

AVENGER II

User Manual



Version 1.0, 11/6/20

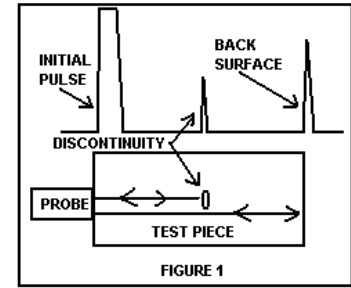
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1. Introduction

The AVENGER II is an ultralight palmtop ultrasonic flaw detector. Weighing in at only 800grams, the ambidextrous operation modes make one handed inspection easy. The portability and compact housing make the Avenger II unique in its class. The AVENGER II is equipped with a 5 inch color WVGA LCD/TFT display with wide viewing angles. A 7.2 VDC, 4AH lithium ion battery gives over eight hours of continuous operation on a single charge. 500 trace patterns and 50 setups can be easily stored and recalled. A micro SD Card up to 32GB and a USB communication port make data transfer to the computer easy.

2. Principal of Operation

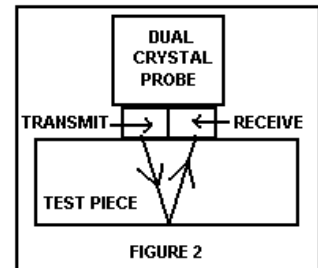
The AVENGER II is a single channel Ultrasonic Flaw Detector used for the inspection of homogeneous material for the presence of inclusions, porosity, and other discontinuities. It can also be used for thickness gauging of homogeneous material, requiring access from only one side of the test piece. High frequency sound (Ultrasonic sound) waves are introduced into the test material/part from a transducer/probe that is coupled to the test piece, usually by water or other suitable coupling liquid. The transducer converts electric signals to Ultrasound and vice versa. A short burst of Ultrasound is introduced into test material. The reflection of the ultrasound energy is a function of the ratio between the acoustic impedance of the discontinuity and the base material. The greater the impedance ratio, the more sound energy will be reflected. The principle of Ultrasonic testing is shown in fig. 1. It shows the ultrasonic energy generated in the test piece and resultant instrument display.



Thickness gauging with the AVENGER II operates on the principle of the time-of-flight measurement. This principle utilizes the precise timing of the transit time of a short burst of ultrasound energy, through a material under test. The ultrasound waves travel to the far side of the test piece and return to the transducer/probe. The round-trip time is recorded and multiplied by a material velocity to produce a thickness measurement.

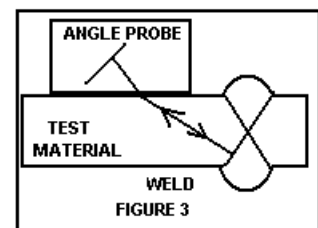
Three types of transducers are available for different applications:

Straight beam Probe: This probe introduces ultrasound normal to the test piece surface utilizing longitudinal or compression waves. Normal beam probes are used mostly for flaw detection and thickness gauging (figure 1.)

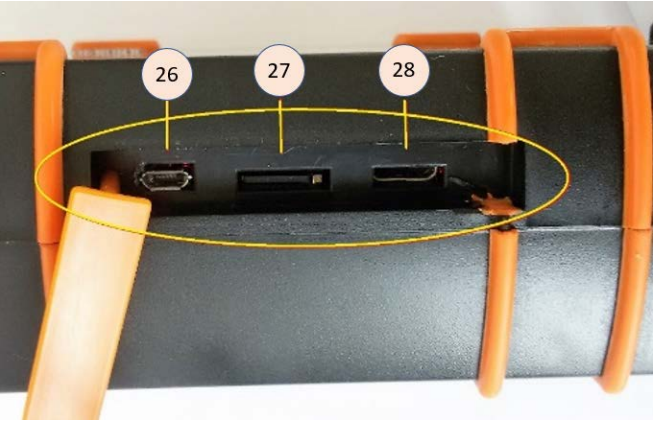
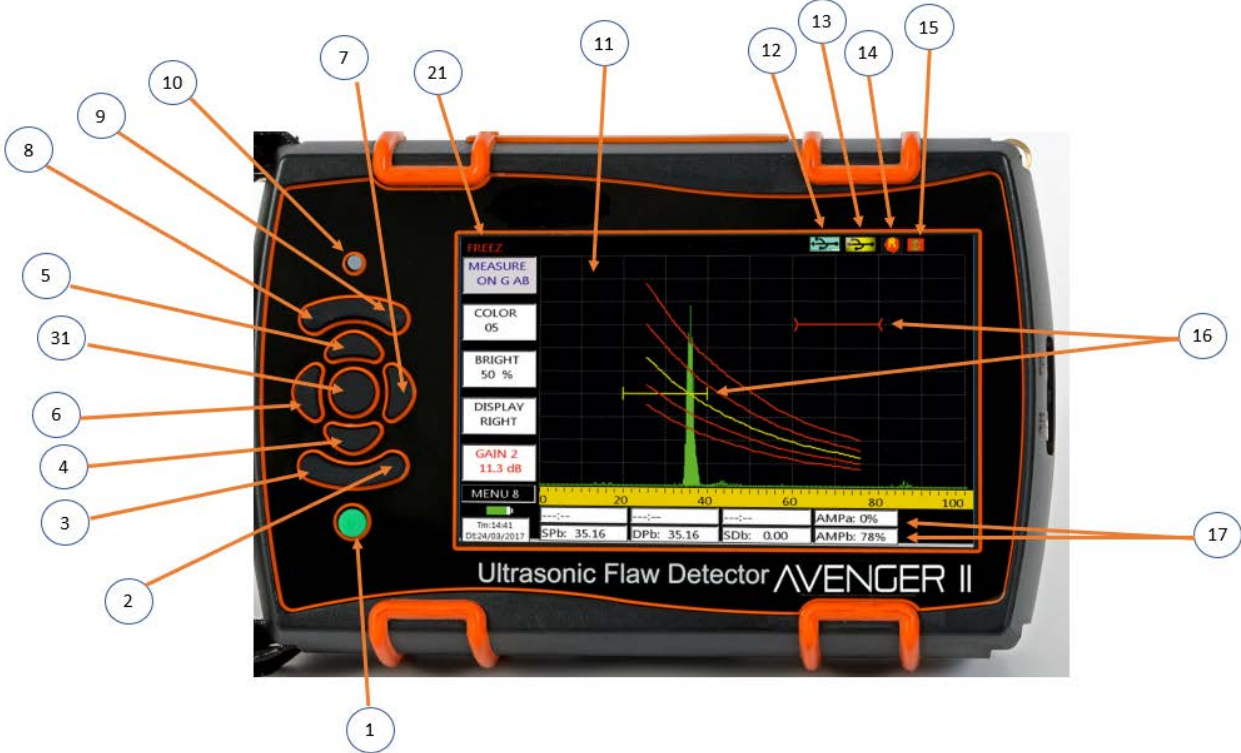


TR probe: This probe contains a transmitter and receiver element (figure 2). This design improves near surface resolution by setting the initial pulse from the received echoes. TR probes produce better near surface resolution, especially useful on pitted and corroded surfaces.

Angle Beam Probe: This probe introduces ultrasound at an angle to the surface of the test piece (figure 3). The wave energy is mode converted from a longitudinal wave to a shear wave by the refraction principle. Angle beam probes are useful for weld inspections and detection of flaws perpendicular to the test surface. The reason for this is its ability to position the transducer/probe away from the weld bead yet propagate energy into the weld zone. Another reason to use angle beam testing on the welds is to position the sound beam more normal to the expected discontinuities.



3. Device Reference



1. **POWER key** : Turn power ON and OFF using this key.
2. **MENU INC key**: Increases MENU value.
3. **MENU DEC key**: Decreases MENU value.
4. **DN key**: Navigation Down inside the particular MENU from one setting to another.
5. **UP key**: Navigate UP inside the particular MENU from one setting to another.
6. **LEFT key**: Navigate Left inside the current setting or activate the prompted action.
7. **RIGHT key**: Navigate Right inside the current setting or activate the prompted action.
8. **GAIN DN key**: Decreases the gain.
9. **GAIN UP key**: Increases the gain.
10. **LED INDICATOR**: Green when device is charging, Red when display is on.
11. **LCD SCREEN**: Displays the A-Scan trace patterns, menu settings and other details.
12. **USB DSK Indicator**: This symbol is visible when a USB DRIVE is connected to AVENGER II or when the AVENGER II is connected to a PC.
13. **SD card Indicator**: This symbol is visible when a SD card is inserted to AVENGER II.
14. **REJECTION**: This symbol is indicated when Rejection is ON.
15. **MODE Selection**: This symbol indicates whether the probe mode is Dual Crystal OR Single Crystal.
16. **GATES**: GATES are displayed when “Gate a” (red) and “Gate b” (yellow) are ON.
17. **MEASURE Details**: When MEASURE is on, details like sound path, depth path, surface distance and amplitude percent are displayed at bottom of screen.
18. **BATTERY Indicator**: Indicates battery level.
19. **TIME AND DATE**: Indicates present date and time.
20. **MENU Nos.:** Indicates the current menu number.
21. **FREEZ**: Current screen FREEZES by pressing CENTER key twice.
22. **CHARGER CONNECTOR**: Connect the charger here to charge the battery.
23. **RX CONNECTOR**: Receiver connection for Dual Crystal transducers.
24. **TX CONNECTOR**: Transmit/Receive connection for Single and Dual Crystal transducers.

- 25. **BATTERY COMPARTMENT:** Battery is fitted in this compartment.
- 26. **USB SLOT:** USB slot for attaching USB drives and DSK.
- 27. **SD CARD SLOT:** SD card slot for external storage and data transfer.
- 28. **I/O PORT:** Encoder interface and Alarm signal.
- 29. **PIN FOR HOLDING STRAP:** Two Pins are provided for hand and neck straps.
- 30. **STAND:** Support Stand is provided for loading of AVENGER II on a surface.
- 31. **CENTER KEY:** Enter selected value, hold while incrementing a value to rapidly increment.

STATUS INDICATORS



SD Card mounted



USB Disk mounted



Probe mode Dual Crystal selected



Probe mode Single Crystal selected



Measurement reading is Flank trigger selected



Measurement reading is Peak trigger selected



Rejection applied



TCG active

4. Operational Menu Details

The AVENGER II is a user friendly, menu driven Ultrasonic Flaw Detector. Details of all menus and settings are below.

Menu 1 – Basic functions of an Ultrasonic Flaw Detector (UFD) Range, Material Velocity, Delay and Gain functions are covered.

ZERO: Adjust artificial zero of the transducer.

RANGE: Adjust test range. Set in terms of Millimeters or Inches. The range available for steel is from 2.50 to 10000 mm (0.100 to 400 inch). Rapidly increment by pressing CENTER key along with the LEFT/RIGHT key.

VELOCITY: Adjust material velocity. Set in terms of m/s or in/s.

DELAY : Partial Range can be set in DELAY using the LEFT/RIGHT keys. Exact shift/delay in mm (Inch) is displayed at the bottom.

GAIN STEP: Gain step value can be set by using GAIN UP/DN key. Increments of 0.1,0.5, 1, 2, 6, or 14 dB.

GAIN: Gain can be increased/decreased as per value of step by using GAIN UP/DN keys.

ZERO
2200
RANGE
100 MM
MTL VEL
5920M/S
DELAY
0.00MM
GAIN 1
25.0 dB

Example: **AVENGER II is to be calibrated for 100 mm Test Range using a Single Element probe.**

- Using UP/DN keys navigate to RANGE in MENU 1.
- Using LEFT/RIGHT keys set required range to 100mm.
- Couple the probe on 25mm thickness of V1 reference block, Navigate to ZERO in MENU 1 using UP/DN keys and set first echo at 25mm using LEFT/RIGHT keys.
- Set 4th echo at 100 mm by changing velocity using LEFT/RIGHT keys in MTL VEL, if required.
- Repeat above two steps until both the echoes are at their respective positions.
- Amplitudes of the echoes can be varied using GAIN keys.

Menu 2 – MONITOR “GATE a” functions.

GATE a : Gate can be changed to PLOGIC, NLOGIC, CRV M, CRV-1, CRV-2, CRV+1, CRV+2, EXPAND or OFF

PLOGIC: When PLOGIC is selected, the MONITOR triggers if an echo is present within the gate and its height is equal to or crosses the set Threshold Level.

NLOGIC: When NLOGIC is selected, the MONITOR triggers if there is no echo within the gate or the height is lower than the Threshold Level.

CRV M : When DAC is turned ON and CRV M is selected the monitor triggers if any Echo signal equals or crosses main DAC Curve

CRV-1: If DAC is turned ON and if any echo signal cross DAC-1 dB curve then the monitor triggers.

CRV-2: If DAC is turned ON and if any echo signal cross DAC-2 dB curve then the monitor triggers.

CRV+1: If DAC is turned ON and if any echo signal cross DAC+1 dB curve then the monitor triggers.

CRV+2: If DAC is turned ON and if any echo signal cross DAC+2 dB curve then the monitor triggers.

GATEa
OFF
STARTa
30.0 mm
WIDTHa
40.0MM
LEVELa
30 %
GAIN 1
25.0 dB

EXPAND: When EXPAND is selected the scale expansion activates and GATEa width expands to Full-screen width for a magnified view.

STARTa: GATEa starting position can be set using START. By pressing LEFT/RIGHT Keys Gate start can be set in term of mm or in.

WIDTHa: Gate width can be set using WIDTH, set in terms of mm or in.

LEVELa: Gate Threshold Level, set in terms of the percentage of the Full Screen Height (FSH).

Example: **The MONITOR to be triggered when any echo crosses the 50% FSH between 35mm and 80mm.**

- In the Gate setting MENU 2, select PLOGIC using LEFT/RIGHT keys.
- Set Gate START to 35mm using LEFT/RIGHT keys.
- Set Gate END to 80mm using LEFT/RIGHT keys in WIDTH.
- Set Gate LEVEL to 50% using LEFT/RIGHT keys.

Menu 3 – MONITOR “GATE b” functions.

GATEb : Gate can be changed to PLOGIC, NLOGIC or OFF

PLOGIC: When PLOGIC is selected, the MONITOR triggers if an echo is present within the gate and its height is equal to or crosses the set Threshold Level.

NLOGIC: When NLOGIC is selected, the MONITOR triggers if there is no echo within the gate or the height is lower than the Threshold Level.

STARTb: GATEb starting position can be set using START. By pressing LEFT/RIGHT Keys Gate start can be set in term of mm or in.

WIDTHb : Gate width can be set using WIDTH, set in terms of mm or in.

LEVELb: Gate Threshold Level, set in terms of the percentage of the Full Screen Height (FSH).

GATEb
OFF
STARTb
30.0 mm
WIDTHb
40.0MM
LEVELb
30 %
GAIN 1
25.0 dB

Menu 4 – Memory storage/recall and Trace printout functions.

MEMORY : Select A SCAN or SET-UP memory functions.

MEM NO : Select desired memory location from MEM NO. If Data is stored and valid, an asterisk (“*”) will be displayed next to “MEM NO”.

ACTION : Required functions like SAVE, DETAIL,DELETE,COPY ALL, RECALL can be selected using LEFT/RIGHT Keys. When DETAIL is selected, Note Data of stored A Scan is displayed.

ENTER : In NOTE ENTER by pressing RIGHT key, the selected ACTION is performed. Pressing the LEFT key brings up the Note menu. Edit/change Note detail if required, press RIGHT key to exit Note edit.

MEMORY
A SCAN
MEM NO*
001
ACTION
RECALL
<NOTE
ENTER>
GAIN 1
25.0 dB

Example: **To SAVE current Calibration and A scan in Memory no 3.**

- Acquire desired signal on the screen. Press CENTER key twice to freeze the screen.
- Select A SCAN in Memory using LEFT/RIGHT keys.
- Set MEM NO to 3 using LEFT/RIGHT keys.
- Set ACTION to SAVE using LEFT/RIGHT keys.
- In NOTE/ENTER press LEFT key so Note menu will be displayed. Edit if required and exit from note menu.
 (**To edit in side text menu**- Using UP/DN keys navigate to LINE UP/DN then by using LEFT/RIGHT key select the line for entering text, and then navigate to CURSOR MOVE and by using LEFT/RIGHT key and GAIN UP DN or MENU INC/DEC (CHAR SCROLL) keys to edit the text content, also to delete a character press MENU INC key along with the CENTER key, and to add a space press MENU DEC key along with the CENTER key.)
- Press RIGHT key in NOTE/ENTER to exit from side text menu. By pressing RIGHT key again in NOTE/ENTER, the current calibration, A-Scan, and Note data will be stored in MEM NO. 3.

Note: If data is already stored at this location, press CENTER KEY and RIGHT key to over write the data.

Menu 5 – DGS, DAC curve, and AWS measurement mode functions. Navigate to Menu 11 to select measurement mode

DAC: DAC setting can be switched to DRAW, ON, OFF, TCG ON or TCG EDIT using LEFT/RIGHT keys.

OFF: DAC curve will be not displayed on LCD.

DRAW: Peak points of echo signals are selected and stored.

ON: The selected peak points are digitally connected to form a DAC curve.

TCG ON: Time Gain Correction activated as per DAC so it brings echo signal to same height irrespective of depth

TCG EDIT : In this mode user can adjust gain/echo amplitude of the recorded echo signal.

STRT a: Start of the GATE can be set in **STRTa** using LEFT/RIGHT keys. To select any peak of the echo signal, move the Gate on the echo signal and then press LEFT/RIGHT Key in the ENTER menu cell. POINT value is automatically incremented to indicate next point.

(If GATE 1 is OFF then turn to PLOGIC).

POINT/TL: Select number of points in DAC OFF or DRAW, change the levels in DAC ON, TCG ON/EDIT

POINT: Cell will change to DAC dB to draw additional offset DAC curve when DAC is ON.

TL : Cell will change to “T-L” when DAC is ON Gain of machine can be change without affecting curve height. It can be used for Transfer/Scanning gain correction.

DAC
OFF
STRT a
030%
PRESS
ENTER
POINT
ENTER
GAIN 1
25.0 dB

DAC REF Gain

In the DAC Draw process when user registers first echo signal, the equipment will automatically bring the registered echo signal to 80% height and Gain (Gain required to bring registered echo to 80%) is stored as REF Gain.

Example: To digitally draw DAC curve to join four peaks of the echo signals using 25mm thick reference block and range of 100mm.

- Set Gain so that all four peaks are visible on the LCD screen above 50% FSH.
- Set DAC to DRAW using LEFT/RIGHT keys in DAC in MENU 5.
- Move cursor using LEFT/RIGHT keys in **START a** to cover the first echo. If GATE 1 is OFF then switch to PLOGIC.
- Press LEFT/RIGHT key in ENTER to accept it and Point No. will be incremented automatically.
- Repeat above two steps for second, third and fourth echo.
- Set DAC to ON using LEFT/RIGHT key in DAC. Now DAC Curve will be displayed on LCD.

Example: To Edit echo amplitude of the recorded echo signal in TCG

- In the DAC menu after drawing DAC curve select "TCG EDIT"
- Select "POINT" using LEFT/RIGHT key
- Select appropriate Point number using LEFT/RIGHT key so Gate will be drawn to indicate selected echo signal.
- Select "DAC dB" using UP/DN key.
- Adjust echo height by pressing LEFT/RIGHT key.

Note: Cursor need not touch the echo for selection and acceptance of the peak point.

AWS: AWS setting can be switched to SET, MEASURE or OFF using LEFT/RIGHT keys.

SET mode: Set GATE 1 to PLOGIC then bring reference echo of reflector in between 40 to 60% , Turn SET REF to ON key so gain of reference echo is recorded and displayed as REF GAIN. (RG)

MEASURE : Display “IL” (Indication level) dB value to bring echo to reference level.

AF: Display attenuation factor to correct for the depth of the echo signal.

IR: Display indication rating as per AWS code. IR=IL-RG-AF.

AWS
OFF
START a
30.0mm
SET-REF
OFF
GAIN 1
25.0 dB

Example: Set up an AWS compliant measurement

- Select MEASURE POSITION, MEAPOS1 and MEAPOS2 to ON.
- Set GATEa to “PLOGIC”
- Couple probe on reference defect and set gain value so echo height within 40 to 60% of Screen.
- Set GATEa in such a way so echo signal within GATE.
- Then turn SET REF to ON so required gain to bring echo to 50% is recorded and displayed as a REF Gain in GAIN box.
- Set AWS to MEASURE to display Indicated Rating as per AWS code.

Indication rating is based below formula.

$$IR=IL-RG-AF$$

Where,

IL : Indicating Level... Gain value to bring echo height to reference level (50%).

RG : Reference Gain.. Gain value to bring reference echo height to reference level(50%)

AF : Attenuation Factor... Attenuation of signal in material as per AWS standard.

Based on below formula.

$$AF= (\text{Sound path (in Inch)} -1) * 2$$

IR : Indicated Rating... Different dB between the indication signal and reference signal with attenuation correction.

DGS: DGS setting can be switched to SELECT, REF REC, ON or OFF using LEFT/RIGHT keys. In SELECT mode probe type, reference diameter, reference type, required DGS curve diameter, etc. can be selected. In ON mode DGS curve will be displayed on Screen as per what is selected in DGS selection menu.

STRT a : To select echo peak as reference move GATE a using STRT a. If GATE a is OFF then select to PLOGIC in Menu 2.

SET-REF: When switched to ON, the reference echo within the gate is registered and the height of the reference echo is brought to ref. curve height. When DGS is turned to ON then SET-Ref will automatically switched OFF.

TL-CORR: This correction is required if test object and reference block have different surface qualities. By varying TL-CORR gain will change but DGS curve height remains same.

DGS
OFF
START a
30.0mm
DGS-REF
OFF
TL-CORR
00.0dB
GAIN 1
25.0 dB

DGS Selection Menu : When DGS is turned to “SELECT”, the DGS selection menu will be displayed on Screen. Use MENU INC/DEC keys & UP/D Keys to navigate inside the DGS SELECT MENU.

Selected setting in the DGS SELECT MENU will be Highlighted.

DGS	SCAL NO	D EFFT	EXIT
SELECT	002	23.1 MM	
STRT a	PROBE	DGS-CRV	ATT-REF
30.0mm	M2SN	11.0 MM	00.0 dB
DGS-REF	FREQ	REFECHO	ATT-OBJ
OFF	2.00MHZ	FBH	00.0 dB
TL-CORR	DEL-VEL	REFSIZE	AMPCOR
00.0 dB	2500M/S	11.0 MM	00.0 dB
GAIN 1			
25.0 dB			

SCAL NO : Scrolls from 0 to 18. Select “0” for a custom probe which is not listed. For custom probe select appropriate probe frequency and probe effective dia.

PROBE : Displays model name of predefined probe.

PRBFREQ : Displays probe frequency of predefined probe. For custom probe select appropriate probe frequency.

DEL-VEL : Displays the ultrasonic velocity of probe delay line. It is fixed for predefined probes.

D-EFFT : Displays effective diameter of probe crystals. It is fixed for predefined probe. Select appropriate value for Custom probe.

DGS-CRV : Select appropriate value for which diameter DGS curve is required.

REF-ECHO : Select reference type FBH, BW, or SDH.

REF SIZE : Select appropriate value as per reference reflector size.

ATT-REF : Select Ultrasound Attenuation factor of reference object. (dB/meter).

ATT-OBJ : Select Ultrasound Attenuation factor of test object. (dB/meter).

AMPLCOR : Gain correction. Use with angle probe where reference echo is taken from 100 mm or 25 mm arc of V1/V2 reference block.

Example: To plot DGS for 11 mm size equivalent reflector for M2SN probe.

- Switch GATE a to PLOGIC. (NLOGIC will also work)
- Select DGS in menu 11 under EVALMOD. It will not turn to DGS if DAC is ON.
- Go to DGS menu 6.
- Couple probe on 25mm thick V1 block and calibrate for required range.
- Bring first echo within screen with height between 40 to 80 % FSH preferable.
- Set first back-wall echo signal within GATE a using START a.
- Change DGS to “SELECT” by pressing LEFT/RIGHT keys.
- Navigate to SCAL NO & Select SCAL NO to 2 by pressing corresponding UP/DN keys.
- Navigate to DGS-CRV and Select DGS-CRV to 11.0 mm by pressing corresponding UP/DN keys.
- Select REFECHO to BW by pressing corresponding UP/DN keys.
- ATT-REF and ATT-OBJ to be set as per appropriate value. Here it is set to 0.
- Navigate to EXIT and Press LEFT/RIGHT keys.
- Select DGS-REF to ON, reference echo height is registered and brought to reference curve. (make sure reference echo is within GATE 1 with 40 to 80% FSH preferable).
- Now navigate to DGS REF REC and Press LEFT/RIGHT key so it turns to ON and appropriate DGS curve will be displayed.

Menu 6 – Damping, Crystal Type, PRF

DAMPING: Probe Damping HIGH/LOW can be selected using LEFT/RIGHT keys in DAMPING.

MODE: Test Mode for the use of SINGLE or DUAL Crystal probes can be selected using LEFT/RIGHT keys in MODE.

PRF: Using LEFT/RIGHT keys PRF can be selected from High, Low and Medium. Low PRF value is useful when ghost echo pattern appears when testing materials with low attenuation.

DAMPING
LOW
MODE
SINGLE
PRF MOD
HIGH
GAIN 1
25.0 dB

Menu 7 – Thickness/Distance measurement functions.

REJECT: Rejection level can be set as per requirement. Set in terms of percentage of FSH. Activation of this function is indicated by R Symbol (14).

SMOOTH : Smoothness of the echo can be set to LOW, MEDIUM, HIGH OR OFF using LEFT/RIGHT keys.

VIDEO: Echo signals can be selected to appear as a line (ENVELOP) or solid (FILLED) using LEFT/RIGHT key in VIDEO. In ENVELOP mode, echo signals appear same as in Analog Ultrasonic Flaw Detector. In FILLED mode, echo signals look solid for better visibility.

SET REF: To set any A-scan pattern as a reference, acquire desired pattern on the screen, then adjust SET REF to ON. The reference pattern will persist for easy comparison. An A-scan pattern from memory can be recalled and set as a reference.

REJECT
00%
SMOOTH
OFF
VIDEO
ENVELOP
SET REF
OFF
GAIN 1
25.0 dB

Menu 8 - Thickness/Distance measurement functions continued.

UNIT: Unit of measurement, mm or inch.

COLOR: LCD Color combination can be selected using LEFT/RIGHT keys in COLOR.

BRIGHT: Brightness of LCD can be adjusted for better visibility using LEFT/RIGHT keys in BRIGHT. Set Low brightness when used for indoor application for the longer battery life.

DISPLAY: Enables rotation of the display for right or left-handed use.

UNIT
MM
COLOR
05
BRIGHT
50%
DISPLAY
RIGHT
GAIN 1
25.0 dB

Menu 9 – Shearwave Analysis Functions.

X-OFF: Set X-OFF value to the front face distance for a correct surface distance reading.

ANGLE: Corresponds to the angle of wedge being used. When measure is set to ON, appropriate Surface and Depth of defect is calculated and displayed on the screen.

THICK: Thickness value should be set as per the thickness of the test piece, enables calculation of depth/distance accounting for multiple skips.

TRIGGER: Select measurement point trigger by the echo pulse FLANK or PEAK.

X-OFF
0.00mm
ANGLE
0.0 DEG
THICK
100 mm
TRIGGER
FLANK
GAIN 1
25.0 dB

COLOR LEG

The color leg display makes it easy to interpret the location of a defect when an angle probe is used for the testing.

To display the Color Leg indication on the screen, follow the below steps:

- Go to Menu 8 and select “COLOR” meter.
- Decrement the COLOR value until “COLOR LEG” displays on the screen by pressing DN key.
- To toggle between COLOR LEG ON/OFF by pressing DN key along with

Example: To measure Beam path, Surface, and Depth distance when 45 deg. probe is used.

- Go to **GATE a** in MENU 2 and make Gate to PLOGIC/NLOGIC.
- Set Gate STARTa and Gate WIDTHa value in such a way so defect signal within the GATE.
- Set Gain or Threshold so height of the echo/defect beyond the GATEa.
- Go to measure menu and MENU11 set MEAPOS1 to “ON G A”.
- Set angle value to 45 DEG in MENU9. Using LEFT/RIGHT keys in angle.
- Set appropriate THICK value in MENU9 so it can account multiple skips for DEPTH distance calculations.
- Sound path, Depth, and Surface distance will be displayed on the bottom of the screen.

Menu 10 – HORN, Key Beep, Clock Settings.

HORN: The horn can be switched ON or OFF using LEFT/RIGHT keys. When HORN is switched ON, an audible alarm will sound when a gate is triggered.

BEEP: Audible beep on key press. Turn beep ON or OFF using LEFT/RIGHT keys.

CLOCK: Clock can be switched ON or OFF using LEFT/RIGHT keys. If CLOCK is set to ON then date and time will be displayed at bottom of A-Scan.

FL_NAME: It is the file name that is stored when MEM is selected to SD CARD or USB DSK.

HORN
OFF
BEEP
ON
CLOCK
OFF
FL_NAME
ARJ0001
GAIN 1
25.0 dB

Menu 11 – Evaluation modes for inspection, measurement settings from respective gates

EVALMOD: Selectable evaluation modes DAC, AWS or DGS. As per selection of evaluation mode settings in Menu 5, will turn to DAC, AWS or DGS.

MEAPOS1: Measured Position 1, Measured values (SP) Sound path (DP) Depth, (SD) Surface distance & (AMP) Amplitude from GATE a OR GATE b will displayed at the bottom of the screen.

MEAPOS2: Measured Position 2, Measured values (SP) Sound path (DP) Depth, (SD) Surface distance & (AMP) Amplitude from GATE a OR GATE b will displayed at the bottom of the screen.

EVALMOD
DAC
MEAPOS1
ON G A
MEAPOS2
ON G B
GAIN 1
25.0 dB

E2E Measurement

To display Echo 2 Echo measurement follow the below steps.

- Go to menu 11 and then select “MEAPSO2” to “ON G B” using LEFT/RIGHT key to display “E2E” measurement reading.

Menu 12 – UT DATA recording and evaluation feature.

FL_NAME: Filename of the Recorded UT Data which is stored in the SD CARD. If Data is stored and valid then asterisk (“*”) will be displayed next to FL_NAME.

ACTION: Functions RECORD, PLAY, ANALYSE, DETAIL, DELETE, CPY USB, CPY ALL can be selected using LEFT/RIGHT Keys. When DETAIL is selected it shows Note data of stored data.

RECORD: To start a new recording select **RECORD** in ACTION and then navigate to ENTER and press the RIGHT key, a new recording will start.

PLAY: Play a saved recording select **PLAY** in ACTION and then navigate ENTER and press RIGHT KEY, a selected recording will be played.

ANALYZE: To manually analyze a saved recording select **ANALYZE** in ACTION and then navigate to ENTER and press the RIGHT key, a selected recording will come on the screen, now navigate to SCROLL and scroll the yellow cursor to analyze the recorded file.

CPY USB: Copy selected (Displayed under FL_NAME heading) file to USB disk. Select CPY USB in ACTION and press RIGHT key in ENTER. Selected file will be copied in the USB Disk.

CPY ALL: To transfer all the recorded files to external USB disk select CPY ALL in ACTION and press RIGHT KEY in ENTER, all files will be copied in the USB Disk.

ENTER/START: By pressing RIGHT key, the function selected in the ACTION.

SCROLL : When ANALYZE is selected in Action, manual evaluation of the CB-SCAN and A-SCAN can be done on the machine screen by scrolling the cursor point.

(NOTE: Recorded files will be stored directly in the SD CARD, if SD CARD is not inserted it will display an error message “File Destination Not Found” and files will not be saved.)

FL_NAME
LAS0001
ACTION
RECORD
ENTER
START
SCROLL
00
GAIN 1
25.0 dB

Menu 13 – ENCODER Inputs and Outputs.

ENCODER: When Encoder is set to ON, Encoder value will be displayed.

CAL FAC: Calibration Factor value is needed to calibrate the encoder.

Encoder Calibration:

- Turn ENCODER to ON by holding CENTER key, current position value will set to "0".
- Move encoder for known distance, about 100 to 500 mm.
- Set displayed position value to actual travel distance value by adjusting "CAL FAC". Check again by moving encoder for known distance so it will display same value.

ENCODER
ON
CAL FAC
1000
BSCAN D
ON
GAIN 1
25.0 dB

Menu 14 – 2-POINT CALIBRATION.

Zero and velocity values can be automatically adjusted using the two-point calibration feature. This is useful for measuring materials with unknown ultrasound velocity.

A CAL
ECHO 1
START a
30.0mm
DIST 1
25.0mm
DIST 2
75.0mm
GAIN 1
25.0 dB

A CAL: AUTO CAL menu

ECHO 1: When this is selected, hold the ENTER and RIGHT keys to capture data for the first reference echo.

ECHO 2: When this is selected, hold the ENTER and RIGHT keys to capture data for the second reference echo.

STARTa: Set the start of GATEa to encompass desired reference echo.

DIST 1: Enter thickness of first reference standard.

DIST 2: Enter thickness of second reference standard.

Example: Probe is coupled on the V1 block on the 25mm thick side and user wants to calibrate equipment for 100mm and velocity is not adjusted to 5920.

- First set RANGE value to 100.0 MM in the first menu.
- Couple probe on V1 block on 25mm thick side and set the range such that at least 1st echo signal (of 25mm) and 3rd echo signal (of 75mm) display on the screen with about 30% or more height.
- Select “DIST1” and using RIGHT/LEFT key set the value to actual sound path value of the first echo signal. (set DIST1 value to 25mm)
- Select “DIST2” and using RIGHT/LEFT key set the value to actual sound path value of the second echo signal.(set DIST2 value to 75mm)
- Select “STARTa” and then using RIGHT/LEFT key move the GATE to encompass the first echo.
- Move to “A CAL ECHO1” using UP/DN key.
- Press CENTER key along with RIGHT key to register first echo signal.
- Select “STARTa” and then using LEFT/RIGHT key move the GATE to encompass the third echo.
- Move to “A CAL ECHO2” using UP/DN key.
- Press the CENTER key and the RIGHT key to register the second echo. Auto calibration complete.

5. Data Transfer

Save Data to SD Card or USB Drive:

- Switch to MENU 4, select USB DSK or SD CARD in MEM NO using LEFT/RIGHT keys and change ACTION to SAVE.
- Switch to MENU 10 and navigate to FL_NAME and choose a file by using LEFT/RIGHT keys.
- Switch to MENU 4 and navigate to NOTE ENTER, press the RIGHT key to save to memory
- To view or edit details in SD CARD or USB DSK, switch to MENU 4, select SD CARD or USB DSK in MEM NO, navigate to ACTION and select DETAIL, navigate to NOTE ENTER and press the LEFT key, a side text menu will appear
- Saved memory in SD CARD or USB DSK can be transfer to a PC.
- To copy all memories from AVENGER II to USB DSK or SD CARD switch to MENU 4, In MEM NO select the destination SD CARD or USB DSK
- Navigate to ACTION and select CPY ALL, then navigate to NOTE ENTER and PRESS RIGHT key all the files will be copied to the selected destination.

Transfer Data to PC:

Three options are provided for transferring or viewing internal memory in PC.

A) USING SD CARD.

- Insert a SD card into the **AVENGER II** to save data. Eject the SD card with saved data from **AVENGER II** and connect the SD card to the PC.

B) USING EXTERNAL USB DRIVES.

- Connect a USB DRIVE to **AVENGER II** using a OTG cable, and transfer or store data to the USB DSK.

C) USING USB DSK.

- Saved data can be transferred directly to a PC without ejecting the SD card from **AVENGER II** by connecting the **AVENGER II** to PC via USB cable.

(**NOTE:** Internally stored memory cannot be directly transferred or accessed in PC without inserting SD card or USB drives.)

6. System Settings

Time/Date set-up:

Hold the UP key and switch ON AVENGER II. After the time and date menu appears on the screen, release the UP key. Set current time and date by using the LEFT/RIGHT keys. Press MENU DEC key to store the current time and date. Press MENU INC key to exit without storing current time and date.

Factory Default Calibration set-up:

The last used calibration setup remains stored in the AVENGER II upon power off. When the device is turned on again, it will recall the last used settings. If the stored setup becomes corrupted, the factory default calibration setup will be recalled. To manually recall the factory default setup manually, hold the DN key and switch ON the AVENGER II. After the menu appears, release the DN key.

7. Power Supply

The AVENGER II is powered by a Lithium-Ion battery pack (MB-1), secured in place by two screws and connected to the AVENGER II via a one terminal contact point. Fully charged, the AVENGER II can operate continuously for over eight hours. The battery pack can be charged when inside AVENGER II by connecting the AC power adapter (AC-1) to the connector (Device Reference #18). An external battery charger (ABC-1) is provided for charging battery pack outside the AVENGER II.

Battery Charging

The battery charger ABC-1 supplied with AVENGER II is a special quick-charge device. The charging time is just 3 to 3 ½ hours. The ABC-1 battery charger is suitable for use with mains supply from 100 to 250 volts AC 60/50 Hz. The LED on the charger illuminates to indicate a charge in progress.

8. System Specifications

Test Range	2.5 mm to 10 meter (0.100 in to 400 in) (in steel). Fine mode adjustable in steps of 0.01/0.1 or 1mm (0.001/0.01/0.1 or 1 in).
Velocity	1000 m/sec to 15000 m/sec (40 in/millisecond to 600 in/millisecond). Fine mode adjustable in steps of 1 m/sec (0.1 in/ millisecond).
Delay	120 mm (30 inch) adjustable.
Gain	100dB calibrated gain adjustable in 0.1,0.5, 1, 2, 6, or 14 dB steps.
Rejection	0 to 125% FSH.
Rectification	Full-wave rectified with filtering.
Frequency	Broad Band amplifier 0.5 MHz to 15MHz.
Linearity Deviation	Vertical: +3 %, Horizontal + 0.5%.
Test Modes	Pulse echo and Transmit/Receive.
Damping	Damping high/low is selectable.
Connectors	LEMO (Size 00) 2 Nos.
Monitor	Dual gate adjustable in 1% of Screen width with Positive/Negative Logic, Gate Expand modes.
Gate Expand	Expands Range to width of the gate.
A-Scan memory	500 Trace Patterns can be stored (with Note/Detail), recalled, or transferred to PC via USB port. A scan trace patterns can be directly stored on SD card or USB disk. USB and SD card External USB disk and Micro SD card (up to 32GB) ports provided for data storage.
Calibration Set-up	50 different calibration set-ups can be Stored and Recalled.
Software	Interface software for transferring A-Scan from AVENGER II to PC is supplied.
Display	5 Inch color wide VGA LCD/TFT display (800*480 pixels, size 108*64mm) with higher resolution LCD for better signal representation and better visibility with different color sets.
Reference A-Scan	Reference A-Scan pattern of standard test object can saved and recalled in the background for easy comparison during testing.

Echo Dynamics	Echo dynamic pattern display.
DAC	Dynamic DAC curve can be digitally plotted (Smooth bolic curve) on screen with selectable offset curves from 0dB to 14dB in 0.5 dB selectable steps. DAC curve can be set as flaw monitor gate. Using minimum 2 to maximum 10 points.
DGS	Defect size evaluation using predefined probe settings and custom probe set-ups, ERS (Equivalent Reflector Size) can also be displayed on the screen.
AWS	Built in Software for Evaluation of defects in accordance with AWS Specification D1.1.
Built-In UT Data	Carries out 100 Hours of continuous /Dynamic A-Scan and
Recording	B-scan recording (in 8 GB SD Card) which can be replayed and analyzed in Machine as well as PC.
Color B-Scan	Real time Color coded Un-Encoded B-Scan along with A-Scan on the Screen which can be transferred to PC, Also analysis of A-Scan and B-Scan can be done in the machine as well as PC
Digital Readout	Thickness/Depth can be displayed in digital readout when using a normal probe and Sound path, Surface Distance and Depth are directly displayed when angle probe is in use.
Measurement Unit	Metric or Imperial unit of measurement is selectable.
Update Rate	50 Hz.
Power	Lithium-Ion Battery pack 7.2VDC, 4AH, gives 8 hours continuous operation from fully charged battery.
Charger	Input voltage 100 to 250 VAC. Charge status indicators provided.
Temperature	0 to 55° C.
Size	117 x 176 x 56 mm (HxWxD).
Weight	800 grams with Battery.

9. Warranty

NDT Systems, Inc. Standard Terms & Conditions including its Warranty Terms can be found at

<https://www.ndt.com/standard-terms-conditions>

APPENDIX I

Longitudinal Ultrasonic Velocity Table		
Material	Inches/us	mm/us
Acrylic Resin	0.105*	2.67**
Aluminum	0.249	6.32
Brass, Navel	0.174*	4.43*
Bronze, Phosphor	0.139*	3.53*
Cast Iron	0.181*	4.60*
Copper	0.183*	4.66*
Glass, Window	0.267*	6.79*
Inconel	0.225*	5.72*
Iron	0.232	5.9
Magnesium	0.248	6.31
Monel	0.237	6.02
Nickel	0.222	5.63
Steel, Mild	0.232	5.9
Steel, 4340	0.23	5.85
Steel, 303 CRES	0.233	5.66
Titanium	0.239	6.07
Zirconium	0.183	4.65