic unit, kg, no more	0.8
Mean-time-between-failures, hours	30 000
Mean lifetime, years, at least	8

1.3 DEVICE STRUCTURE AND OPERATION

1.3.1 Device structure

The flaw detector includes an electronic unit to which a phased array transducer (PA) is connected by cables and an AC power adapter.

1.3.1.1 Electronic unit

Figure 1 shows the basic unit connected to a shear wave phased array transducer. Instrument settings are controlled with a membrane keyboard. Indication of signals, calibration data, and instrument state are displayed and indicated with LEDs on the device case. Device power is supplied by a lithium-ion battery or from the AC power adapter plugged into the bottom of the unit. In addition to the AC power connection, there is also a USB port for connection to a PC. At the top of the instrument case, there are connections for the transducer and one for the optional encoder (purchased separately).

1.3.1.2 Power Supply/Battery Charger

The power supply unit provides an external (15V) power source and is also used to charge the lithium-ion battery pack. Once the instrument is fully charged, it can be used for approximately 8 hours under normal operating conditions. The instrument can be operated during charging. Please allow 8 hours to charge a fully depleted battery.

To avoid device damage, it is recommended that the power supply be connected to the instrument before it is connected to a power outlet.

⚠ WARNING THE BATTERY IS NOT ACCESSIBLE BY THE END USER. DO NOT ATTEMPT TO OPEN THE INSTRUMENT. THIS WILL VOID THE EQUIPMENT WARRANTY.



Figure 1



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1.3.2 Main Interface

The A1525 SOLO is designed for ease of use and quick access to the most commonly used features. The icon-based menu layout allows the new user to learn the operation process quickly. These design features make the instrument ideal to easily transition from conventional ultrasonic testing to phased array inspection.

After basic calibration is performed, these settings can be easily saved and named to allow for fast recall. The name can be job-specific or can relate to the type of component being examined. Once the setup files are in memory, they are quickly retrieved at a later date for similar inspections.

1.3.3 Instrument operation modes - Overview

There are three operating modes of the A1525 SOLO: TOMOGRAPH, FLAW DETECTOR, and SCANNER. These modes are selected by pressing the mode key **Mode** located at the bottom right on the keypad.

The **TOMOGRAPH** mode is the main method of inspection for this instrument and is designed for real-time inspection imaging, but the scan is not captured or encoded. This is a manual scanning mode and is used in the same manner as conventional A-Scan ultrasonic inspection. However, instead of an oscilloscope display showing the time of flight and amplitude, the phased array image (tomograph showed in Figure 2 below) displays a cross-sectional view of the part under examination. Both the X-axis position from the transducer and the Z-axis depth of the indication are displayed at the top. In addition, the sensitivity in decibels (dB) is also displayed along with a visual indication of severity in the form of a color bar.

In the above example, a weld overlay is displayed to help visualize the surface position (X-Axis) and depth (Z-Axis) of the indications displayed in the phased array image (frame). Also, the color denotes the severity in relation to the scale shown on the right of the screen.

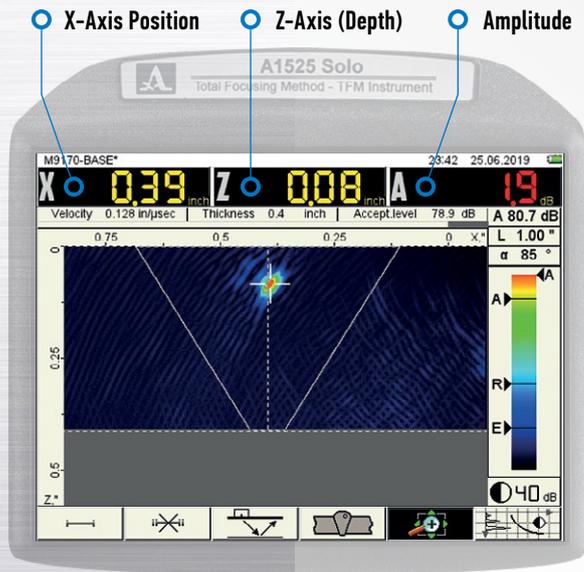


FIGURE 2 TOMOGRAPH MODE

In the image above, red indicates the greatest reflected energy, whereas blue and black represent the least reflected energy.

There is a crosshair highlighting an indication present on the screen above. The data displayed in X,Y, and A relates to just that one indication. This selection process can be manual, as shown above, or it can be automatic when gates are active. The details of gating will be discussed in a later section.

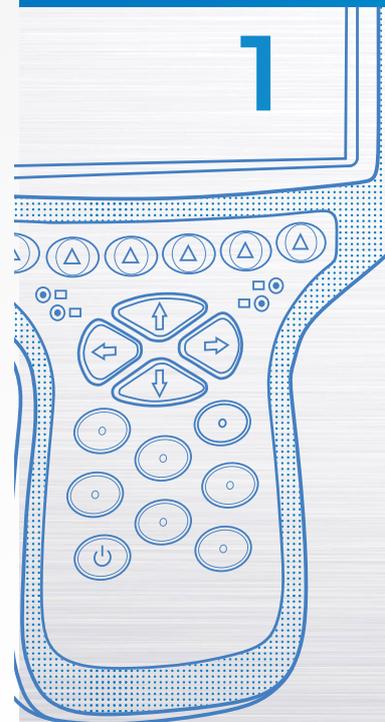
The **FLAW DETECTOR** mode is used when a conventional single element or dual element transducer is required for the examination. **The array transducers do not function while the instrument is in this mode.** This mode is the traditional A-Scan display, which shows the time of flight and amplitude of the signals displayed on the screen.

It is assumed that the operator of this instrument fully grasps this style of inspection. Therefore, further explanation of longitudinal contact testing and shear wave testing theory will not occur in this manual beyond the necessary steps used for calibration. Those steps will be covered in a later section.

FLAW DETECTOR mode is selected by **holding the mode key**  for 2 seconds when currently operating in the TOMOGRAPH mode. The following window will appear on the screen.

To confirm the selection of FLAW DETECTOR mode press the enter key 

To cancel the mode change, press the escape key,  and you will return to the TOMOGRAPH mode.



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Once enter is pressed, a screen similar to that shown in Figure 3 on the next page will be displayed (the signal shown in the center is representative and will not be on your display). The information fields X, Z, and A are also displayed in a similar fashion as in the TOMOGRAPH mode. Once again, they represent the distance to the indication, the depth of the indication, and the amplitude of the signal response of the indication.

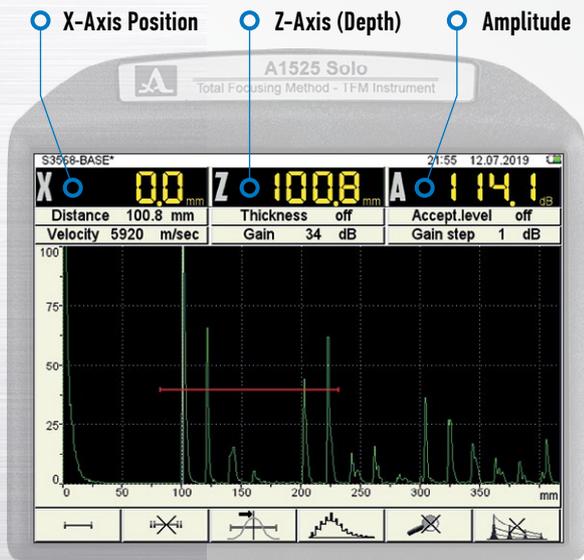


Figure 3: FLAW DETECTOR MODE

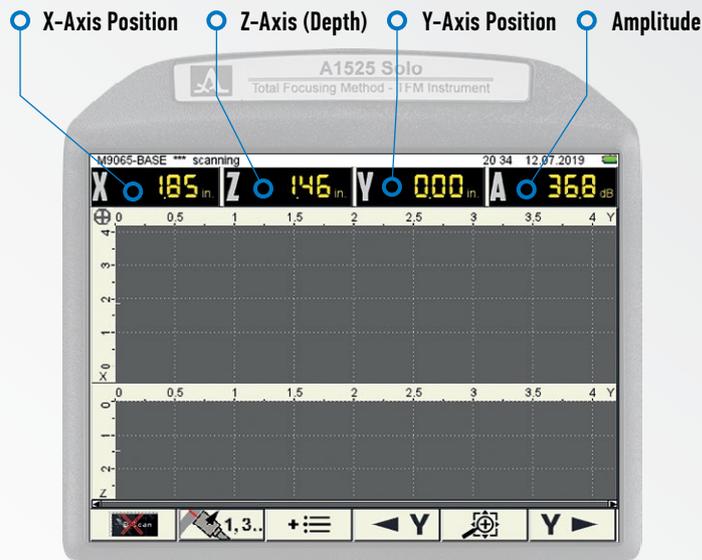


Figure 4: SCANNER MODE

The **SCANNER** mode (next page) is only functional when paired with an optional single-axis encoded scanner. Press the mode key **Mode** briefly (do not hold the key or you will be presented with the FLAW DETECTOR selection described earlier). Upon pressing the key, the unit will automatically switch to a screen, as shown in Figure 4.

This mode of operation is used to create a scan file that shows the transducer's relative position to the part under examination. The scan is recorded and can be played back at a later time for analysis. Should your inspection requirements mandate thorough documentation including detailed positional coordinates, it is advisable to purchase this optional scanner.

The Y-axis is encoded to show the linear position of the indication along the weld (or another component under examination).



Optional Scanner

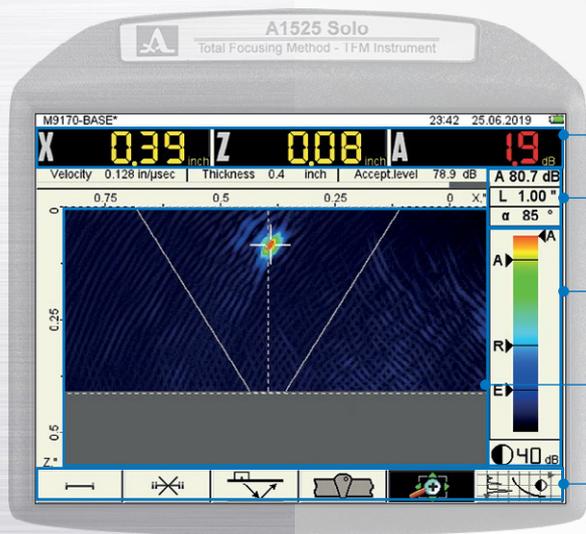


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1.3.4 Basic Display Features

A color TFT 640x480 pixel display is used on the A1525 SOLO.

The screen space in each mode is divided into several functional areas. Figure 5 shows the screen in TOMOGRAPH mode, and the various features are labeled. Though some features change with the mode of operation, the basic design is similar throughout.



- Measurement Bar
- Gain, Sound Path and Angle
- Color bar for sensitivity response
- Tomograph Frame
- Icon bar for selection of instrument functions

FIGURE 5 TOMOGRAPH FRAME

Control/Function Keys F1 to F6

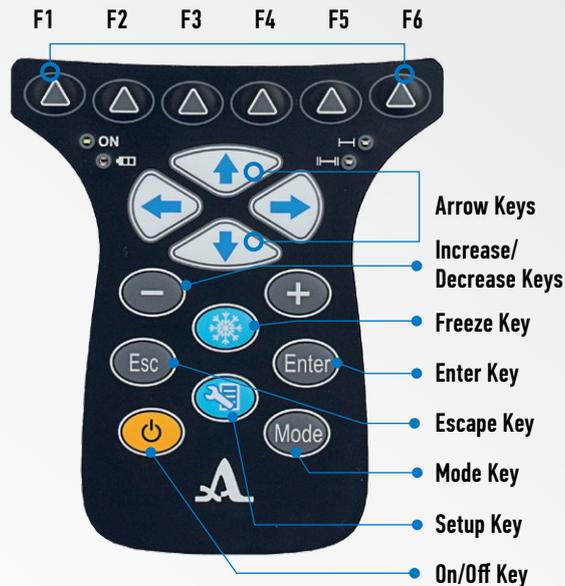


FIGURE 6 TOMOGRAPH KEYBOARD

1.3.5 Keyboard

The A1525 SOLO keyboard is shown in Figure 6.

The green LED indicator in the top left corner of the device  informs the user that the instrument is switched on.

The LED indicator  shows a battery charging process. An orange/yellow color indicates the battery is charging, and green – the charging process is complete.

The two red indicators under Function Key 5 monitor response for the first  and second gates  accordingly.

Main functions and parameters are controlled by icon selection keys - function keys (F1-F6),  placed under the display, the corresponding icon is located over each.

Active parameters are selected and edited by the command keys placed on the left and right of the display. Their actions are similar for different operating device modes and are designed for intuitive recognition by an operator, i.e., their symbols are typical for the action.

An autorepeat mode is implemented for some keys. The longer the key is held, the faster the given parameter increases or decreases.

For switching between TOMOGRAPH / FLAW-DETECTOR modes, press the  key, in the open mode selection window (Figure 7) select an operating mode by the arrow keys.



To confirm the selection, press the  key, to cancel the mode

change press the  key. Device key functions are described in Table 2.



FIGURE 7



Table 2

Key	Key function in various operating modes			
	TOMOGRAPH	SCANNER	FLAW- DETECTOR	SETUP
	Switching the device ON/OFF Hold the key for over 0.5 sec			
	Enter SETUP mode		Exit SETUP mode	
	Quick Press			
	Previous operating mode selection	Enter TOMOGRAPH mode	Enter TOMOGRAPH mode	Exit SETUP mode
	Hold - Operating mode selection (TOMOGRAPH/FLAW DETECTOR)			
 	Tomogram brightness adjustment (in dB)	N/A	Cursor movement	Active parameter value adjustment
	N/A	Reset the encoded scan	N/A	Exit changing parameters marked with ▶, without saving
	Cursor movement on the tomogram	Cursor movement on the tomogram or the scan during replay	Range adjustment - horizontal arrows Gain (dB) adjustment - vertical arrows	Parameter selection for adjustment (vertical arrows) Enter / Exit parameter editing mode
	Enter Freeze mode – used to save files			Deleting the configuration
	N/A	Turning on / off scanning with encoder	Turning on / off reference level	Start parameters setting, marked with ▶. Memory erase during system parameters adjustment
	Icon selection and function control keys			

1.3.6 Use of Icons

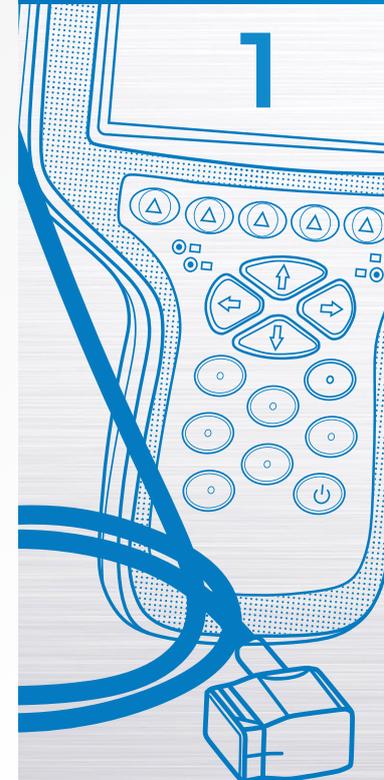
The device interface is characterized by an icon-based menu, as shown in Figure 8, placed in six rectangular windows at the bottom of the screen. Icons represent symbols associated with test object or property. Each mode has its own icon set.

Icons can be passive or active. An active state of the current icon selected signifies that the corresponding device properties or parameters can be edited (or have been edited). In the above example, the ZOOM feature is activated so that the display can be decreased or enlarged.



FIGURE 8: TOMOGRAPH MODE ICON BAR

NOTICE FROM THIS POINT FORWARD, NUMBERING FROM F1 TO F6 (LEFT TO RIGHT) WILL BE USED WHEN DESCRIBING ICON SELECTION FOR A GIVEN FUNCTION KEY.





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INTENDED USE

2.1 OPERATING LIMITATIONS

The device is designed for operation under environmental conditions specified in clause 1.1.2.

2.2 DEVICE PREPARATION FOR USE

Before operating the instrument for inspection, remove the protective film that was used during manufacturing and transport. It can remain if the end-user prefers to keep it in place, but removal will increase image contrast and brightness on the display.

2.2.1 Switching device ON/OFF

To switch the device ON, press the  key, and the LED below the F1 key lights up green. The "ACS LLC" logo appears for 10 seconds on the screen, pressing the  key again will turn the device OFF.

2.3 OPERATING DEVICE MODES

2.3.1 Setup for TOMOGRAPH mode

SETUP mode is designed for device parameters setting.

Figure 9 shows the main screen in SETUP  mode for operating in the TOMOGRAPH mode.

Select an icon using the function keys F1 through F6

The left column contains the configuration list, and the right column contains the associated parameters and values.

To edit the parameter values, press the  key.

Icon functions in SETUP mode during editing are displayed below in Table 3.

Table 3

Key	Icon	Function
F1		Calibration parameters setup
F2		Transducer array parameters selection and setup
F3		Transducer array elements operation checking
F4		Weld configuration settings
F5	-	N/a
F6		System parameters setup. Global parameters for all operating modes

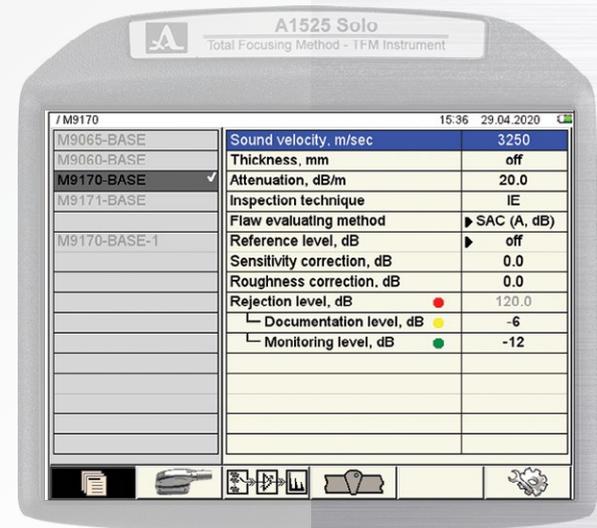


FIGURE 9



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The various keys used for manipulation are shown in Table 4.

Table 4

Key	Function
	Move up and down for editing parameter selection
	Parameter value editing
	Exit parameter editing
	Exit SETUP mode
	Operating mode window call and exit SETUP mode during operating mode change

2.3.1.1 Calibration parameters editing

Calibration parameter names and allowed values are given in Table 5.

Table 5

Parameter	Value	Description
Sound Velocity, in/ μ sec	0.039 to 0.591 in .001 steps	Transducer selection for use
Thickness, inches	0.1 to 9.8 in 0.1 steps	Material Thickness
Attenuation, dB/in	Material dependent	Loss of sound energy
Inspection Technique	IE	Test method

Table 5

Parameter	Value	Description
Flaw Evaluating Method	SAC (Spatial Amplitude Correction)	Amplitude Evaluation criteria 
Reference Level, dB	Off or numerical 0 to 200 calibration dependent	Used to set the reference level for testing 
Sensitivity Correction, dB	-40 to 40 in 0.1 steps	Sensitivity increase or decrease from the ref level
Roughness Correction, dB	0 to 12 in 0.1 steps	Surface variation sensitivity correction
Rejection Level, dB 	0 to 160 in steps of 1	Sets the red color trigger point-based on ref level
Documentation Level, dB 	-12 to 0	Sets the yellow color trigger point-based on ref level
Monitoring Level, dB 	-20 to 0	Sets the green color trigger point-based on ref level

2.3.1.2 Array transducer parameter editing

Figure 10 shows the array transducer parameters edit screen SETUP mode for operating TOMOGRAPH mode.

To select array transducer parameters, press the  key.

The following array transducer parameters and values are available.

Array transducer parameters and permissible values are given in Table 6.

Table 6

Parameter	Value	Description
Phased array Probe	M9065, M9060, M9170, M9171	Transducer selection
Phased array Probe Type	angle/straight	Transducer style

2



2

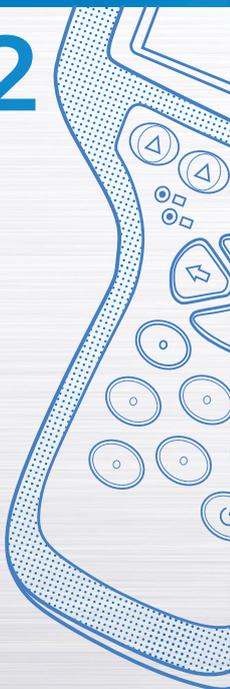


Table 6

Parameter	Value	Description
Operating frequency, MHz	1.0 / 1.25 / 1.8 / 2.0 / 2.25 / 2.5 / 3.0 / 3.5 / 4.0 / 5.0 / 7.5 / 10.0	Transducer frequency
Excitation pulse, periods	0.5 to 5.0 with 0.5 step	Increase or decrease pulse cycles
Pitch, inch	0.020 to 0.197 with 0.001 step	Distance between transducer array elements
Delay, μ s	0.0 to 9.2 with 0.1 step	The setting of signal delay time in the transducer
X-value, in	0.0 to 1.97 with 0.1 step	X-value setting (distance from the index point on the transducer)
Sectorial view	on/off	
Min view angle	0 to 89 with 1 step	Minimum angle
Max view angle	1 to 90 with 1 step	Maximum angle
Angular sensitivity correction	on/off	
Divergence compensation	on/off	
SAFT reflections limit	2 to 7	Synthetic aperture setting
X-axis zero	Probe Front or Middle	Measurement of X-position from an array index point

2.3.1.3 Instrument gain, array transducer element selection, and TCG settings

Figure 11 shows the instrument RF signal response at a given gain setting for a reference reflector. This setting is quite important since it controls the sensitivity of the tomographic display. There is a fine balance between the gain setting here and the “brightness” setting labeled in dB on the TOMOGRAPH display.

This setting is the true instrument gain and should be set to obtain the desired sensitivity response. The brightness value on the TOMOGRAPH view visually adjusts the display to conform to the color gradient representing evaluate, report, and rejection levels. Those thresholds are set under the calibration parameters menu described on page 21.

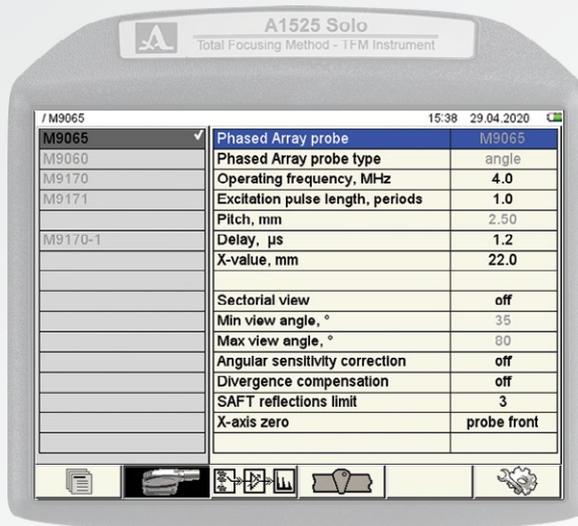


FIGURE 10

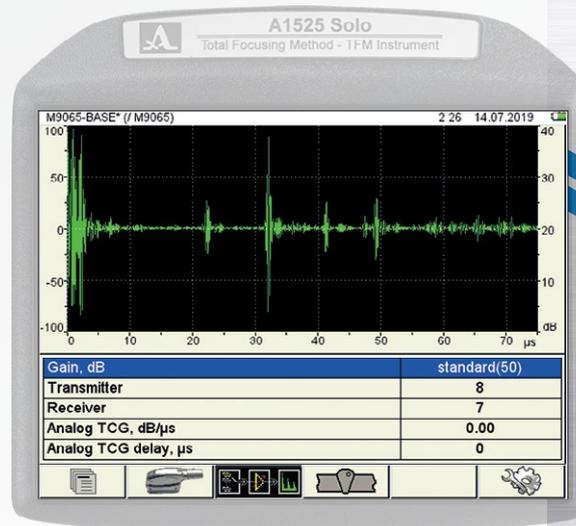


FIGURE 11



2



Gain parameters and permissible values are given in Table 7

Table 7

Parameter	Value	Description
Gain, dB	from 0 to 80 with 1 step	Receiver gain value, sensitivity adjustment
Sender	from 1 to 16 with 1 step	Number of transducer elements set for sending
Receiver	from 1 to 16 with 1 step	Number of transducer elements set for receiving
Analog TCG, dB/ μ s	from 0.00 to 1.00 with step 0.01	Setting the analog TCG value
Analog TCG delay, μ s	From 1 to 50 μ s	Setting analog TCG delay value

Key functions are given in Table 8.

Table 8

Key	Function
	Select and move up and down for editing parameter selections
	Parameter value editing
F1, F2, F4, F6	Exit gain parameter editing
	Exit SETUP mode
	Operating mode selection and exit SETUP mode during operating mode change

2.3.1.4 Weld configuration settings

When the A1525 SOLO is used for basic weld inspection, it is quite beneficial to place a weld overlay on display. This feature is only applicable to the TOMOGRAPH mode, as shown in Figure 12 below.

With the weld overlay active, the inspector is able to relate the presence of indications within the frame to the position within the weld. This makes classification much easier since the root, crown, and beveled regions are clearly displayed.

Only single V and double V weld configurations are available at this point in time. The various configuration settings are shown in Figure 13 and 14 on the next page.

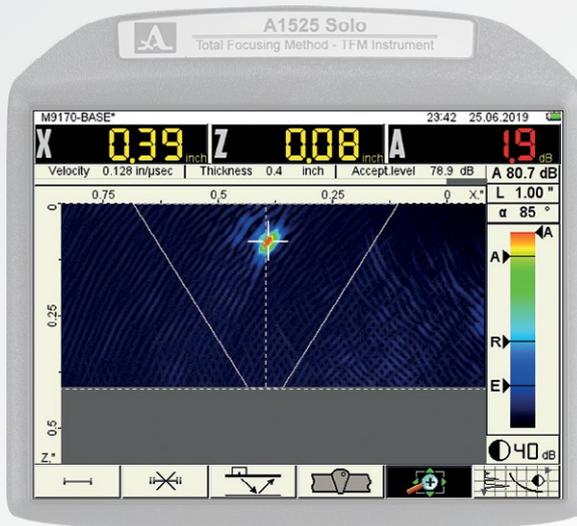


FIGURE 12

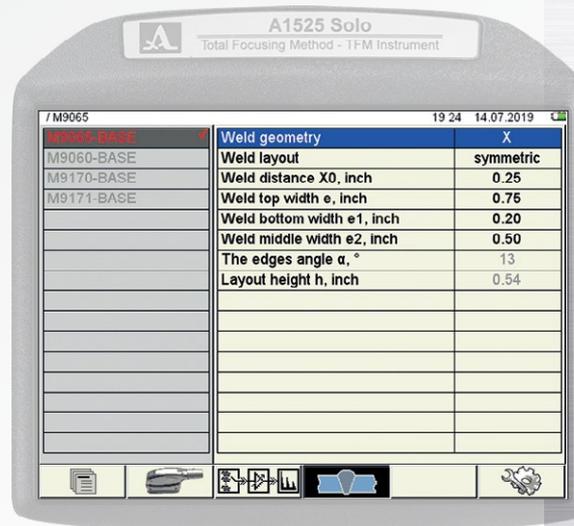


FIGURE 13

2



2

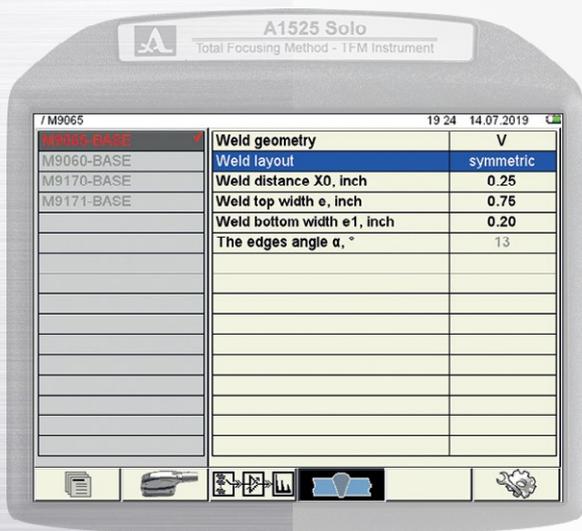


FIGURE 14

Weld configuration parameters and permissible values are given in Table 9.

Table 9

Parameter	Value	Description
Weld geometry	X or V	Weld Shape
Weld layout	Symmetric, left or right	Shape characteristic
Weld distance to X0, inch	0 to 7.87	Distance from initial scan X-axis 0 point to the weld C/L
Weld top width e, inch	0 to 7.87	Width of weld crown
Weld bottom width e1, inch	0 to 7.87	Width of weld root
Weld middle width e2, inch	0 to 7.87	Width of the weld (bevel dependent)
Weld preparation angle	Not adjustable	Based on e, e1, and e2 values
Height h, inch	Not adjustable	Based on e, e1, and e2 values

As described in previous sections, the above parameters are selected and changed using the same keys

2.3.1.5 System parameters setup

System parameters are the same for all operating modes (global) Figure 15 shows the system parameters setting available. Parameters and permissible values are given in Table 10.

2

Table 10

Parameter	Value	Description
Firmware version	X.X.X	The current firmware version
Time	HH.MM	The current time in 24-hour format HOURS:MINUTES Enter time setting mode by the Enter key
Date	DD.MM.YYYY	The current date in DAY.MONTH.YEAR format Enter date setting mode by the Enter key
Frame Repetition Rate, Hz	1to 10, MAX	Pulse rep rate
Reading resolution	0.1 or 1	Measurement resolution
Brightness	from 0 to 100	Display brightness setting
Volume	OFF / from 10 to 100 with 10 step	Sound level setting
Color Scheme		Color palette for acceptance and rejection
Screen grid	On or Off	Visible measurement grid
Language	English	Device Interface Language selection

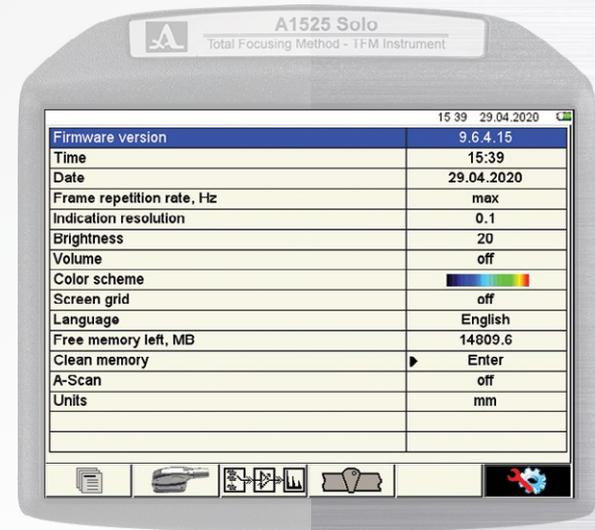


FIGURE 15

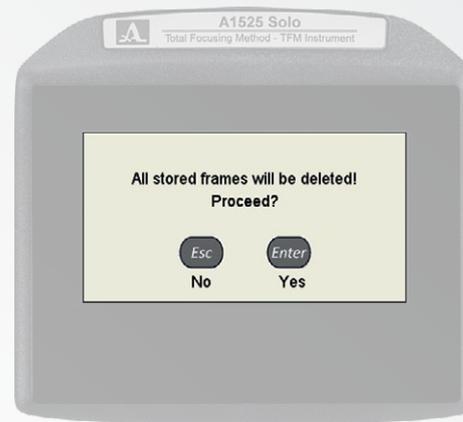
2

Table 10

Parameter	Value	Description
Free memory, MB	XXXX.X	Amount of free memory
Clean memory	Enter	Initiates deletion - Enter NOTICE A FULL MEMORY ERASE, ALL SETTINGS AND DATA ARE TO BE DELETED!
A-Scan	On or Off	Displays small A-Scan on TOMOGRAPH mode
Units	mm or inch	Unit of measurement

To edit parameters "Time" or "Date," select an appropriate parameter, and press the **Enter** key. Use the  and the **-** **+** keys to make changes to the date and time. To confirm changes, press the key **Enter**, to cancel press the **Esc** key.

CAUTION MEMORY ERASE Starting "Clean memory" is accompanied by a warning box.



2.3.1.6 Editing and saving and deleting configurations in SETUP

Selecting and changing any of the base setup parameters for each transducer array initiates a new configuration. The selected array will display a checkmark, as shown below in Figure 16.

The four base setup files for the arrays cannot be overwritten or deleted in order to provide a common starting point for every inspection. If the **←** key is pressed while one of these setups is checked, the following warning box will be displayed (Figure 17).

However, a new configuration can be created and saved under a different name so that this new setup file can be used at a later date. Though there is a limit on the number that can be created (based on memory capacity), it is doubtful the average inspector will ever require this many setup files.

Saving a new configuration file:

a. Make the necessary adjustments for the inspection, such as reference level, material thickness, etc.

b. Once the changes required for the new inspection have been entered, press the **↔** key to return to the checked array file name.

c. Press the **Enter** key and the confirmation screen shown in Figure 18 will be displayed.

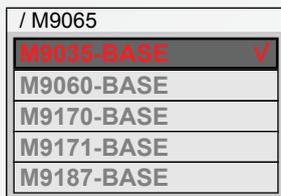


FIGURE 16



FIGURE 17



FIGURE 18

2

- d. To cancel the changes that have been made and return to the basic array setup, press the **Esc** key or use the  key and press **Enter**.
 - e. To save the changes and give the file a new name, press the **Enter** key.
 - f. The screen shown in Figure 19 will be displayed.
 - g. The save configuration screen defaults to the array used as the initial setup (in this example M9065-BASE) and automatically adds the number 1, or the next increment from the previous value if the default naming procedure is used.
 - h. To accept the default name, press the F1 key, and the new file name will appear at the bottom of the setup list.
 - i. To change the name of the setup from the default to another description (such as a job-specific nomenclature or the material under inspection), use a combination of the F2 through F5 keys to create the desired name. Press the F1 key to save.
 - j. Press the **Esc** key to go back to the main screen and exit the saving procedure.
- Key functions during name editing are shown in Table 11.

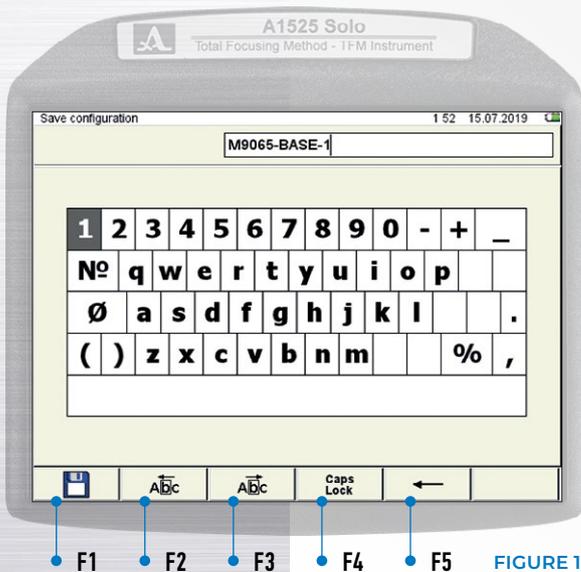


FIGURE 19

Table 11

Key	Function
	Select and move up and down for editing parameter selections
	Parameter value editing
	Operating mode selection and exit SETUP mode during operating mode change
	Exit name editing in the SETUP mode without name saving

Icon functions in SETUP mode during name editing are shown in Table 12.

Table 12

Key	Pictogram	Function
F1		Save a file name
F2		Left cursor movement in the name field
F3		Right cursor movement in the name field
F4		Enter uppercase letters
F5		Left symbol deletion

Deleting a configuration

To delete any saved configuration, press the  key, and the following confirmation window appears.

Press the  key to accept deletion or the  key to cancel the deletion.

 WARNING IT IS IMPOSSIBLE TO DELETE A BASE OR CURRENT CONFIGURATION THAT IS UNDERGOING CHANGES THAT HAVE NOT BEEN SAVED.

This will result in the following window.

To return to the calibration mode without the current configuration change, press the key .



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2.3.2 Setup for FLAW DETECTOR mode

The FLAW DETECTOR mode (Figure 20) of operation allows the user to utilize the A1525 SOLO as a conventional A-Scan device. Longitudinal and shear wave inspection procedures can be used along with DAC, TVG, and DGS sensitivity measurement procedures. In order to access this mode, press the **Mode** key for 2 seconds and press the **Enter** key when presented with the dialogue box confirming this mode of operation.

As described in the TOMOGRAPH mode, the icon bar at the bottom of the display controls the parameter selection and functions using the arrows aligned with F1 to F6 (Figure 21). Each of these functions will be described in regards to their function during calibration of the instrument.

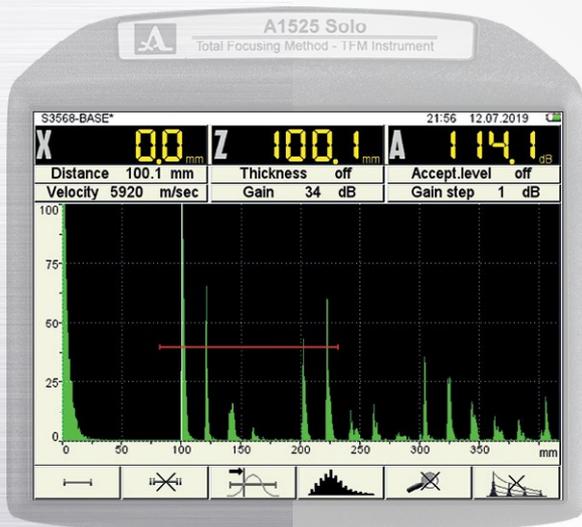


FIGURE 20

FIGURE 21: FUNCTIONAL KEYS



TABLE 13: FUNCTIONAL KEYS

Key	Pictogram	Function
F1		Gate 1 settings
F2		Gate 2 settings
F3		Flank, Peak or Peak-to-Peak measurement
F4		A-Scan visual controls
F5		Gate Zoom control
F6		DAC, TVG or DGS Display control

SETUP – FLAW DETECTOR is used to adjust the parameters of the device while working in the FLAW DETECTOR mode.

Figure 22 shows the main display in SETUP mode for FLAW-DETECTOR mode.

An active icon is always presented in the icon menu on the bottom.

The A-scan is displayed at the upper portion of the screen so that any adjustments affecting the signal response will be visible.

The left column contains the sample transducer configuration list; the right one contains the associated parameters and values for the selected transducer. Preview, selection, editing, and creation of a new configuration are similar to SETUP/TOMOGRAPH mode. (section 2.3.1.5).

Icon functions in SETUP/FLAW DETECTOR mode are shown in Table 14.

TABLE 14: FUNCTIONAL KEYS

Key	Pictogram	Function
F1		Transducer parameters settings
F2		Signal parameter settings
F3		Test specimen parameter settings
F4		Amplitude correction parameter settings
F5		Visualization parameter settings
F6		System settings

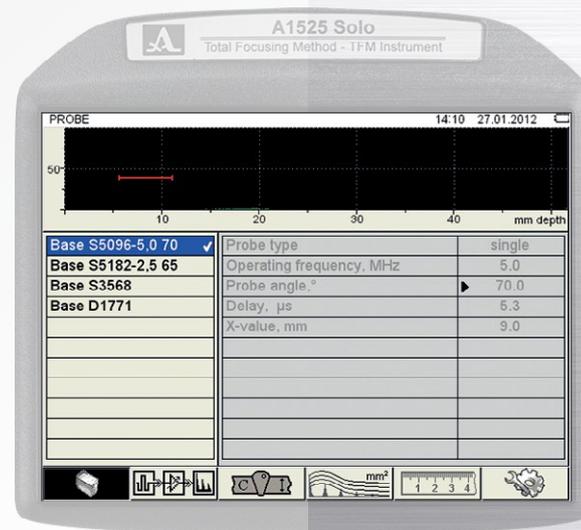
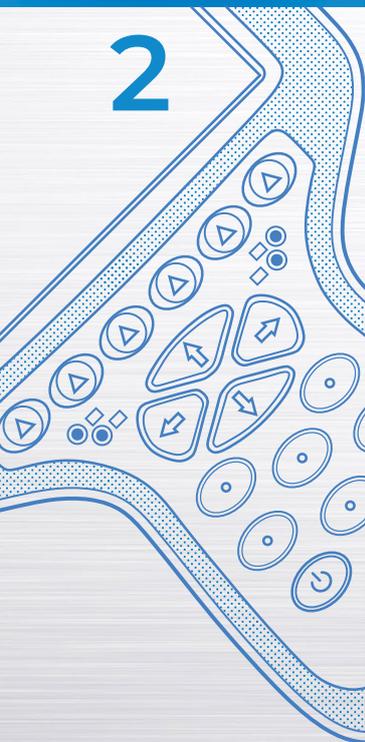


FIGURE 22

2



Key functions during parameter editing are given in Table 15

Table 15

Key	Function
 	Move up and down for editing parameter selection
 	Parameter value editing
	Exit parameter editing
	Exit SETUP mode

2.3.2.1 Transducer parameter editing

Calibration parameters and permissible values are given in Table 16.

Table 16

Parameter	Value	Description
Probe type	Single Element/Dual Element	Transducer selection
Operating frequency, MHz	1.0 / 1.25 / 1.5 / 1.8 / 2.0 / 2.25 / 2.5 / 3.0 / 3.5 / 4.0 / 5.0 / 7.5 / 10.0	Adjusted depending on transducer and material properties
Probe angle °	from 0.0 to 90.0 with 0.5 step	Adjustment of the refracted angle(usually 45,60 or 70) At zero-point setting, THICKNESS parameter is automatically changed into OFF state. Start calibrating on specimen V2 procedure by pressing 
Delay, µs	from 0.0 to 100.0 with 0.1 step	Acoustic delay setting
X-value, mm	from 0.0 to 50.0 with 0.1 step	Transducer index point distance from the front of the probe

2.3.2.2 Signal parameters editing

Screen view while editing signal parameters is shown in Figure 23.
Signal parameters and permissible values are given in Table 17.

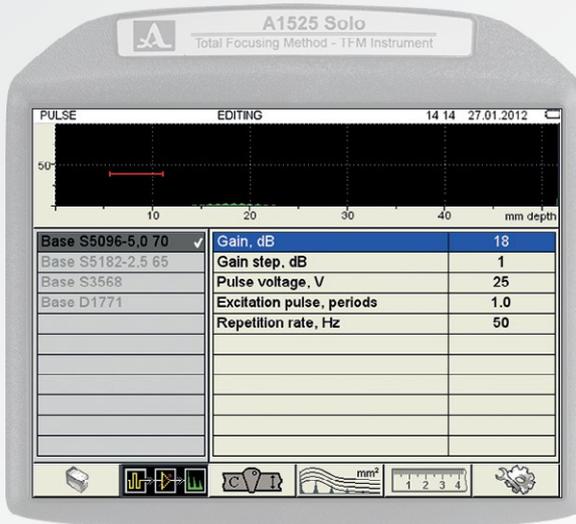


FIGURE 23

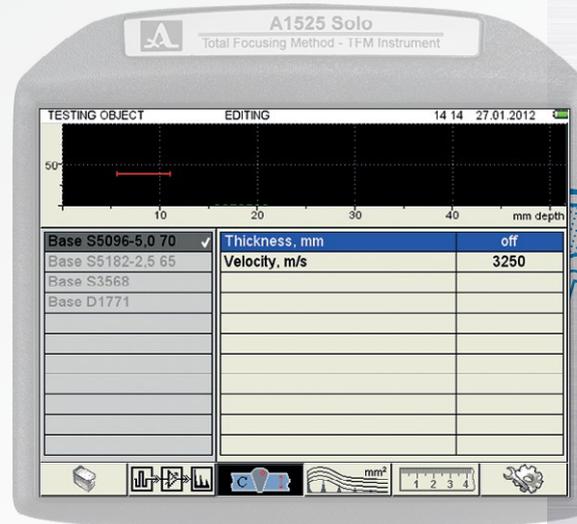


FIGURE 24

2



2



Table 17

Parameter	Value	Description
Gain, dB	from 0 to 80	Receiver gain setting
Step of gain, dB	1 / 6 / 10	Selection of step of gain
Pulse voltage, V	25 / 50 / 100	Probe pulse amplitude
Excitation pulse, periods	from 0.5 to 8.0 with step 0.5	Controls transducer element ringing
Frame rate, Hz	5 / 10 / 50	The number of displayed frames

2.3.2.3 Test specimen parameter editing

Screen view while editing is shown in Figure 24.

Test specimen parameters and permissible values are given in Table 18.

Table 18

Parameter	Value	Description
Thickness, mm	OFF / from 1.00 to 100.00 with step 0.05	Thickness setting/switching off Switching with the key Changing the angle parameter to zero automatically changes the value to OFF
Velocity, ms	from 1 000 to 10 000 with 1 step	Material ultrasonic velocity setting

CALIBRATION: FLAW DETECTOR MODE

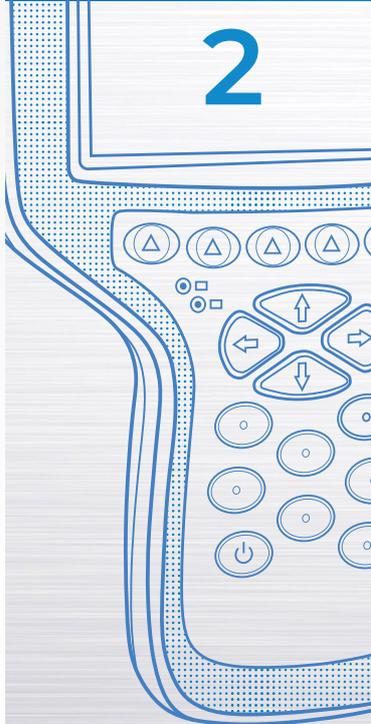
Once the transducer, signal, and test specimen parameters have been properly configured for the inspection procedure, the A1525 SOLO is ready for calibration. The equipment can be calibrated manually or with an automatic procedure (shear wave only).

Manual Calibration Technique: Example – 5 mm and 25 mm

The A1525 SOLO calibrates manually in the same manner as any digital flaw detector. Two known thicknesses of the same material are required for accuracy to be obtained. The lower thickness value is adjusted using the delay parameter, and the higher thickness value is adjusted using the velocity parameter. This procedure is valid for longitudinal (straight beam) tests or shear wave (angle beam) tests.

NOTICE IF CARBON STEEL IS BEING EXAMINED. THE DEFAULT SETTINGS OF THIS INSTRUMENT WILL BE CLOSE TO PERFECT – REQUIRING VERY LITTLE ADJUSTMENT.

- 1) Using a 00 LEMO cable connected to a single element contact transducer, connect to the **right side** 00 LEMO connection at the top of the instrument.
- 2) Select the  **F1 icon on the SETUP** menu of the FLAW DETECTOR mode.
- 3) Select the  **S3568-BASE transducer**. A checkmark will appear by the transducer name. This is a single element 2.5 MHz transducer and can be used as an initial starting point for any single element longitudinal transducer you utilize with this instrument. If a shear wave calibration is being performed, select the S5096-5.0 70 BASE or the S5182-2.5 65-BASE as your starting point.
- 4) If the frequency of the transducer being used is different from the default value, change it to the correct value by highlighting this parameter and using the  or  key.
- 5) The probe angle should be zero degrees, and the X-value should be 0.0 since this is not a shear wave calibration.
- 6) **Place the transducer on your thin reference standard** after applying couplant. Select the  **F2 icon** and increase the default gain setting until a signal is obtained on-screen of approximately 75% screen height.
- 7) If you do not see any signals, make sure that the screen range setting (width) is large enough to encompass the thickness values being used in calibration.





8) If you must change this value, it will be necessary to press the setup  key to return to the A-Scan display. Use the left or right arrow keys to change the screen display range (sweep) to an appropriate value which allows both signals (thin and thick) used in calibration to be seen.

9) **While on the A-Scan display screen, press the  F1 key to adjust the position of gate 1**, so that it will cover the thickness range from the thin step to the thick step. Use a combination of the left, right arrow keys, and the increase decrease keys to adjust accordingly.

10) **Once complete, press the setup key again to return to the prior parameter screen where the gain is located. Adjust gain accordingly.** Depending upon the user's knowledge of ultrasonics, the other signal parameters (voltage and excitation pulses) can also be used to affect the signal response of the unit. For novice users, it is best to leave the default values where they are set.

11) **Select the  F5 icon and make sure the material velocity shown is accurate for the material being examined.** The default for this transducer style is 5920 m/sec. This is the longitudinal velocity of carbon steel. For simplicity, we will use this in our example.

12) With the transducer located on the thin step, **press the setup key to display the A-Scan.** Read the Z-value displayed on the measurement bar. In the example shown in Figure 25, it is 5 mm.

13) **If the Z-value is incorrect, press the setup key and select F1 (transducer parameters) again. Increase or decrease the Delay value until the thickness is correct.**

14) **Place the transducer on the thick step.** Read the Z-value displayed on the measurement bar. In the example shown in Figure 26, it is 25 mm.

15) **If the thick value is incorrect, select the F3 icon  . Increase or decrease the material velocity value until the correct result is obtained.**

16) **Repeat steps 12 to 15** until both of the thickness values displayed equal the correct values.

17) Return to the A-Scan and set the display range (sweep) to accommodate the material thickness being examined.

NOTICE THE SAME STEPS ARE UTILIZED TO MANUALLY CALIBRATE THE RANGE FOR SHEAR WAVE TESTING. HOWEVER, THE TWO KNOWN THICKNESS VALUES WOULD COME FROM A SHEAR WAVE REFERENCE STANDARD, SUCH AS THE IIW V1 OR V2 BLOCKS. THE DELAY VALUE WILL BE MOST CRITICAL SINCE IT IS A FUNCTION OF THE ACOUSTIC WEDGE MATERIAL AND THE TIME REQUIRED THROUGH THAT DISTANCE.

Automatic Shear Wave Calibration Technique:

The automatic calibration method is currently only applicable when used with a metric version V2 calibration standard. No other standard can be used.

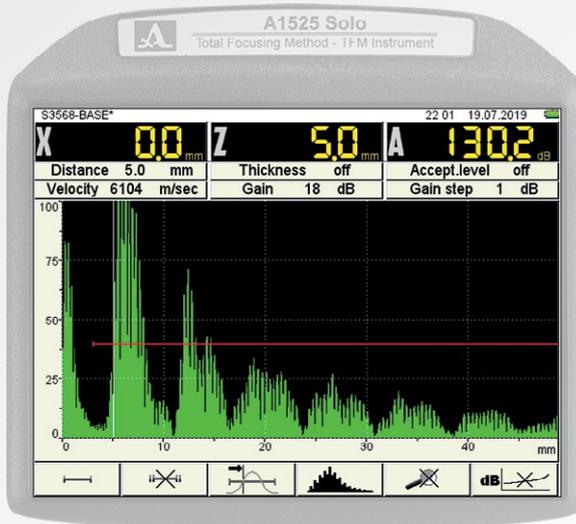


FIGURE 25

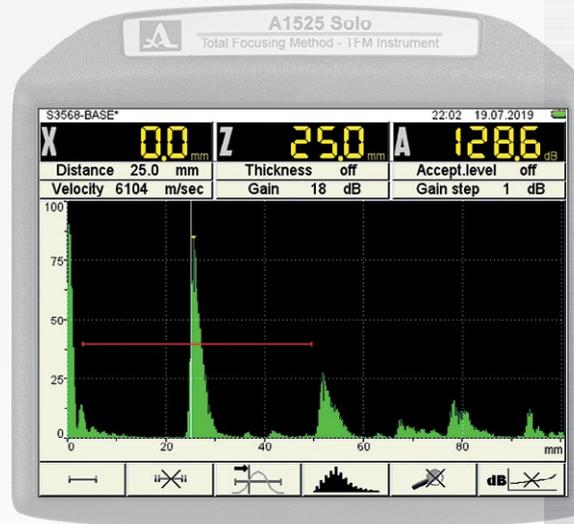


FIGURE 26

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Automatic calibration procedure (V2 reference standard required)

The A1525 SOLO has an automatic calibration feature for instructions, appearing on the screen.

- 1) Select the  **F1 icon on the SETUP menu** of the FLAW DETECTOR mode.
- 2) Select the **Probe Angle** and press the enter  **key.**
- 3) **Follow the directions displayed on the screens** shown in Figures 27,28, and 29). Upon accepting the results, the instrument is calibrated.

NOTICE PEP REFERS TO THE TRANSDUCER

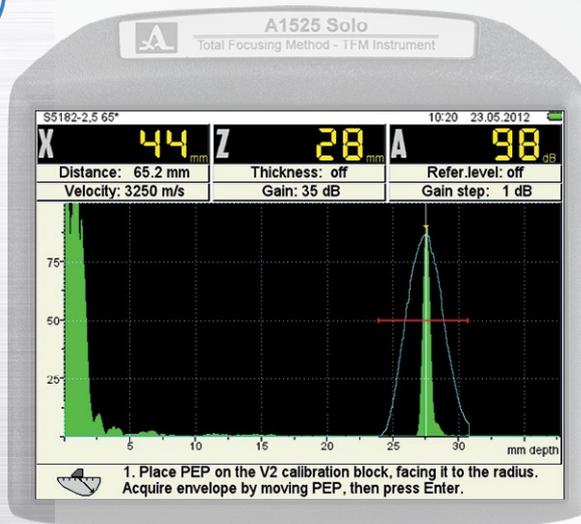


FIGURE 27

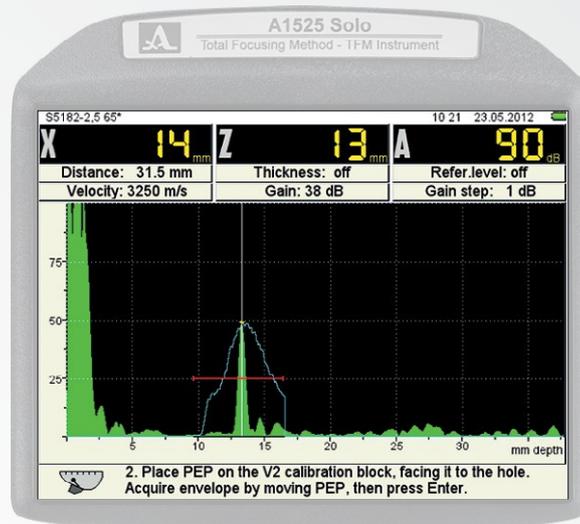


FIGURE 28

2.3.2.4 Soundpath dependent sensitivity compensation parameters editing (TCG, DGS, DAC)

There are three methods for soundpath dependent sensitivity compensation implemented in the instrument: TCG, DGS, DAC. The method for sensitivity compensation can be activated in by pressing F4 functional button and chosen by pressing +/-

Soundpath dependent sensitivity compensation: "Time Corrected Gain – TCG"

Screen view in TCG parameters setting is shown in Figure 30

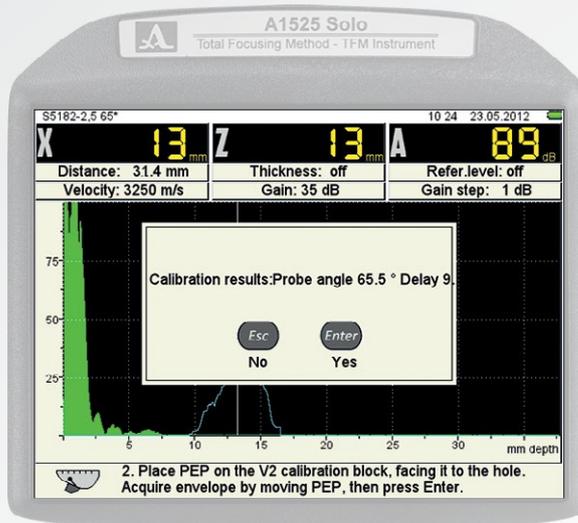


FIGURE 29

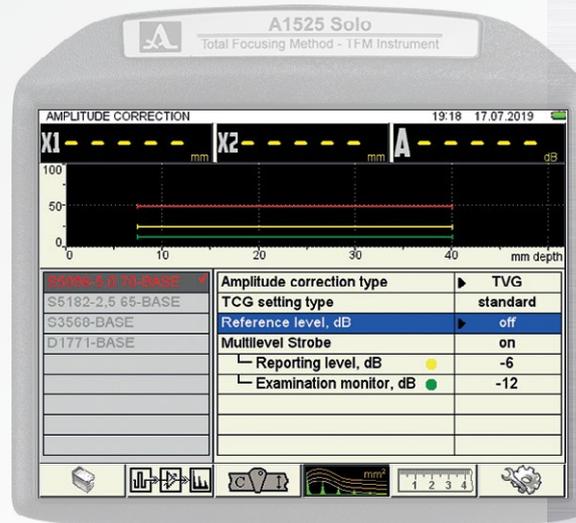
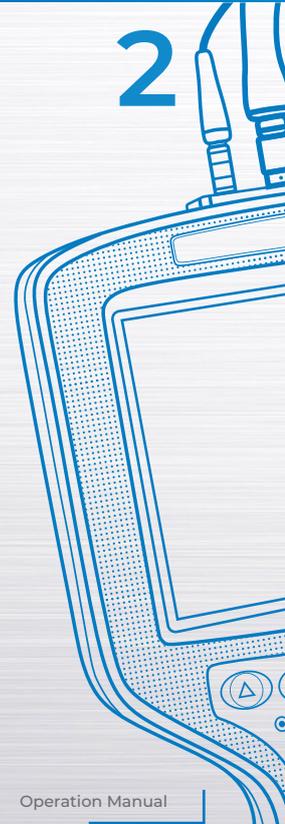
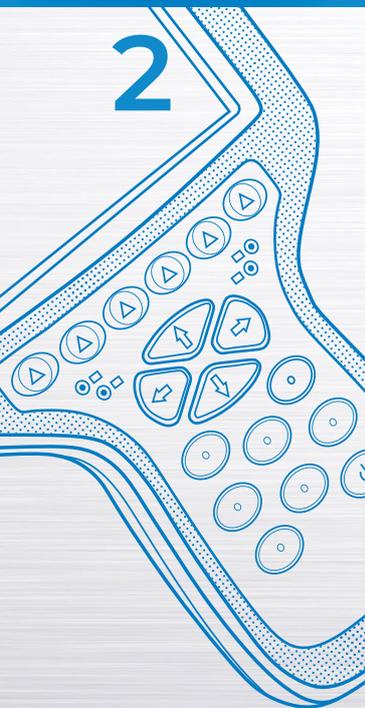


FIGURE 30





2



TCG function is used to correct for the loss of signal amplitude due to the attenuation of sound energy over distance. The instrument displays signals of the same size over a varying distance at the same reference response (% screen height).

As an example, the reference response from a 2 mm side drilled hole is set at 80% screen height when the hole is drilled at 25 mm, 50 mm and 75 mm. The TCG function suppresses the amplitude of the shallow hole and amplifies the amplitude of the deepest hole so that the response is identical even though the distance travelled varies.

TCG parameters and permissible values are given in Table 19.

Table 19

Parameter	Value	Description
TCG Setting Type	Standard, manual	Automated or manual setup
Reference Level, dB	Off or active	Press Enter key to initiate TCG or DGS setup
Multi-level strobe (Gate)	Off or on	Sets 3 gating levels for amplitude (red, yellow, green)
Documentation ●	From - 10 to + 10 with a step of 1	Changing of calibrated values relative to a reference level
Examination ●	From - 16 to + 4 with a step of 1	Changing of calibrated values relative to a reference level

NOTICE IN ORDER TO EFFECTIVELY UTILIZE TCG, IT IS NECESSARY TO HAVE A REFERENCE STANDARD OF THE SAME METALLURGY AS THE MATERIAL BEING EXAMINED. THIS STANDARD MUST HAVE IDENTICAL SIZE REFLECTORS DRILLED OR MACHINED AT VARYING DISTANCES ALONG THE EXPECTED SOUND PATH. THE STEPS BELOW ARE BASED UPON THIS FACT, AND ALSO ASSUME THAT THE INSTRUMENT HAS BEEN PROPERLY CALIBRATED.

To initiate the TCG setup procedure, select the Reference Level parameter, and press the **Enter** key. The reference level setting window appears (Figure 31). An echo envelope in blue is shown for all signals on the screen.

After getting the signal maximum into the gate, press Enter for the reference level.

To initiate the TCG setting select TCG in the menu and press **Enter** (Figure 32)

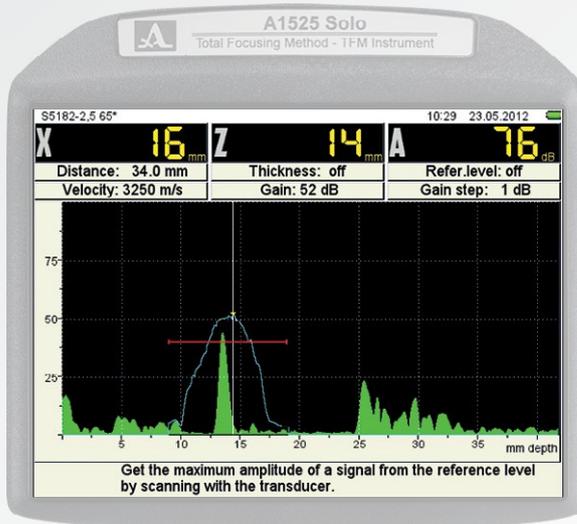


FIGURE 31

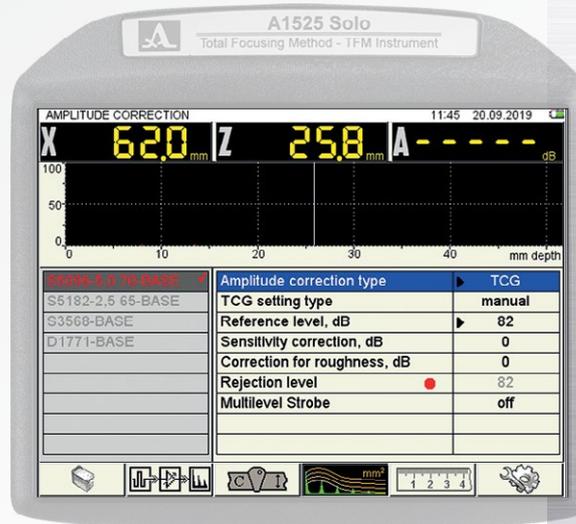
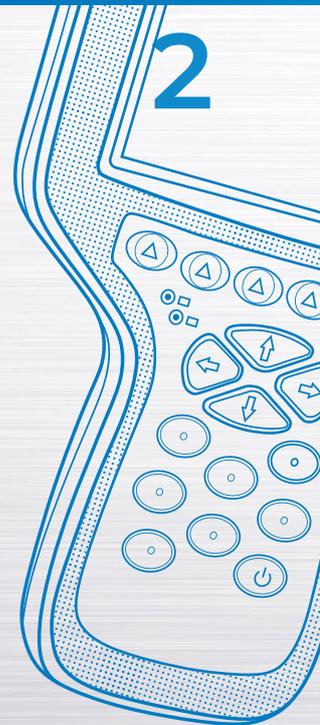


FIGURE 32



2

Functional keys for modification the TCG parameters are described in Table 20.

Table 20

Key	Function
	Parameter selection and cursor movement for TVG data points
	Exit TVG, DAC, DGS setting
	Used to initiate the TVG, DAC, DGS procedure when reference level is highlighted
	Point addition/deletion in the cursor position
	N/a
	Operating mode selection and exit SETUP mode during operating mode change

- 1) Move the transducer to the first indication and peak the amplitude of that signal. Use the arrow keys to move the gate over the signal. Increase the gain to adjust the amplitude so that the signal peaks at 50% screen height like the prior signal.
- 2) Press the  key to capture the signal. A yellow dot will appear at the signal peak. See Figure 34.
- 3) Move the transducer to the second indication and peak the amplitude of that signal and fix the next point of the TCG curve.
- 4) Repeat creation of the points for all control sample reflectors;
After all TCG points are saved, press the  key for saving TCG parameters.

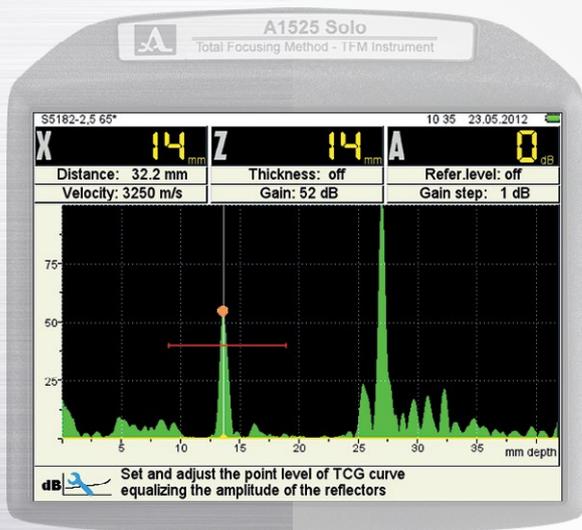


FIGURE 33

Soundpath dependent sensitivity compensation: Distance – Gain – Size – DGS

The A1525 SOLO has an automatic DGS-diagram calculation function for dual element transducers. With the DGS-diagram, test sensitivity can be set, and an equivalent square of the defect can be automatically calculated.

Screen view in setting DGS parameters is shown in Figure 35.

DGS parameters and permissible values are given in Table 21.

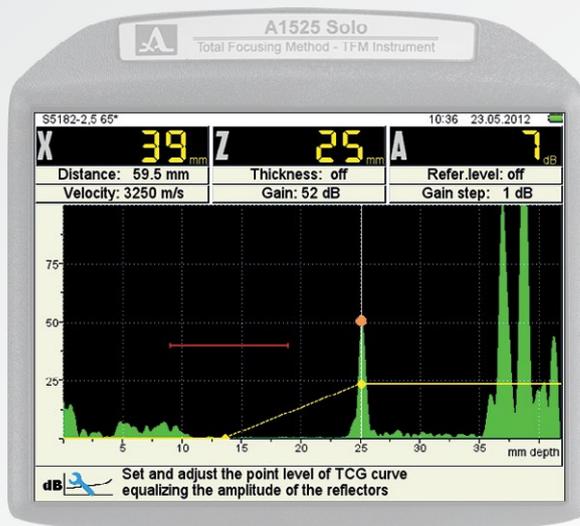


FIGURE 34

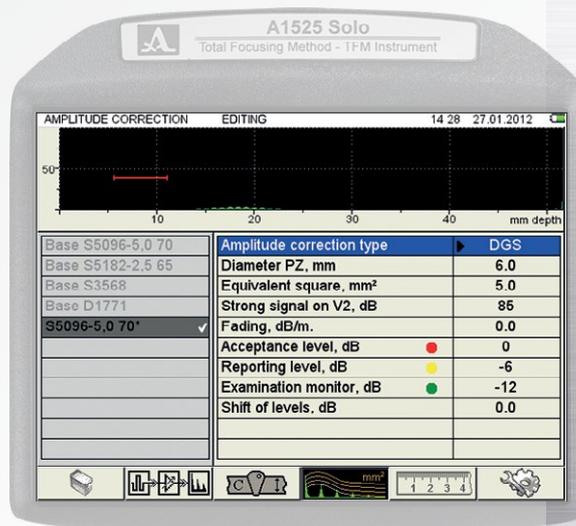


FIGURE 35

2



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Table 21

Parameter	Value	Description
The diameter of piezoelement, mm	from 0.0 to 25.0 with 0.1 step	The diameter of piezoelement is specified in the transducer documentation or is to be measured
Equivalent square, sq.m	from 0.0 to 25.0 with 0.1 step	Value of acceptance equivalent square of the flat-bottomed hole sets DGS curve of the acceptance level (it's specified in ultrasonic control methodology)
Reference signal on V2, dB	from 0 to 200 with 1 step	It is set under V2 calibration sample. Depending on the angle of the applied transducer, the signal level is determined in dB from the 5mm dia hole: - by the large V2 radius, if the angle is less or equal 62°; - by the small V2 radius, if the angle is more 62
Fading, dB/m	from 0.0 to 99.9 with 0.1 step	Attenuation coefficient value (it's specified in ultrasonic control methodology)

The key functions at DGS setting are given in Table 22

Table 22

Key	Function
 	Gain adjustment
 	N/a
 	Sweep length adjustment
	Exit DGS setting
	Initiates the DGS setting procedure

Table 22

Key	Function
	N/a
	N/a
	Operating mode window call and exit SETUP mode at operating mode changing

To initiate the DGS setup procedure, select the Reference Level parameter. Select DGS and press the **Enter** key. The DGS setting window will appear (Figure 36).

To save the setting, press the **Enter** key and the DGS setting confirmation window appears.

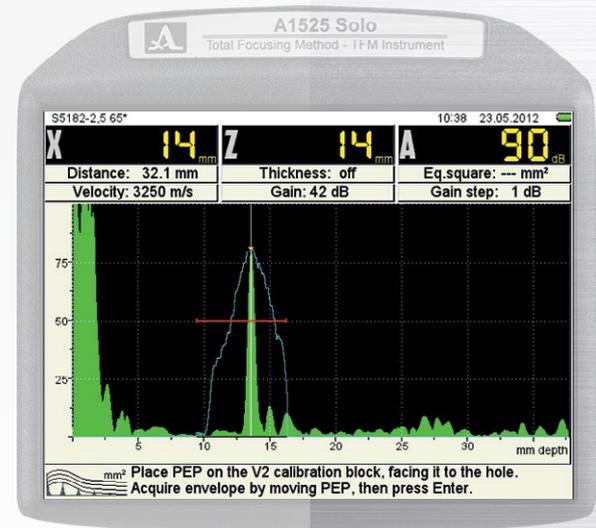
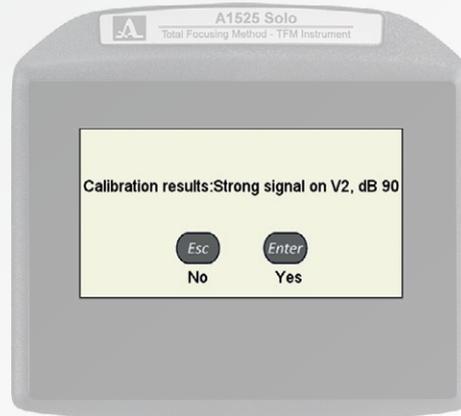
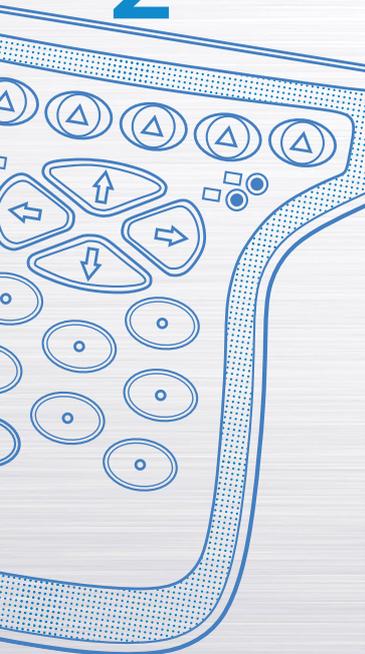


FIGURE 36



2



If the parameters are set correctly, the device display shows three DGS-curves corresponding to rejection, reporting, and examination levels (Figure 39).

If the calculation parameters are set incorrectly, the information window appears, and the icon is shown as follows - . In this situation, check if the DGS parameters are set correctly and repeat the procedure until the curves are displayed.



Changing of any parameter used in the DGS-diagram calculation results in an automatic recalculation.

Once DGS is active, any signal exceeding the examination or reporting level within the active gated area will result in a rating being displayed with a sign (+/-) relative to rejection/acceptance

Besides the basic DGS settings, the following parameters: OPERATING FREQUENCY, ANGLE, DELAY, VELOCITY are used in calculations.

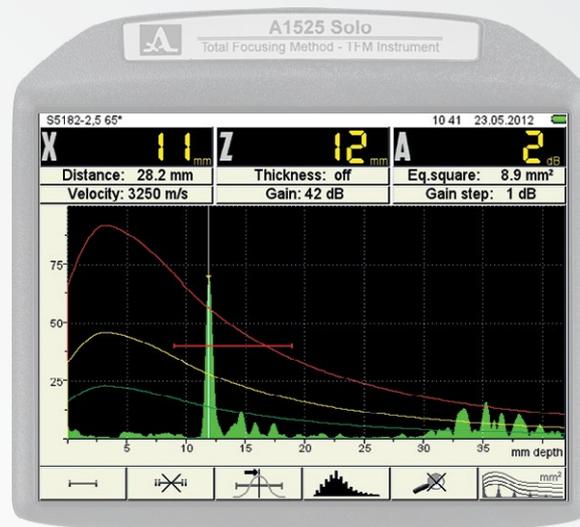


FIGURE 37

Soundpath dependent sensitivity compensation: Distance Amplitude Correction DAC

Screen view in DAC parameters setting is shown in Figure 38.
The key functions for DAC setting are given in Table 23

2

Table 23

Key	Function
	Gate level adjustment
	Gate length adjustment
	Gate position adjustment
	Exit DAC setting
	The first pressing – curve creation The second pressing – curve application
	DAC point saving

To initiate the DAC setup procedure, select the Reference Level parameter.
Select DAC and press the  key. The DAC settings window will appear (Figure 39).

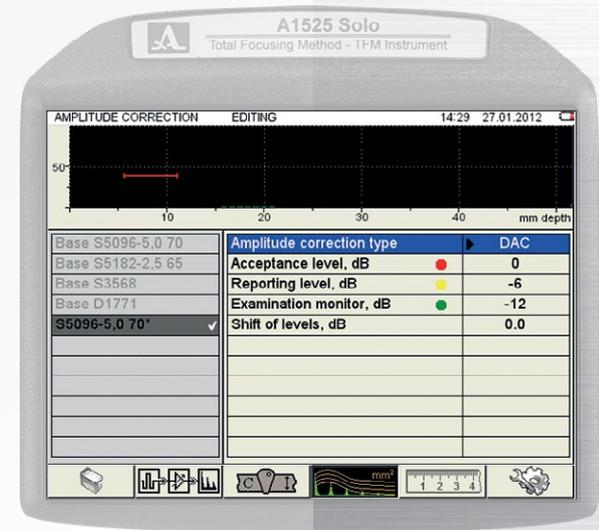


FIGURE 38

2

Proceed as follow for setting DAC curve:

- Find a peak signal from the first reflector, change the gate setting to get the signal into the gate and press ;
- Find the maximum signal from the second reflector and repeat the same steps for the second point pf the DAC curve
- Repeat creation for all reflectors on your reference specimen;

After all DAC points are saved, press the key  DAC curve appears on the screen (Figure 40).

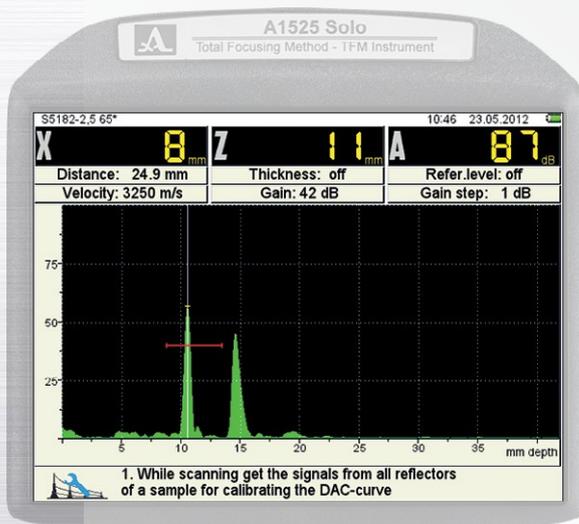


FIGURE 39

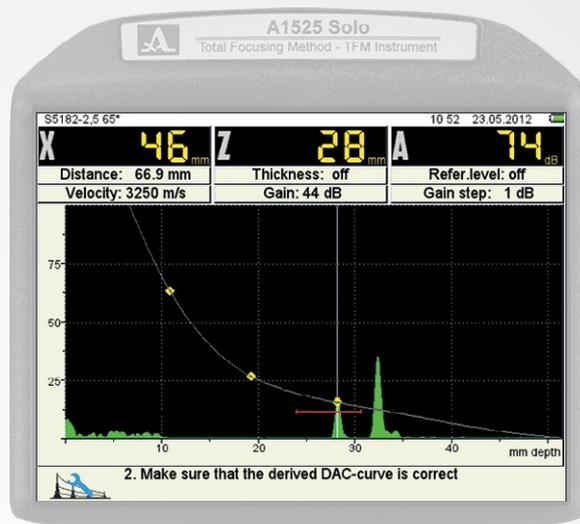


FIGURE 40

To save setting, press the key **Enter**, the DAC setting confirmation window appears (Figure 41).

Pressing **Enter** you exit DAC settings window without saving changes.

After DAC setting exit, the device display shows three DAC-curves corresponding to acceptance, reporting and examination levels (Figure 42).

The key functions at DAC setting are given in Table 23.

Upon setting up DAC or TCG the F6 icon becomes active. It indicates the method of amplitude correction currently set up and allows the user to turn the method on or off. For the status update, see below.



DAC is on (and displayed on the screen)



DAC is off



FIGURE 41

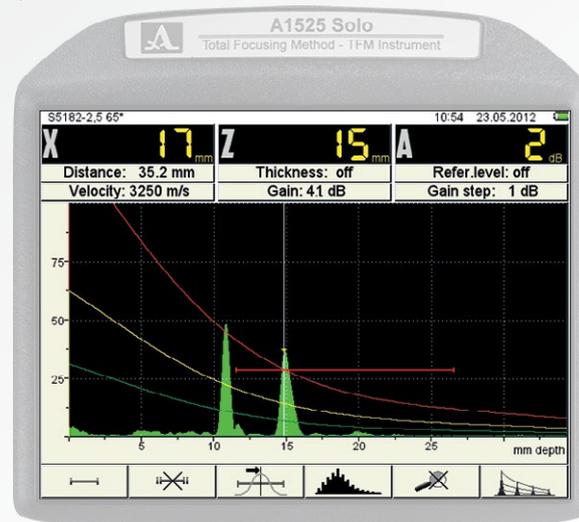


FIGURE 42

2

2

2.3.2.5 Visualization parameters editing

Screen view in visualization parameters setting is shown in Figure 43.
Visualization parameters and permissible values are given in Table 24.

Table 24

Parameter	Value	Description
Scale	µs / mm / mm depth	Horizontal scale unit selection
Discreteness	0.1 / 1	Selects the discreteness of the measured results
Cursor	On / off	Selects whether the vertical measurement cursor is displayed on the screen
Cutoff, %	off / from 1 to 100 with 1 step	Signal reject (noise rejection at baseline)



FIGURE 43



2

2.4 TOMOGRAPH MODE

This is the main operating mode of the A1525 SOLO

In TOMOGRAPH mode, the device displays the test information in a logical, visual format called a **frame**. Indications of an anomaly in the test piece can be visually interpreted much easier than they can with a conventional A-Scan display.

For example, look at the cracked weld sample shown in Figure 45 below and compare this crack to the frame displayed on the A1525 SOLO. The shape and orientation are well defined. This is an advantage when showing indications to non-technical personnel, and is very beneficial to the ultrasonic technician during analysis.

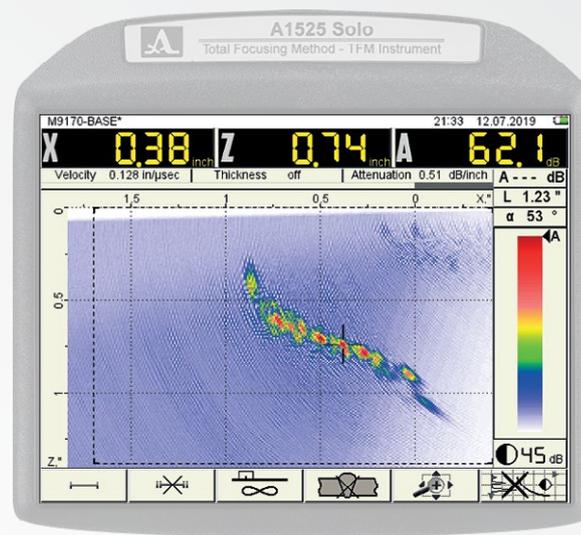
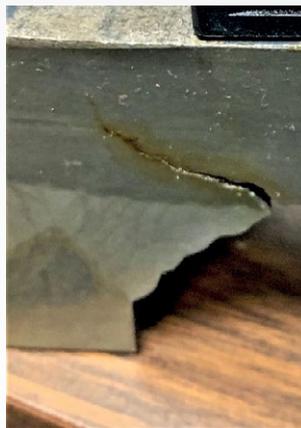
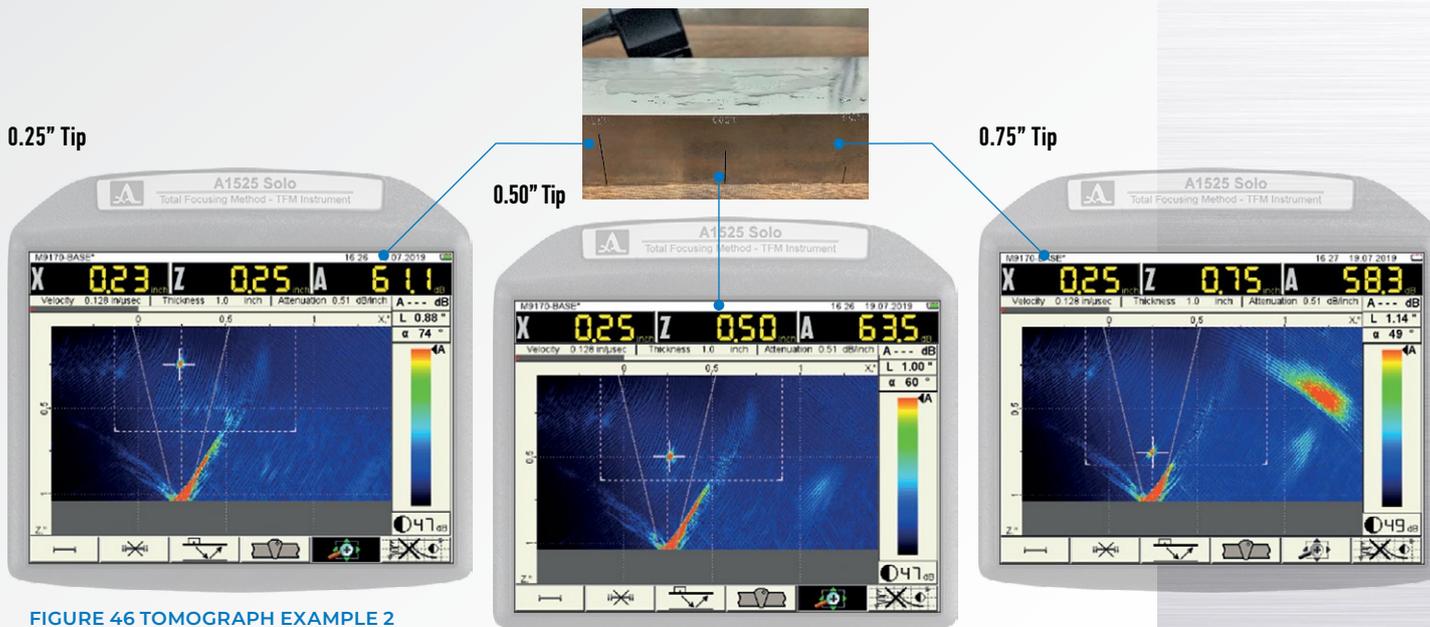


FIGURE 45 TOMOGRAPH EXAMPLE 1

In Figure 46 below, a 1.0" reference standard with three EDM notches at depths of 0.75", 0.50" and 0.25" is shown. Each notch is displayed in the three tomographs. Take note of the Z-value shown in the measurement bar. The depth of the tips of each EDM notch is accurately depicted, along with an excellent visual representation of the reflected wave off of each notch bottom.

The X-axis value shows the distance from the front of the transducer across the surface of the part to the tip (surface distance). The A-value shows the amplitude response from the tip. The L-value displayed under the A-value shows the angular sound path to the tip. The α -value under the L-value shows the angle at which the tip is reflecting the highest amplitude.



2

2.4.1 Device screen in TOMOGRAPH mode

Figure 47 shows the device screen in TOMOGRAPH mode.

The **measurement results panel** consists of three blocks (Figure 48). The parameters displayed in blocks are changed depending on the device operating mode. In tomograph mode - the cursor coordinates and signal amplitude are displayed for the most severe indication within the active gate (1 or 2).



FIGURE 48



- Cursor
- Measurement Bar
- Gain, Sound Path and Angle
- Color bar for sensitivity response
- Tomograph Frame
- Icon bar for selection of instrument functions

FIGURE 47

2.4.2 Gating within a Frame

The gates on the A1525 SOLO are very different from conventional ultrasonic instruments. On a conventional instrument (such as described earlier on FLAW DETECTOR mode), the gate is set to monitor a small area of the material to be inspected. The starting point, ending point, and threshold of the gate are set in conventional ultrasonics. The instrument can monitor the first signal in the gate (flank mode) or the highest amplitude in the gate (peak mode).

With TFM (Total Focusing Method) phased array processing, the unit is capable of looking at a two-dimensional frame within the material. The cursor (cross-hair) displayed within the active frame automatically monitors the entire gated region for the highest amplitude response in both the X and Z axis.

As in conventional ultrasonics, the inspector must be careful during analysis. The highest amplitude signal response is not always an anomaly in the test piece.

Refer to Tomograph Example 2. The gate has been established to monitor a specific area within the displayed frame of reference. There are higher amplitude signals coming from the bottom of the test piece (corner reflector), but they are not in the gated region of interest. For this reason, they are not “seen” by the instrument.

When Gate 1 or Gate 2 is selected with function keys F1 or F2, the measurement results change from the location of the cursor that highlights the most severe signal response to the coordinates of the gate. (Figure 49).



FIGURE 49

In Figure 50, at the bottom left of the display, the icon representing Gate 1 is darkened (active). Gate 2 is currently inactive. This is indicated by the presence of the X through the gate and the fact that the icon is not darkened.

The left side of Gate 1 is shaded yellow. The X-axis coordinates of the gate position are displayed. If the Z-axis is selected with the arrow keys, then the coordinates will display those positions.

The four arrow keys  are used to control which side of the gate is active for location control purposes. Once a quadrant is active, that arrow and its opposing arrow are in control. In order to change to another axis, the arrows must be pressed in a clockwise or counterclockwise fashion.

Both gates can be displayed in the frame at the same time. However, when gate 2 is active, it is always the gate in control of the cursor. To turn either gate off, press the appropriate

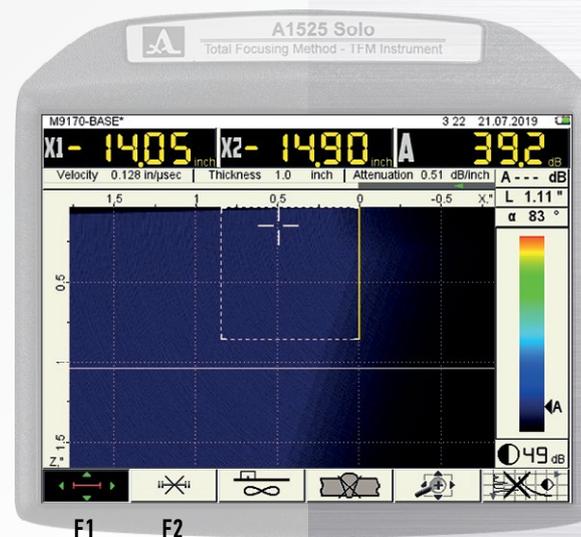
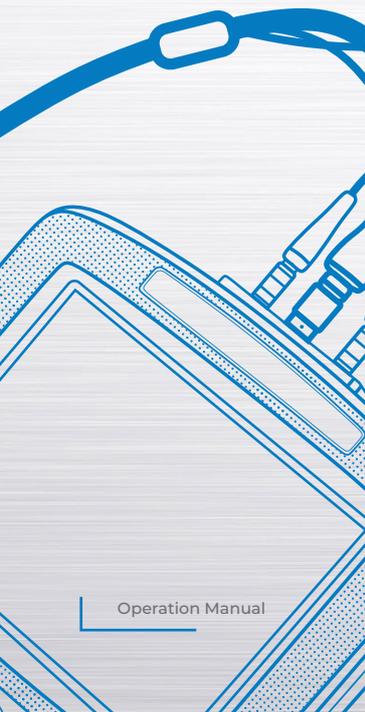


FIGURE 50



2



key (F1or F2) and then press the escape key . Upon pressing this key, an X will be displayed over the selected gate, as shown over gate 2 above in Figure 48.

Two gates are used when an inspection requires two regions to be monitored simultaneously. This allows the inspector to monitor the regions without the need to adjust one gate continuously.

NOTICE REMEMBER – WHEN GATE 2 IS ACTIVE, THE MEASUREMENT BAR ALWAYS DISPLAYS GATE 2 CURSOR COORDINATES.

2.4.3 Tomograph Display Features – Continued

The values shown in Figure 51 are explained below.

- The attenuation value is shown in dB/inch (or dB/m if in metric) is input on the Calibration parameters Setup screen. This is material dependent.
- The A value here is only displayed if a reference level is established under the Calibration parameters Setup screen. Once input, the larger A in the measurement bar will always reference this value. Indication values more severe will appear in red with their dB difference shown, and indication values less severe will appear in yellow or green depending upon their evaluation status. That dB difference will also be displayed.
- The L-value is equal to the linear distance between the transducer exit point and the indication triggering the cursor. In shear wave examinations, this is the angular distance. The X-value in the measurement bar is the surface distance, and the Z-value is the depth. The mathematical relationship is shown below.



FIGURE 51



- The α angle corresponds to the incident wave in the material under examination.
- The green arrow shown in Figure 49 indicates the position of the array transducer and its direction. The color green indicates that the array testing direction is to the left. The arrow indicates red for testing directions toward the right.
- During an inspection, the user inputs the direction of the test by pressing the F5 key . Once pressed (the X will disappear), press the enter  key, and the arrow will shift to the opposite direction. The on-screen grid coordinates will also shift the position of 0. Negative values on the X-axis, in relation to zero, are behind the array. Positive values on the X-axis are in front of the array.

• In Figure 52 below, the color bar displays the relative sensitivity of the system to the indication highlighted by the cursor. The black triangle on the right side points to the color displayed under the cursor. **The black triangles on the left side delineate the zones that indicate Monitor (M), Document (D), and Rejection (R) criteria. These are only active if a reference level is set.**

• The color bar is controlled by the   keys. **This control feature is only available if none of the function keys (F1-F6) are in the active mode.** Increasing the value makes the frame appear more sensitive, and decreasing the color bar makes the frame appear less sensitive. In other words, increasing makes the display redder, and decreasing makes the display darker.

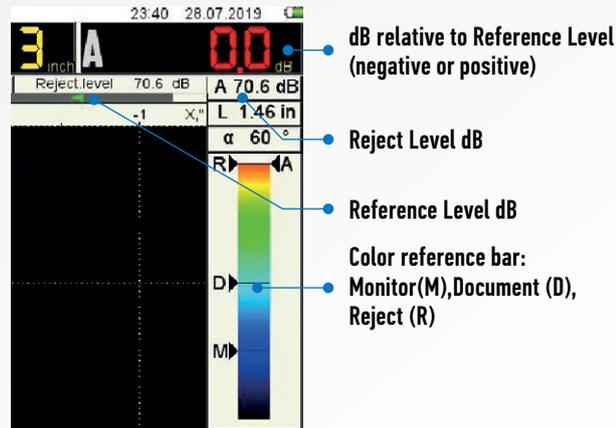


FIGURE 52



2

2.4.4 Sensitivity setting using SAC (Spatial Amplitude Correction)

Establishing sensitivity with the A1525 SOLO is relatively simple using the automatic compensation tool built into the unit. The steps below describe how to effectively establish relative sensitivity to a known reflector over variable distances. The SAC feature automatically compensates for changes in the angle of reflection and the distance of the reference reflector.

⚠ WARNING THIS STEP IS ONLY PERFORMED ONCE CALIBRATION ON THE REFERENCE STANDARD HAS OCCURRED. SENSITIVITY CANNOT BE ACCURATELY ESTABLISHED UNLESS BASIC CALIBRATION IS ACCURATE. THE REFERENCE REFLECTOR SHOULD BE PROPERLY ESTABLISHED ON-SCREEN AND THE GATING SET TO COVER THE EXPECTED CALIBRATION RANGE.

1) From the TOMOGRAPH mode, press the SETUP  key and select the device parameters screen pertaining to the array that is connected to the instrument, as shown in Figure 53.

2) Use the arrow keys to highlight Reference Level and press the enter  key.

3) The following screen will be displayed in Figure 54

4) Follow the directions at the bottom of the screen and maximize the amplitude of the reference reflector on the calibration standard (side drilled hole, EDM notch, etc.). Once maximized, press enter.

5) The large A in the measurement bar will change to 0.0 dB, and the small A underneath it will change to display the reference level in dB (Figure 55).

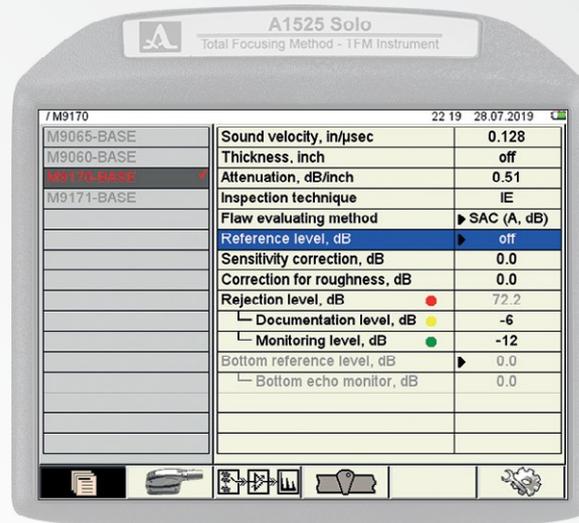


FIGURE 53

6) In this example, the reference level from the reflector is 70.6 dB. This will also become the Reject Level (R). The Monitor (M) and Document (D) levels will now be based on this value. Those levels are established on the screen displayed in Figure 53 earlier. Generally speaking -12 dB and -6 dB are used, respectively. This is determined by code or job specifications and can be changed as needed.

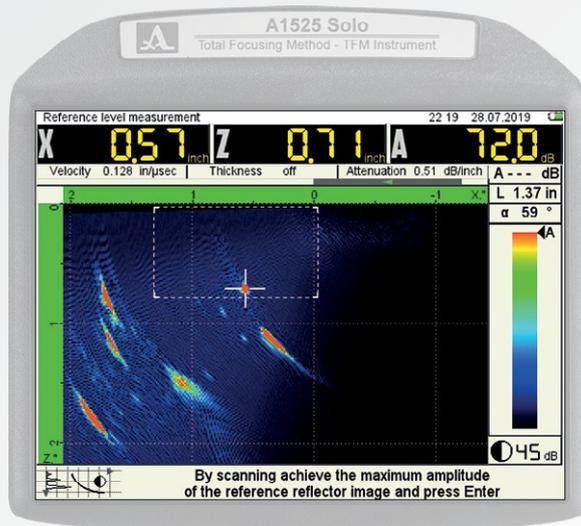


FIGURE 54

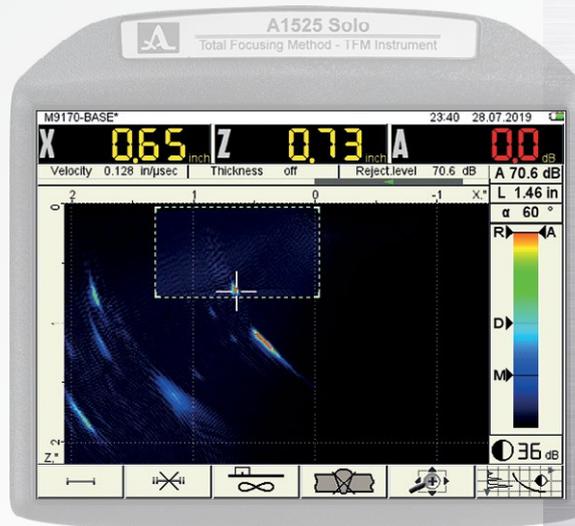


FIGURE 55

2



2

7) Press the SETUP key again and highlight the Flaw Evaluating parameter SAC and press enter. The following screen will appear in Figure 56.

8) Move the transducer and capture at least 5 different positions along the reflector's total path. Each time the transducer is moved, use the arrow keys to slide the small gate over the signal. Press the Freeze  key at each various location once the gate is moved to cover it.

NOTICE IT IS IMPORTANT TO COVER AS MUCH OF THE EXPECTED TESTING RANGE AS POSSIBLE. THE MORE POINTS CAPTURED, AND THE LARGER THE DISTANCE COVERED, THE MORE ACCURATE THE SENSITIVITY.

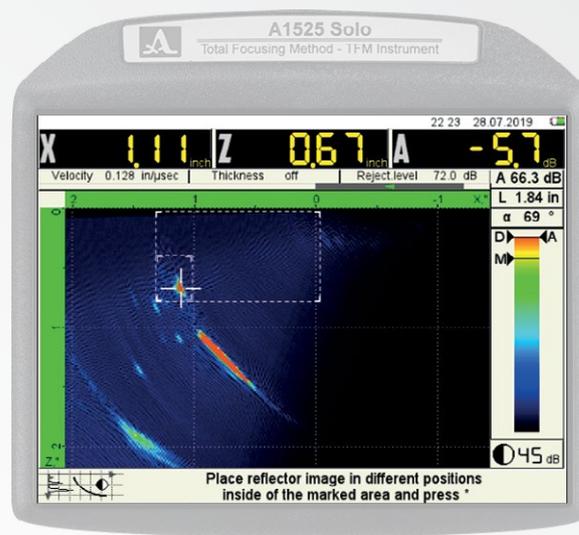


FIGURE 56

9) The screen images below show a brief sequence to understand the process (Figures 57 – 61).

10) Press the Enter key upon completion. A confirmation screen will display asking if this should be applied. Press Enter to apply or Escape to start over.

2

Point 1 Peak reflector – press Freeze

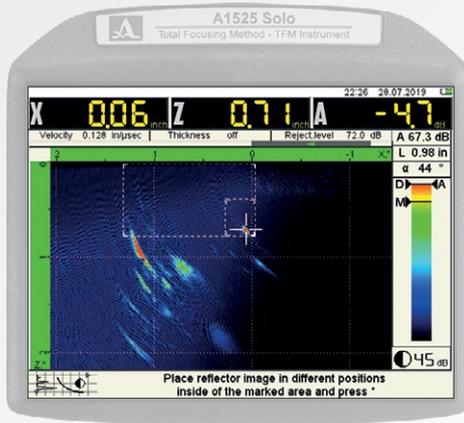


FIGURE 57

Point 2 Peak reflector – press Freeze

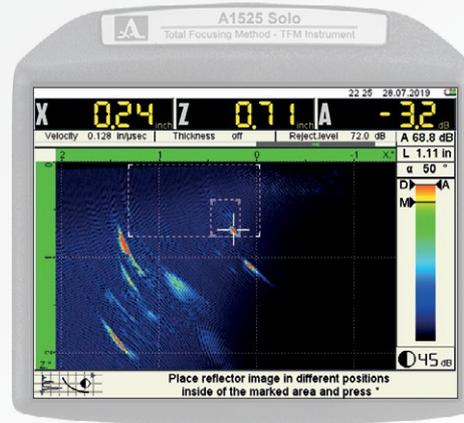


FIGURE 58

Point 3 Peak reflector – press Freeze

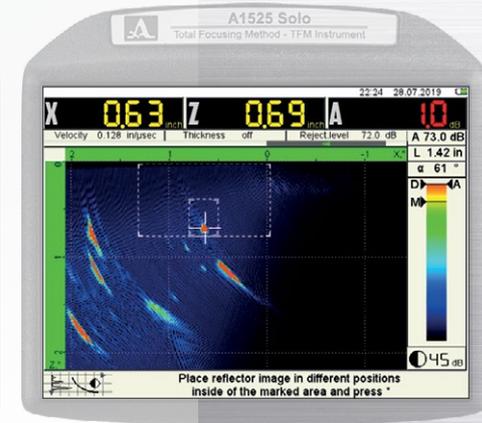
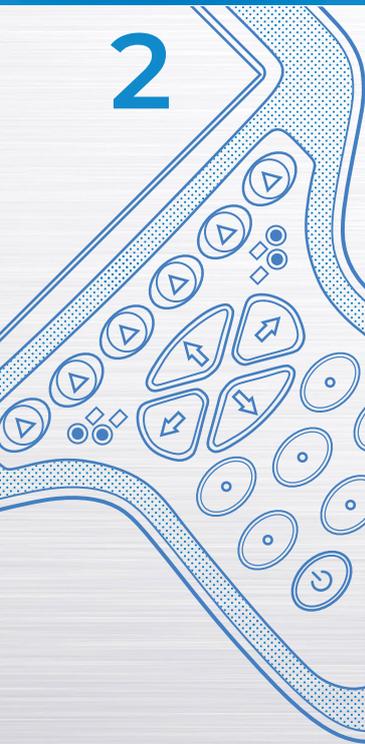


FIGURE 59



2



11) To confirm the accuracy of the SAC procedure, move the transducer array over each of the reflector positions used in the setup. Peak each indication and read the A value in the measurement bar. Variation from 0.0 dB should be minimal on each reflector since the instrument is compensating for the angle and the distance. Depending upon the examination's stringent criteria, this process may need to be completed several times to ensure uniform coupling and technique used on each point.

Point 4 Peak reflector – press Freeze

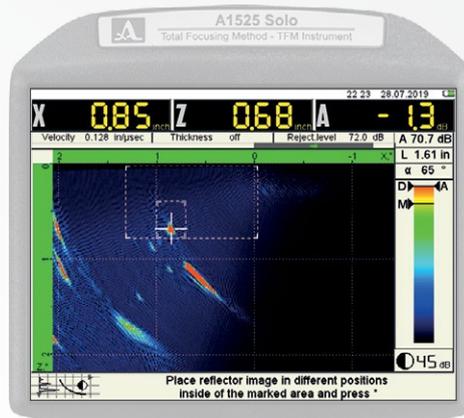


FIGURE 60

Point 5 Peak reflector – press Freeze

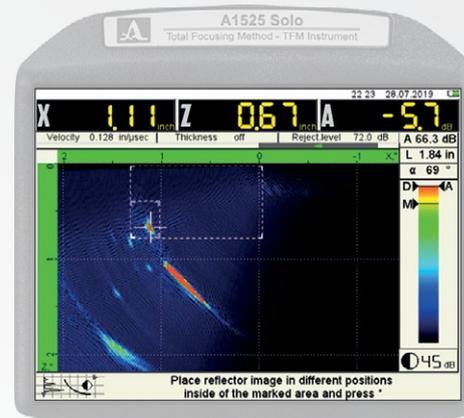


FIGURE 61

12) EXAMPLE: The two screens below (Figure 62) show the same point at greater than 0.75" distance apart at 72 and 53-degree angles (respectively) with only 0.3 dB variation.

SAC Calibrated and Activated

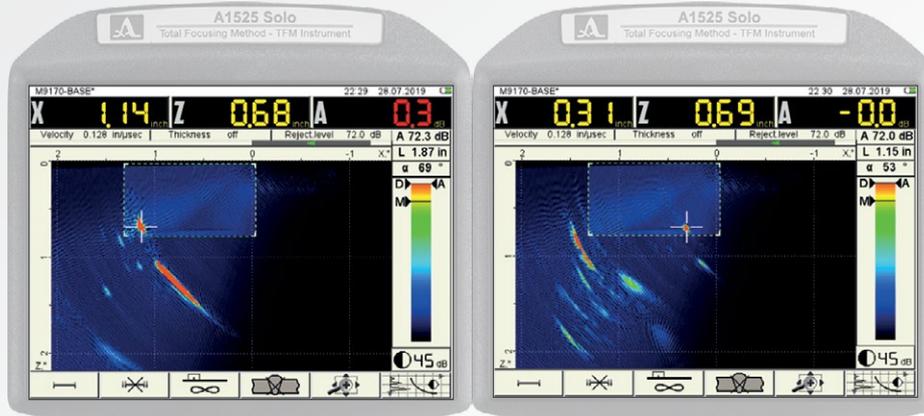
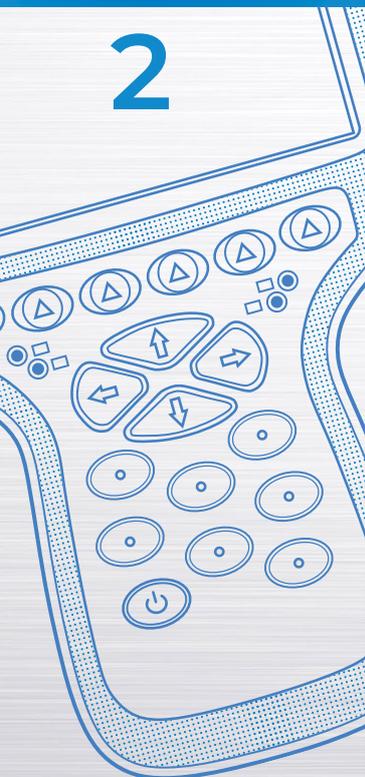


FIGURE 62

2

2



2.4.5 Tomograph Frame evaluation modes

Pressing the F3 key  activates the tomograph display algorithm selection feature. Each of the five modes of evaluation utilizes a different algorithm to correspond to varying test conditions. These modes and their corresponding testing conditions are described in Table 25 below.

Table 25

Symbol	Inspected object	Reflector Shape	Sounding	Purpose
	Unknown Thickness Mode	point	direct	For items of irregular shape, without definite thickness, or items with a rough back surface
	Plate Mode Material T between 10 mm and 100 mm	point	direct and reflected	For plane-parallel items with known thickness
	Surface Mode Material T less than 10 mm	point	reflected	For plane-parallel items with known thickness, small thickness objects while finding flaws near the surface
	Vertical Reflector Mode Material T less than 100 mm	flat	direct and reflected	For detection of vertically- oriented flaws and plane-parallel surfaces
	Multi-SAFT Mode Material T less than 100 mm	volumetric	direct and reflected	Universal mode for plane- parallel items with known thickness and all types of discontinuity flaws

The various modes are used together in order to evaluate a test specimen. It is good practice to begin the examination with the Unknown Thickness mode and use the Zoom function (F5) to display a large area view of the part under inspection. This provides an overview and highlights areas of interest for further investigation.

Once the initial view is obtained, select the mode that best fits the type of indication expected and the material thickness being examined. It may be convenient to progress through each mode in order to select the ideal view. At that point, gating can be established to perform the complete scan.

2.4.6 Magnify (Zoom) control

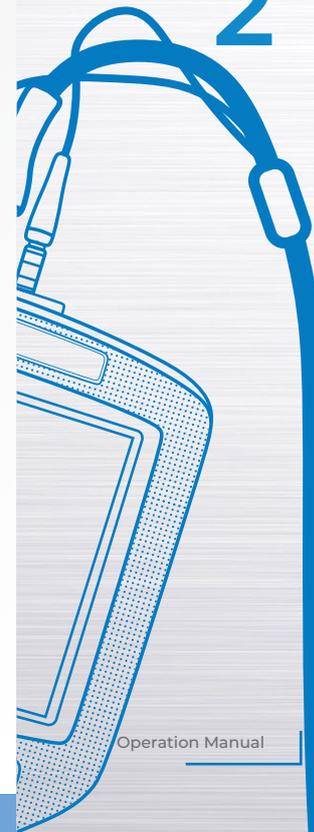
Pressing the F5 key  allows the user to change the scale of the display so that more or less of the object being examined can be shown. If a large area overview is desired, press, and hold the  key. The display area will continue to expand until it reaches the maximum view.

To decrease (magnify) the area of inspection, press and hold the  key until the desired magnification is obtained. Key functions active during Magnify are given in Table 26.

Table 26

Key	Function
	Moves the image frame in the corresponding direction of the arrow.
	Increases or decreases the field of view
	Changes the transducer direction

2



2

2.4.7 TOMOGRAPH Freeze mode

Frames are saved and previewed by pressing the freeze key  in the Tomograph mode (Figure 63).

Once saved, the frames can be transferred to the computer for reporting purposes. As an alternative to saving the frame, it is possible to take a screenshot by pressing and holding the escape  key for 2 seconds. The only difference is that saving gives the ability to name the file. A screenshot is not named. It is numerically indexed in a linear fashion.

The key functions in STOP/ TOMOGRAPH are given in Table 27.

Table 27

Key	Icon	Function
F1		Frame saved
F2		Move to the first saved frame
F3		Move to the previously saved frame
F4		Move to the next saved frame
F5		Move to the last saved frame
F6		The current shot deletion

The device enters a new shot name editing at pressing the key F1 (Figure 64).

Measurement Feature:

While the freeze mode is active, it is possible to measure the distance between two points (or indications) within the frame.

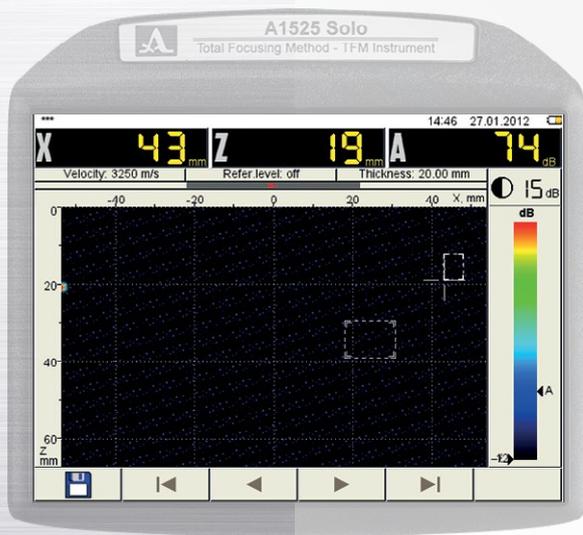


FIGURE 63

By pressing the enter key  the defect distance measuring mode is activated, as shown in Figure 65. The distance between the current indication and any other are measured in this manner.

Move the calibration cursor to a specified point by using the arrow keys.

The calibrated values are displayed in the value panel. ΔX , ΔZ , and D are displayed.

Once the measurement is made, the value can then be stored as part of the saved file.



FIGURE 64

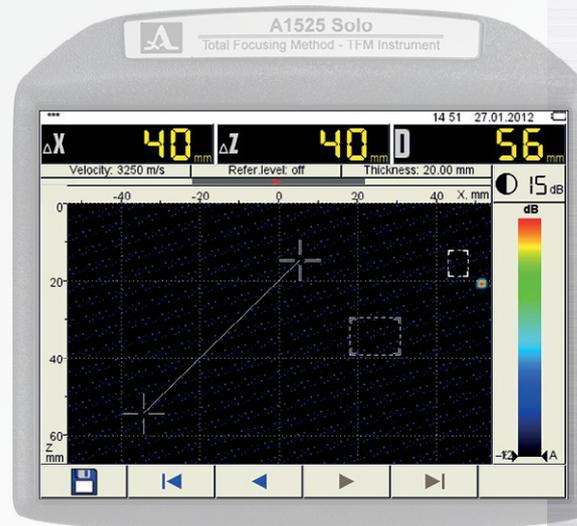


FIGURE 65

2

2.4.8 TOMOGRAPH Scanner mode

In tomograph Scanner mode provides the possibility for data acquisition along the weld.
The Settings related to sensitivity and range are set in Tomograph mode first and are applied during the scan.
After data acquisition all information can be stored and reviewed.
The device scanning mode is shown in Figure 66 (without display of B-Scan) and Figure 67 (with display of B-Scan)

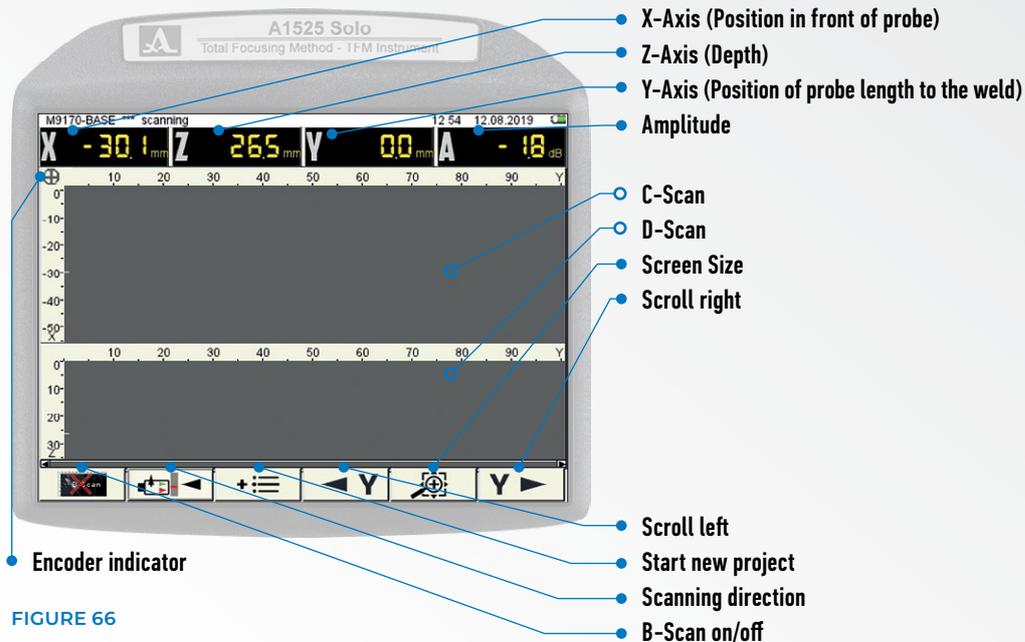


FIGURE 66

The key functions in Scanner mode before definition of a new weld object are given in Table 28.

B-Scan with weld representation

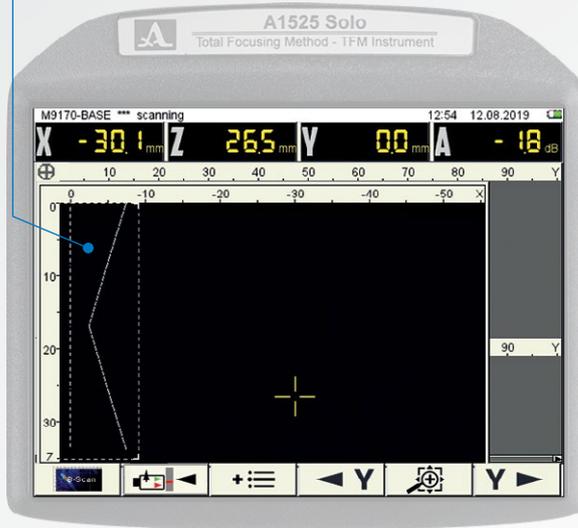


Table 28

Key	Icon	Function
F1		Switch B-Scan on/off
F2		Definition of scanning direction/direction of data acquisition
F3		Define new weld object
F4		N/A
F5		N/A
F6		N/A

FIGURE 67



2



Press F3 to open the "Save Frame" window (Figure 68).

Enter desired Name by using the arrow keys for moving from letter to letter and press for entering. After Naming of the Frame press F1 for saving.

After naming and saving the new weld object the screen changes and the function keys change. As shown in the following Figure 69 The F3 button has changed to **REC**

The key functions for F3 in this mode are now according Table 29.



FIGURE 68

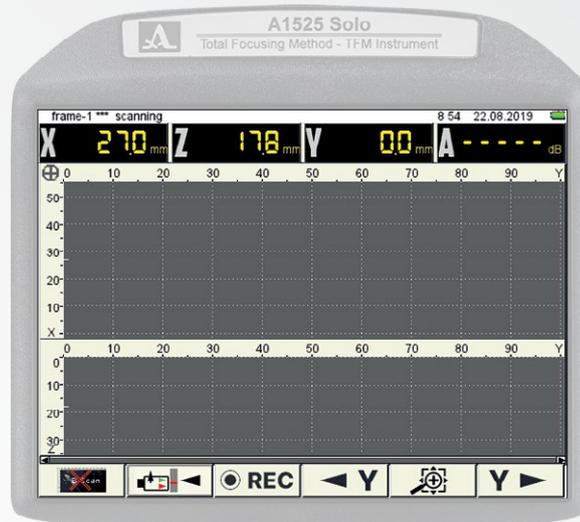


FIGURE 69

2

Distance probe
front to weld
middle

Table 29

Key	Icon	Function
F1		Switch B-Scan on/off
F2		Definition of scanning direction/direction of data acquisition
F3		Define new weld object

Choose the scanning direction according picture. Possible positions are given in Table 30

Table 30

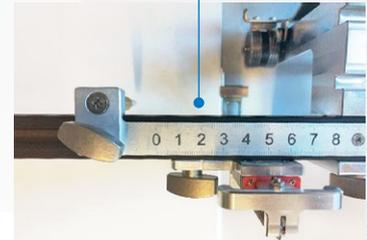
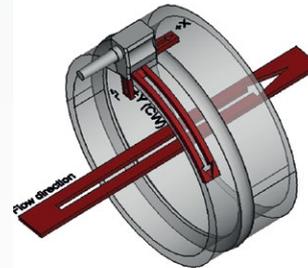
F2	Function
	Probe on right weld side, moving direction according arrow
	Probe on right weld side, moving direction according arrow
	Probe on left weld side, moving direction according arrow
	Probe on left weld side, moving direction according arrow

NOTICE NOTE THAT THE DATA ACQUISITION WILL NOT START IF THE SCANNING DIRECTION IS NOT CHOSEN CORRECT. THE DEFINITION OF CLOCKWISE AND COUNTERCLOCKWISE MOVING DIRECTION IS ALWAYS ALIGNED WITH THE FLOW DIRECTION OF THE FLUID IN THE TUBE!

ALWAYS LOOKING IN FLOW DIRECTION! PORBE POSITION LEFT OF THE WELD AND RIGHT FROM THE WELD ARE POSSIBLE

Define the of distance of the antenna array to weld middle.

Fist measure the distance of your antenna array to the weld middle on



2

your testing setup. Please note, that the distance of the weld middle to the antenna array is depending the chosen x-axis zero that can be AA front or AA middle.

Press F3  **REC** to open the window for definition of distance antenna Array to weld middle (Figure 70). Enter the distance by using the  and  keys. Press  to finish data input and start the measurement. By pressing  again, the measurement can be paused.

To finish the current scan press F3 and you will be asked if you want so close the current scan. acknowledge with  to store the Data or return to the measurement by pressing . To start the next scan, repeat the steps described above.

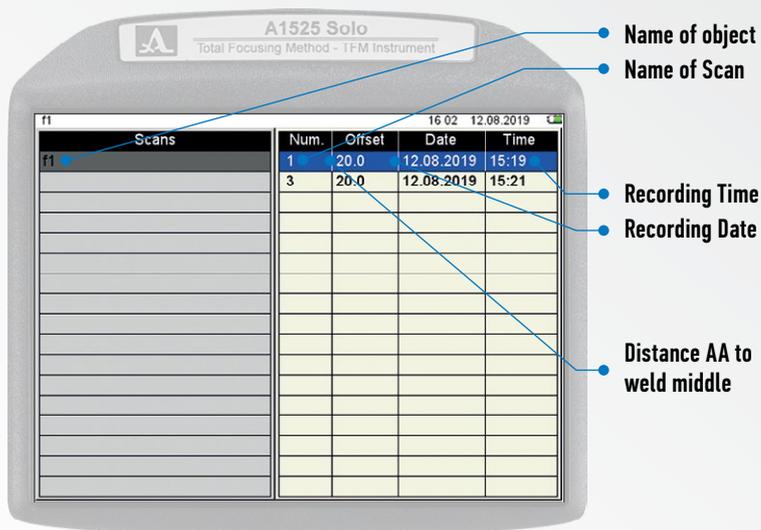
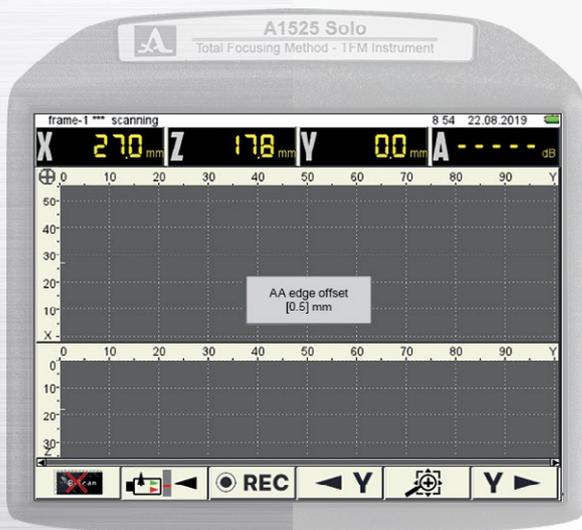


FIGURE 70

FIGURE 71: ALL RECORDED WELD OBJECTS

To close the weld object press . You will be asked if you want to close the current weld object. Acknowledge with

 to store the Data or return to the measurement by pressing .

The Screen will change, and the list of all recorded weld objects is displays as shown in Figure 71.

To review the recorded data, use the arrow keys  to navigate through the weld objects and scans. By pressing  the chosen data set will be loaded and the screen changes to review mode like shown in the following Figure 72.

This mode is intended to provide information about the collected Data and to show the already processed Scans. The data representation is available as B-, C- and D-Scans (Figure 73).

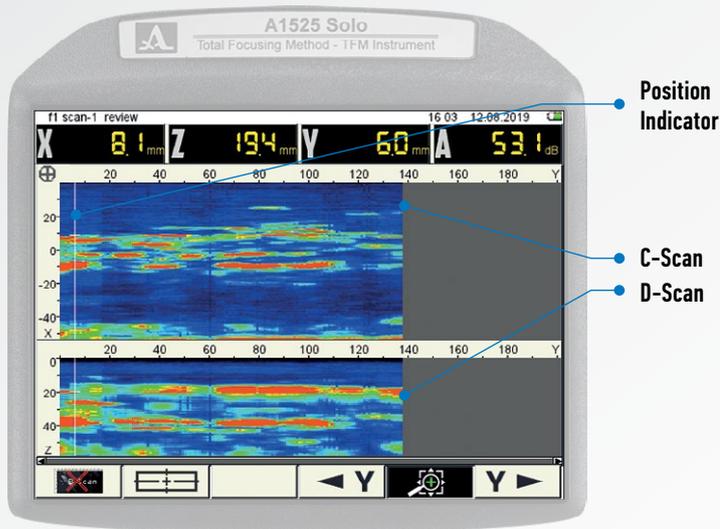


FIGURE 72

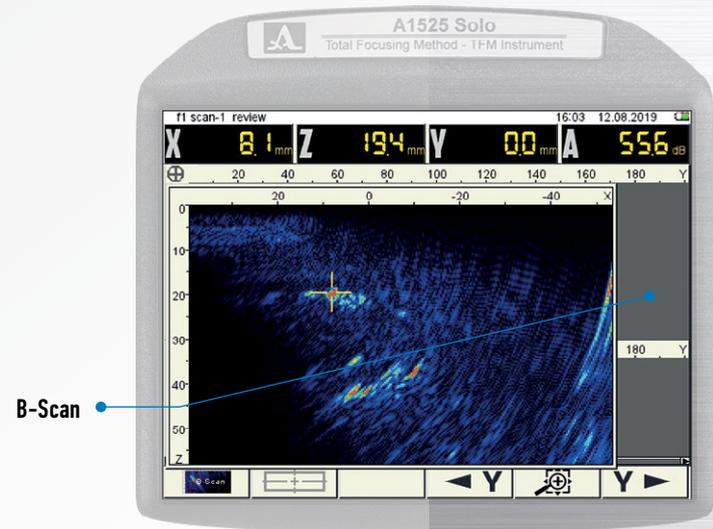


FIGURE 73

2

The key functions are given in Table 31

Table 31

Key	Icon	Function
F1		Switch B-Scan on/off
F2		Activate gate
F3		N/A
F1		Y-coordinate scroll left
F2		Screen Size
F3		Y-coordinate scroll right

The arrow keys  are used to navigate the cursor through the data sets. The cursor values are shown like before.

X 8.1 mm | **Z** 194 mm | **Y** 00 mm | **A** 556 dB

To make screenshots for documentation purposes, press  for three seconds and the saving of the screenshot will be acknowledged by displaying the following message

Screenshot 15 is saved to file
015.Screen.bmp

3.1 POWER SUPPLY AND POWER CONSUMPTION

Checking the state of the power source

While the device is in operation, a built-in charge controller monitors the discharge degree of the power source. its embedded discharge controller monitors the state of charge of the power source. This state is displayed as a battery icon in the upper right corner of the display. The battery icon will be filled according to the degree of charge. Completely filled green battery icon means that the accumulator battery is charged completely. As far as the battery discharges the filling degree decreases and the icon changes its color from orange to red. The device will be automatically switched off when the battery is critically discharged. All the settings and recorded information will be saved.

3.2 MAINTENANCE FREQUENCY

During the operation it is recommended to clean the device body from dirt and dust regularly using a cleaning agent for plastic items. If the protective glass of the screen is dirty, please wipe it with a soft cloth moistened in a household cleaning agent for plastic glasses. The dirty keyboard can be cleaned with alcohol. If dirt or foreign matter get in the arming connectors, they should be cleaned with a soft brush.

3.3 POTENTIAL PROBLEMS

In case of any problems or questions concerning the use of the device, please, contact the company representative by phone. The numbers are indicated in the data sheet of the device.

3.4 STORAGE

The device should be stored in a transport suitcase included in the scope of delivery of the device. The devices should be stored in racks. The arrangement of the devices in warehouses shall enable their free movement and unrestricted access to them. The distance between the devices and the walls, floor of the warehouse and other warehoused instruments shall be at least 100 mm. The distance between heating units of the storage room and the devices should be min. 0.5 m. The storage room shall be free from the current-conducting dust, admixtures of aggressive gases and corrosive vapors able to attack the instruments.



4

TRANSPOR- TATION

The device should be transported in a transportation suitcase included in the scope of delivery of the device.

The packaged devices can be transported in any vehicles at any distances without speed limits.

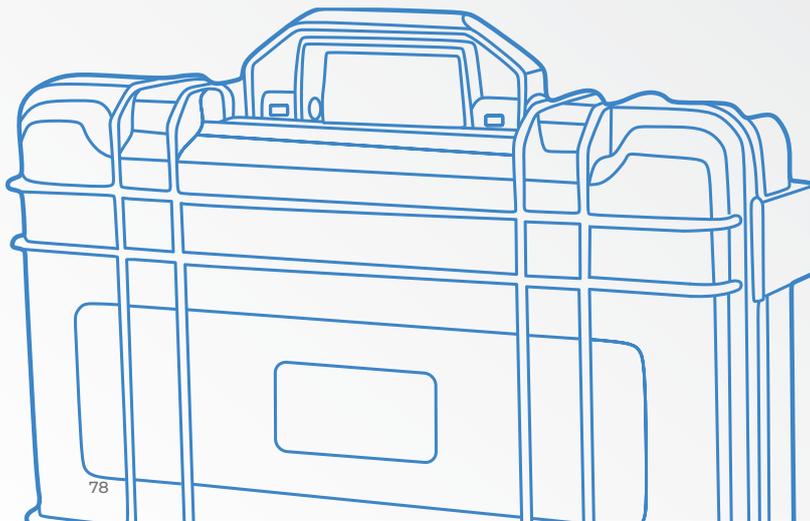
Packaged devices should be properly and steadily fixed to prevent their hitting against one another and against vehicle walls during transportation. When transported in open vehicles the instruments shall be protected from rain and water splashes.

The arrangement and fixation of the packed devices in transport facilities should provide their stable position and exclude strokes against each other as well as against the walls of the transportation facilities.

The conditions for device transportation should meet the requirements of the valid specifications, rules and norms for each type of transport.

If shipped by air, properly packed devices should be placed in hermetically sealed heated compartments.

If transportation conditions differ from the operation conditions, the device shall be kept under normal weather conditions for at least 2 hours prior to operation.





TFM ULTRASONIC FLAW DETECTOR

A1525 SOLO



OPERATION MANUAL

Revision: June 2020