Krautkramer USN 60

Operating Manual

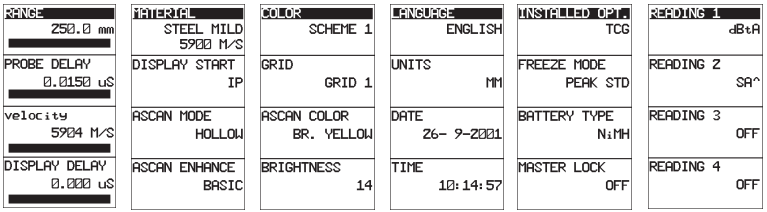
GEInspectionTechnologies.com

USN 60

Technical Handbook and Operating Manual

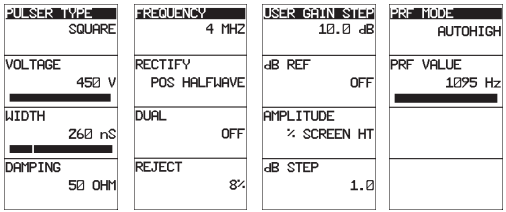
Id. No. 28 691
021-002-178 Rev AF

Submenu BASIC



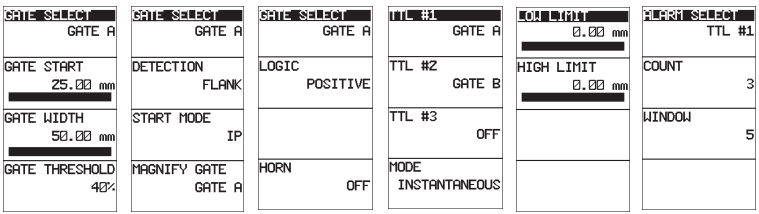
RANGE | CONFIG | DISPLAY | REGIONAL | OPTIONS | RESULTS

Submenu PLSRCVR



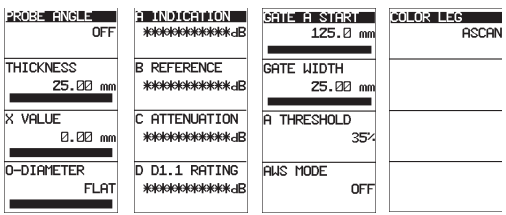
PULSER | RECEIVER | GAIN | PRF

Submenu GATES



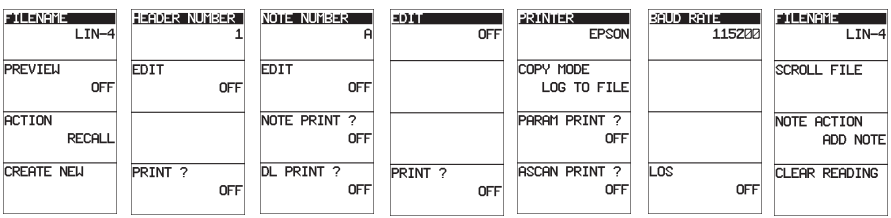
POSITION | GATEMODE | ALARMS | TTL OUT | LIMITS | NSE IMMN

Submenu TRIG



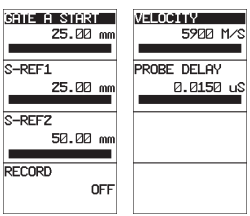
SETUP | AWS D1.1 | A POS. | COLORING

Submenu FILES



FILENAME | REP HEAD | NOTES | MEMO | PRINTER | SER COMM | DL DATA

Submenu AUTOCAL



SETUP | READING

Select function group: u Select function: v

Icons in the status field

Icon	Meaning
	A-scan frozen
	Reject active
	Dual mode
	Single-element mode
	Through-transmission
	Master lock active
	Test piece diameter > 0
	SMART VIEW active
	External pulser
	Gate magnify active

Key functions

Key	Function
o	Turns the instrument on or off.
w	Calls the test menu.
?	Calls context-sensitive help.
h	Calls the main menu.
f	Freezes the A-scan.
c	Transfers data, saves reading.
u	Selects a submenu or a function group.
v	Selects a function, changes function value.

Introduction 1

1.1 Safety information

The USN 60 is designed and tested according to EN 12668-1: 2010, “Non-destructive testing, characterization and verification of ultrasonic examination equipment – Part 1 – Instruments.” and was technically in perfectly safe and faultless condition when leaving the manufacturing works.

In order to maintain this condition and to ensure a safe operation, it is absolutely necessary that you read the following safety information before putting the instrument into operation.

⚠ **Attention:**

The USN 60 is an instrument for materials testing. Any use for medical applications or other purposes is not allowed!

The instrument may only be used in industrial environments.

Batteries

The USN 60 can be operated using alkaline batteries, NiMH, NiCad storage batteries, the Lithium-Ion storage battery LIA 60, or a power supply unit. For mobile operation, we recommend the use of Lithium-Ion storage battery that has a maximum capacity and therefore ensures a long operating time.

Standard storage batteries (NiMH or NiCad) must be charged in an external battery charger. You can charge the Lithium-Ion storage battery during operation directly on the USN 60 using the external power supply/charger unit UN 670.

As soon as you connect the power supply unit (plug-in power supply unit) to the USN 60, the power supply to the battery compartment is interrupted. Please read chapter 14 *Care and Maintenance* to learn mhow to use storage batteries.

Software

According to the current state of the art, software is never completely free from errors.

Before using any software-controlled test equipment, please make sure that the required functions operate perfectly in the intended combination.

If you have any questions about the use of your Krautkramer test equipment, please contact your nearest representative of GE Inspection Technologies.

Defects/errors and exceptional stresses

If you have reason to believe that a safe operation of your USN 60 is no longer possible, you have to disconnect the instrument and secure it against unintentional reconnection. Remove the batteries if necessary.

A safe operation is e.g. no longer possible

- if the instrument shows visible damages,
- if the instrument no longer operates perfectly,
- after prolonged storage under adverse conditions (e.g. exceptional temperatures and/or especially high air humidity, or corrosive environmental conditions),
- after being subjected to heavy stresses during transportation.

1.2 Important information on ultrasonic testing

Please read the following information before using your USN 60. It is important that you understand and observe this information to avoid any operator errors that might lead to false test results. This could result in personal injuries or damages to property.

Preconditions for testing with ultrasonic test equipment

This operating manual contains essential information on how to operate your test equipment. In addition, there are a number of factors which affect the test results. A description of these factors would go beyond the scope of an operating manual. The following list therefore only mentions the three most important conditions for a safe and reliable ultrasonic inspection:

- the operator training,
- the knowledge of special technical test requirements and limits,
- the choice of appropriate test equipment.

Operator training

The operation of an ultrasonic test device requires a proper training in ultrasonic test methods.

A proper training comprises for example adequate knowledge of:

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

Lack of such knowledge could lead to false test results with unforeseeable consequences. You can contact for example NDT societies or organizations in your country (DGZfP in Germany; ASNT in the USA), or also GE Inspection Technologies, for information concerning existing possibilities for the training of ultrasonic inspectors as well as on the qualifications and certificates that can finally be obtained.

Technical test requirements

Every ultrasonic test is subject to specific technical test requirements. The most important ones are:

- the definition of the scope of inspection,
- the choice of the appropriate test method,
- the consideration of material properties,
- the determination of limits for recording and evaluation.

It is the task of those with overall responsibility for testing to ensure that the inspector is fully informed about these requirements. The best basis for such information is experience with identical test objects. It is also essential that the relevant test specifications be clearly and completely understood by the inspector. GE Inspection Technologies regularly holds specialized training courses in the field of ultrasonic testing.

The scheduled dates for these courses will be given to you on request.

Limits of testing

The information obtained from ultrasonic tests only refers to those parts of the test object which are covered by the sound beam of the probe used.

Any conclusions from the tested parts to be applied to the untested parts of the test object should be made with extreme caution.

Such conclusions are generally only possible in cases where extensive experience and proven methods of statistical data acquisition are available.

The sound beam can be completely reflected from boundary surfaces within the test object so that flaws and reflection points lying deeper remain undetected. It is therefore important to make sure that all areas to be tested in the test object are covered by the sound beam.

Ultrasonic wall thickness measurement

All ultrasonic wall thickness measurements are based on a time-of-flight measurement. Accurate measurement results require a constant sound velocity in the test object. In test objects made of steel, even with varying alloying constituents, this condition is mostly fulfilled. The variation in sound velocity is so slight that it is only of importance for high-precision measurements. In other materials, e.g. nonferrous metals or plastics, the sound velocity variations may be even larger and thus affect the measuring accuracy.

Effect of the test object's material

If the test object's material is not homogeneous, the sound may propagate at different sound velocities in different parts of the test objects. An average sound velocity should then be taken into account for the range calibration. This is achieved by means of a reference block whose sound velocity corresponds to the average sound velocity of the test object.

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

Effect of temperature variations

The sound velocity within the test object also varies as a function of the material's temperature. This can cause appreciable errors in measurements if the instrument has been calibrated on a cold reference block and is then used on a warm or hot test object. Such measurement errors can be avoided either by warming the reference block to the same temperature before calibrating, or by using a correction factor obtained from tables.

Measurement of remaining wall thickness

The measurement of the remaining wall thickness on plant components, e.g. pipes, tanks and reaction vessels of all types which are corroded or eroded from the inside, requires a perfectly suitable gauge and special care in handling the probe.

The inspectors should always be informed about the corresponding nominal wall thicknesses and the likely amount of wall thickness losses.

Ultrasonic evaluation of flaws

In present-day test practice, there are basically two different methods of flaw evaluation:

If the diameter of the sound beam is smaller than the extent of the flaw, then the beam can be used to explore the boundaries of the flaw and thus determine its area.

If, however, the diameter of the sound beam is larger than the size of the flaw, the maximum echo response from the flaw must be compared with the maximum echo response from an artificial flaw provided for comparison purposes.

Flaw boundary method

The smaller the diameter of the probe's sound beam, the more accurately the boundaries (and therefore the flaw area) can be determined by the flaw boundary method. If, however, the sound beam is relatively broad, the flaw area determined can substantially differ from the actual flaw area. Care should therefore be taken to select a probe which will give a sufficiently narrow beam at the position of the flaw.

Echo display comparison method

The echo from a small, natural flaw is usually smaller than the echo from an artificial comparison flaw, e.g. circular disc flaw of the same size. This is due, for instance, to the roughness of the surface of a natural flaw, or to the fact that the beam does not impinge on it at right angles.

If this fact is not taken into account when evaluating natural flaws, there is a danger of underestimating their magnitude.

In the case of very jagged or fissured flaws, e.g. shrink holes in castings, it may be that the sound scattering occurring at the boundary surface of the flaw is so strong that no echo at all is produced. In such cases, a different evaluation method should be chosen, e.g. use of the backwall echo attenuation in the evaluation.

The distance sensitivity of the flaw echo plays an important part when testing large components. Attention should be paid here to choosing artificial comparison flaws which are as far as possible governed by the same “distance laws” as the natural flaws to be evaluated.

The ultrasonic wave is attenuated in any material. This sound attenuation is very low, e.g. in parts made of fine-grained steel, likewise in many small parts made of other materials. However, if the sound wave travels larger distances through the material, a high cumulative sound attenuation can result even with small attenuation coefficients. There is then a danger that echoes from natural flaws appear too small. For this reason, an estimate must always be made of the effects of attenuation on the evaluation result and taken into account if applicable.

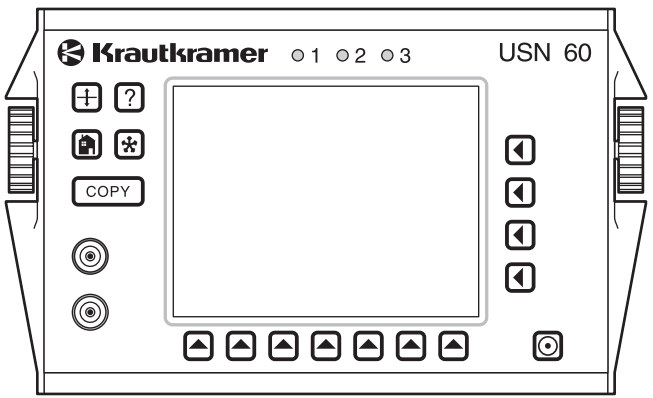
If the test object has a rough surface, part of the incident sound energy will be scattered at its surface and is not available for the test. The larger this initial scattering, the smaller the flaw echoes appear, and the more errors occur in the evaluation result.

It is therefore important to take the effect of the test object’s surfaces on the height of the echo into account (transfer correction).

1.3 The USN 60

The USN 60 is a compact ultrasonic flaw detector which is especially well suited for

- locating and evaluating material flaws,
- measuring wall thicknesses,
- storing and documenting all test results and readings.



Special features

Special features of the USN 60:

- high-resolution color LCD (640 × 480 pixels) with variable analog dynamic range,
- 4 color scheme options for the monitor display,
- simultaneous display of 4 selected readings,
- magnified display of one measured value for easy reading even from longer distances,
- two monitor gates with real-time-TTL outputs,
- mains power or battery operation,
- integrated alphanumerical Data Logger for data storage and convenient data management,
- RS232 interface for data transfer, A-scan displays and reports, or for remote control of the USN 60,
- storage of control data sets enabling quick calibration and reproducibility of the test,
- frequency ranges from 0.25 - 25 MHz,
- echo representation: RF signal, full-wave, positive and negative half-wave,

- optimized probe matching by means of 4 adjustable damping values between 50 and 500 ohms,
- automatic calibration of the sound velocity and probe delay according to data from 2 calibration echoes (with plausibility check),
- freely adjustable pulse repetition frequency to avoid phantom echoes,
- indication of amplitude and sound path for flaw testing and thickness measurement,
- analog outputs for external control purposes: proportional voltage for amplitude and sound path of the echo in the monitor gate,
- A-scan freeze mode, recording of peak amplitude, A-scan persistence in 3 steps,
- preview of all stored A-Scans and readings,
- locking function to avoid unintentional alteration of set values,
- context-sensitive help on all functions,
- an easy-to-clean keypad.

1.4 How to use this manual

Before operating the USN 60 for the first time, it is absolutely necessary that you read the chapters 1, 3 and 4 of this manual. They will inform you about the necessary preparations of the instrument, give you a description of all keys and screen displays, and explain the operating principle.

In doing this, you will avoid any errors or failures of the instrument and be able to use the full range of instrument functions.

You will find the latest changes to this operating manual in chapter 17 *Changes*. It describes corrections that have become necessary at short notice and have not yet been included in the general manual. If no corrections have become necessary, this chapter is empty.

To make it easier for you to use this manual, all operating steps, notes, etc., are always presented in the same way. This will help you find individual pieces of information quickly.

1.5 Layout and presentation in this manual

Attention and Note symbols

Attention:

The **Attention** symbol indicates peculiarities and special aspects in the operation which could affect the accuracy of the results.

Note:

Note contains e.g. references to other chapters or special recommendations for a function.

Listings

Listings are presented in the following form:

- Variant A
- Variant B
- …

Operating steps

Operating steps appear as shown in the following example:

– Select the function **VELOCITY**.

– If necessary, use the ◧ key to toggle between coarse and fine setting.

– …

Standard package and accessories 2

Standard package and accessories

This chapter informs you about the standard package and the accessories available for the USN 60.

It describes

- accessories included in the standard package,
- recommended accessories.

2.1 Standard package

Product code	Description	Order number
USN 60	Compact ultrasonic flaw detector, with VGA display	36 051
USN 60	Compact ultrasonic flaw detector, with VGA display and VGA output	36 052
	Each including:	
LIA 60	Lithium-ion battery pack, 12 Ah, in battery lid	102 443
UN 670	Power supply/charger unit (for mains operation and internal charging of the lithium ion battery pack)	102 444
UN 61	Protective screen foil (1 set = 10 pieces)	101 127
	Operating manual in German	28 689
	Operating manual in English	28 691
	USN 60 upgrade utility (CD-ROM with application for firmware upgrade download)	
	Manufacturer's certificate	

2.2 Recommended accessories

Product code	Description	Order number
UN 660	Plug-in power supply unit (only for mains operation)	101 128
LIA 60	Lithium-ion battery pack, 12 Ah, in battery lid	102 443
UN 670	Power supply/charger unit (for mains operation and internal charging of the lithium ion battery pack)	102 444
NIMH 3-6	6 NiMH cells, 8 Ah, for battery operation as alternative or in addition to Lithium-ion battery pack	101 126
UN 665	Battery charger for external charging of the NiMH cells in the charging frame	101 129
UN 685	Charging frame/battery lid for external charging of 6 NiCad or NiMH cells (during mains operation)	33 763
UN 61	Protective screen foil (1 set = 10 pieces)	101 127
UN 63	Carrying bag with integrated light shield	101 133
UN 64	Accessory bag for carrying bag	101 134
LCC 315	Robust lockable PVC transport case for instrument and accessories	100 625

Product code	Description	Order number
UNCO	Remote trigger for key COPY for measured-value storage	05 301
UN 65	Analog cable, 15-pin Sub-D (unit), open at one end	101 131
PRTCBL 842	Parallel printer cable	100 632
TGDL/PC	Data transmission cable for data transfer to the PC (GCH 1 or GCH 3 required)	13 647
MS-464	Synchronizing cable	35 643
GCH 3	Adapter (Gender Changer) to connect the TGDL/PC cable to a Seiko-DPU414 printer	34 797
SEIKO DPU 414	Thermal printer for mains and battery operation	17 993
GCH 1	Adapter (Gender Changer) to connect the TGDL/PC cable to a EPSON LX/FX printer	13 648
EPSON LX	Matrix printer for mains operation, single sheet and continuous stationary	17 995
UN 6 DAC	Extra DAC/TCG function with multi-curve representation	101 125
UN 6 DGS	Extra function DGS	101 851

Product code	Description	Order number
UN 6 IFG	Extra function IF-Gate	101 348
UN 6 BEA	Extra function Backwall Echo Attenuation	101 968
UN 6 RF	HF output (socket: Lemo 00)	101 350
	Adapter: Plug Lemo 00 (HF output), socket BNC to connect a BNC cable to the HF output	18 700
UN 60	UltraDOC 4, software for data exchange with PC	101 132
ULMATE	Standard evaluation and documentation software for series of thickness measurements	18 797
PZ-USN	Calibration certificate according to EN 12668-1	35 434
	Folder for probe data sheet	59 176

Initial start-up 3

3.1 Setting up the USN 60

Place the USN 60 on a flat and even base surface so that you can easily read the screen display.

If the instrument has been brought in from a cold room into a warmer room, wait until it has adapted to the room temperature before you turn it on (to avoid of condensation).

3.2 Power supply

The USN 60 can be operated using a plug-in power supply unit, or by means of batteries.

You can connect the USN 60 to mains supply even if it has batteries inserted into it. The battery power is then automatically interrupted.

Operation using plug-in power supply unit

You should exclusively use the plug-in power supply unit UN 660 recommended by us for the operation with plug-in power supply unit.

Mains adapter

The power supply unit included in the supply is equipped with two different plug adapters – for the European and for the U.S. standard. If the adapter plugged on your power supply unit does not correspond to your plug standard, you can exchange it.

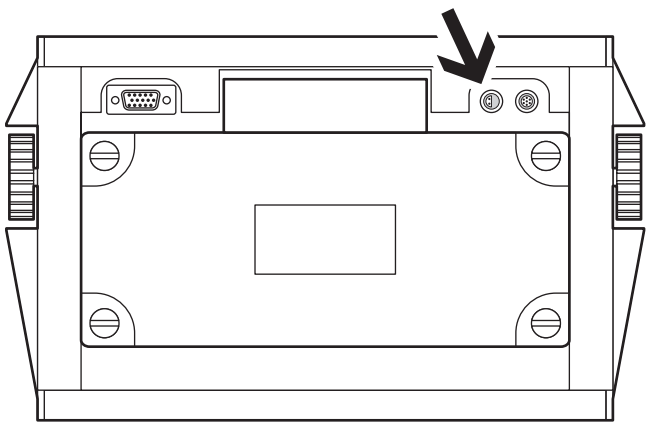
– To do this, simply pull off the plug-on adapter, and replace it with the required one.

☞ Note:

Exchange the plug adapter only once;
the plug-in power supply unit is not suitable for frequent changes.

Connecting

Connect the USN 60 with the power supply unit to the mains socket-outlet. The receptacle is at the top right on the unit's rear panel.



– Push the Lemo plug of the power supply unit into the receptacle until it locks home with a clearly audible click.

– When pulling the Lemo plug off, push back the metal sleeve on the plug at first in order to release the lock.

⚠ Attention:

In order to properly turn off the instrument, press the ⏻ key. If the power supply is interrupted (open battery lid, pull mains plug), the instrument is not properly turned off.

Operation using Lithium-Ion storage battery

A powerful Lithium-Ion storage battery is available for the USN 60 as an option (ref. chapter 22 *Recommended accessories*). The Lithium-Ion storage battery has a high capacity and therefore ensures a long operating time of the USN 60.

Installing the Lithium-Ion storage battery

The Lithium-Ion storage battery is delivered permanently installed in a battery lid. Before installing it, you may first have to remove any battery lid used previously.

– If necessary, unscrew the four screws of the battery compartment and remove the battery lid with the 6 D-cells.

– Place the battery lid including the Lithium-Ion storage battery on the battery compartment and retighten all four screws manually.

Note:

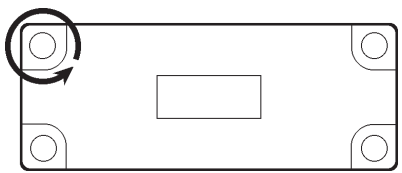
To charge the Lithium-Ion storage battery, you have to use the special power supply/charger unit UN 670.

Operation using batteries

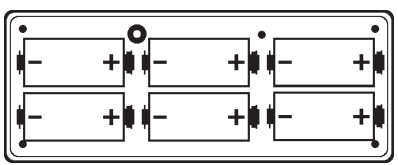
You can alternatively use either 6 NiMH storage batteries, NiCad storage batteries, or alkaline batteries MONO (D) for battery operation. In this case, we recommend the use of NiMH storage batteries having a higher capacity.

Inserting batteries

In order to insert new batteries, you must first loosen the four screws at the rear panel of the instrument and remove the lid of the battery compartment.



Every single battery in the battery lid is fixed to a separate holder.



– Loosen the four screws of the battery lid.

– Insert the batteries into the battery lid.

– Close the battery compartment.

☞ **Note:**

Check the correct polarity when inserting the batteries.

Selecting the battery type

In order to achieve the best possible mode of functioning of the USN 60 in battery operation, you have to select the battery type to be used. The USN 60 offers you the following options.

- **LITHIUM** – lithium-ion storage battery
- **NiMH** – metal hydrid storage batteries
- **NiCAD** – nickel-cadmium storage batteries
- **ALKALINE** – alkaline batteries

– Turn the instrument on. To do this, keep the ⊙ key pressed down until the LEDs are lit and an audible signal sounds.

– Use the ▲ key to go to the submenu **BASIC**.

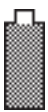
– Use the ▲ key to select the function group **OPTIONS**.

– Use the ◀ key to select the function **BATTERY TYPE**.

– Use the right-hand rotary knob to select the battery type to be used.

Low-battery indicator

Located in the top right-hand corner of the USN 60 display is a low-battery indicator showing you the current state of battery charge:



batteries charged

low battery voltage

☞ **Notes:**

The low-battery indicator only indicates the correct battery charge if you have selected the battery type to be used in the function **BATTERY TYPE** .

If the low-battery indicator indicates a low battery charge, you should exchange the batteries as soon as possible.

The USN 60 is turned off automatically if the operation is no longer ensured. In the case of prolonged field operations, we recommend you to carry a second set of charged batteries with you.

All settings remain saved during battery exchange, and they are immediately available again afterwards.

Used or defective batteries are special waste and must be disposed of according to the legal provisions. You should exclusively use the NiMH 3-6 products recommended by us for battery operation.

Charging of batteries

NiMH storage batteries

NiMH storage batteries can only be charged using an external battery charger. You need the charging frame UN 685 as well as the battery charger UN 665 for this purpose.

Lithium-Ion storage battery

To charge the Lithium-Ion storage battery, you need the special power supply/charger unit UN 670.

The standard package of the charger unit includes a brief operating manual describing the charging procedure. Please read this description before connecting the charger unit.

☞ **Note:**

You can charge the Lithium-Ion storage battery during normal operation. You don't have to remove the battery lid for this purpose but only connect the charger unit with the connection on the battery lid.

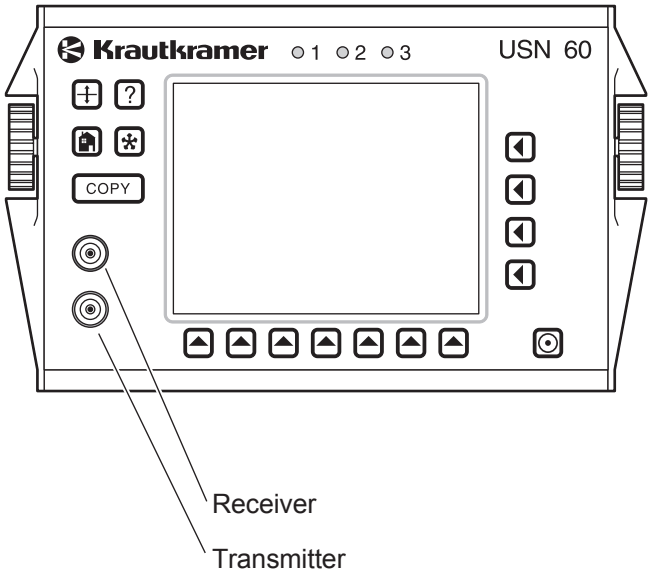
You can charge a separate Lithium-Ion storage battery by connecting it (or the battery lid) to the charger unit. The battery lid does not have to be installed on the USN 60 for this purpose.

3.3 Connecting a probe

In order to prepare the USN 60 for operation, you have to connect a probe.

The probe is connected to the sockets at the lower left on the housing. Both connecting sockets are equal (connected in parallel) for the connection of probes that have only one ultrasonic element (ultrasonic transducer) so that it does not matter which one of the two sockets is used.

When connecting a dual-element probe (having a pulser element and a receiver element) or two probes (of which one acts as pulser, and the other as receiver), it should be ensured that the pulser element (transducer) is connected to the lower socket (green ring), and the receiver element (transducer) to the upper socket (red ring).



⚠ Attention:

An incorrectly connected probe causes a mismatch which may lead to considerable power losses, or even to distorted echo waveforms.

3.4 Starting the USN 60

Turning on

To turn on the USN 60, press the ⊙ key, and keep it pressed down until the LED's are lit, and an audible signal sounds.

You will first see the start display of the USN 60 showing the current software version and other information. After a short waiting period, the normal screen display appears, and the instrument is now ready for operation.

The settings of all function values and the basic settings (language and units) are the same as they were before the instrument was turned off.

Cold start

If the functions can no longer be operated after the normal turn-on procedure, you should carry out a cold start by pressing the keys ⊙ and COPY simultaneously, and by keeping them pressed down until the start display appears.

The instrument is initialized, with any stored data and settings being maintained during this.

Reset

⚠ **Attention:**

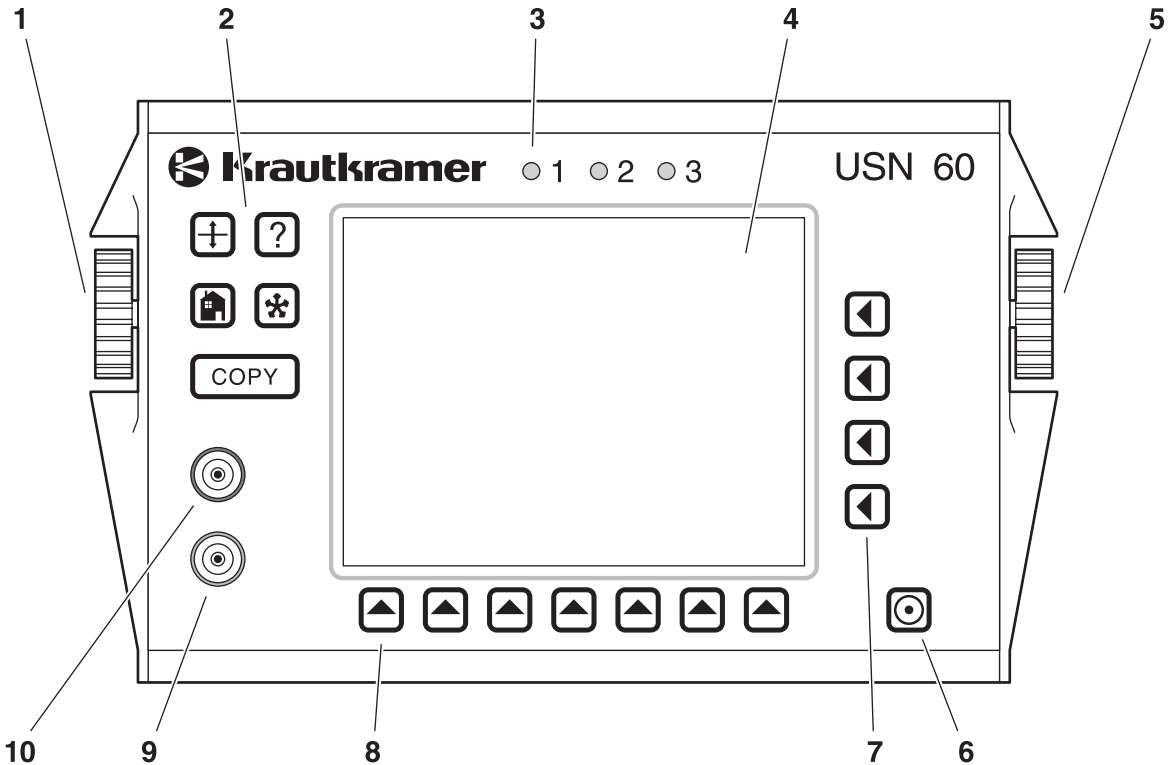
All stored data are deleted in the case of a reset.

If you would like to reset the instrument to its default settings, you can use the ⊞ and ⊙ keys to carry out a reset. Press the two keys simultaneously, and keep them pressed down until the start display appears.

The instrument is initialized and reset to its default settings (dialog language: English, please refer to chapter 4 to find out how to select the language).

Fundamental principles of operation 4

4.1 Control elements



1 Left-hand rotary knob
for direct gain setting

2 Special keys
for special instrument functions

3 LEDs
for alarm display

4 Display

5 Right-hand rotary knob
for setting the selected function

6 On/Off key

7 Select keys
for selecting a function, and for changing its setting

8 Select keys
for selecting menus and function groups

9 Pulser socket
for connecting pulser probes

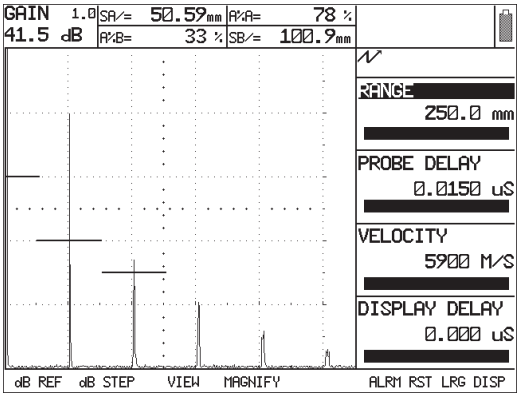
10 Receiver socket
for connecting receiver probes

4.2 Display

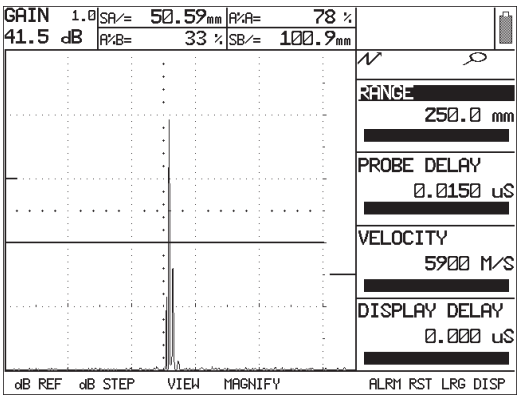
A-scan

The digital display of the USN 60 shows the A-scan in different ways according to the setting.

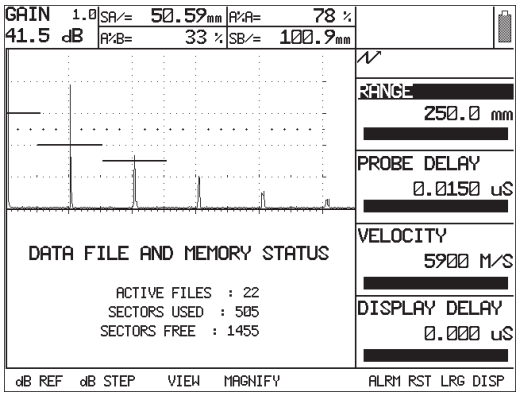
- A-scan in the (normal) hollow mode.



- Gate detail.
  The zooming is achieved by means of the **MAGNIFY** function in the test menu.



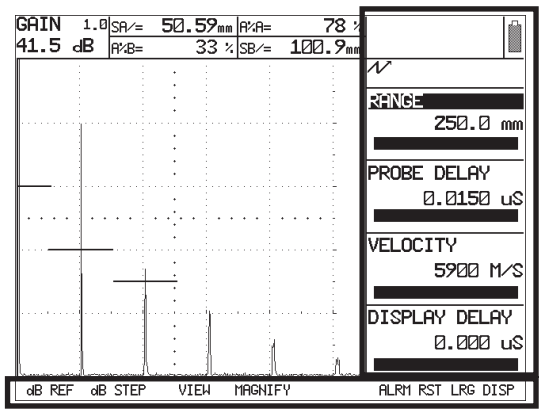
- A-scan in the reduced mode.
  This view is shown by means of the **VIEW** function in the test menu. Moreover, it is visible when using data sets or the Data Logger.



Functions on the display

The menu bar below the A-scan shows menus, function groups, or functions.

Next to the A-scan, on the right-hand side of the display, the functions of the selected function group are shown. The functions of the function group **RANGE** in the submenu **BASIC** can be seen there immediately after the USN 60 has been turned on.



Displays above the A-scan

Gain field

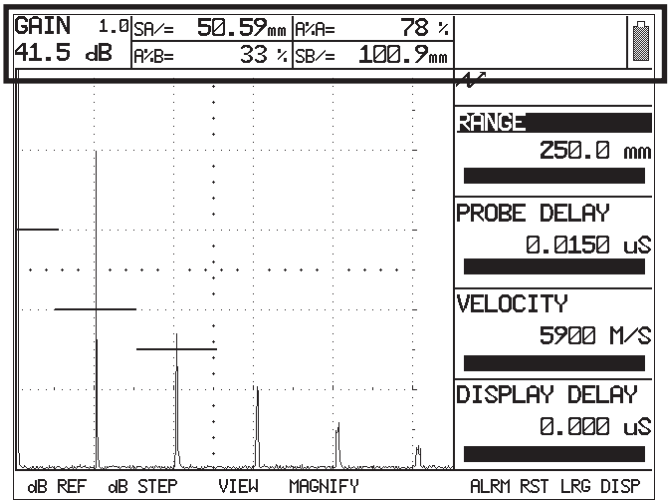
The current gain is displayed on the left above the A-scan. In addition, you can see the incrementation for gain variation in this field.

Display boxes for readings

Four small display boxes, and a large one, are available above the A-scan for the display of readings. The four small display boxes enable to display four different readings at the same time. One of these readings can be additionally displayed in the large display box. The contents of the display boxes depend on the settings of the functions **RESULTS** and **dB REF**.

Low-battery indicator

Located next to the large display box, on its right-hand side, is the low-battery indicator showing you the current state of battery charge.



Status field

This shows icons referring to certain settings, e. g. pulser-receiver separation.

The USN 60 has 12 icons for showing the current instrument status:

- A-scan frozen
- Reject active
- Dual mode
- Single-element mode
- Through-transmission
- Master lock active
- Diameter of test piece for curvature correction
- SMART VIEW active
- XT External triggering active
- Gate magnify active
- ^ Detection point peak
- / Detection point flank

4.3 Keys and rotary knobs

Function keys

For selecting submenus and function groups, or for operating functions.

For selecting and setting functions, and for toggling between coarse and fine setting.

On/Off key

For turning the USN 60 on or off.

Special keys

For direct activation of single instrument functions:

For calling the test menu and for varying the display scaling.

For calling the context-sensitive help.

For calling the main menu.

For freezing the A-scan.

COPY For transferring or saving data.

Rotary knobs

The USN 60 is equipped with two rotary knobs.

The left-hand rotary knob enables you to directly set the gain; the right-hand rotary knob serves for setting the currently selected function. Both rotary knobs are also needed when editing texts.

The two rotary knobs enable both step-by-step and accelerated settings. You can define a setting step by step by slightly operating the rotary knob which will snap into place at the next setting. To accelerate the setting, operate the rotary knob continuously, i. e. at a constant speed. This enables you to quickly bridge great differences between the settings.

4.4 Help function

The USN 60 keeps a help function available which you can activate by means of the [?] key. You can call the help on any active function group. The help gives you information on how to handle the functions of the active function group.

– Press the [?] key in order to call the help on the active function group.

– Press the [?] key another time in order to make the help disappear.

4.5 Operating concept

The USN 60 is an easy-to-use instrument. The functions of the USN 60 are arranged in two menu categories.

- The main menu offers you six submenus for an easy instrument configuration. The submenus contain several function groups, each consisting of four functions. You can use the main menu to define all settings required for the preparation of a test.
- The test menu offers you a quick access to six functions. All functions of the test menu can even be operated with a frozen A-scan.

Operating functions in the main menu

You will find all functions for the configuration of the USN 60 in the main menu. You can use the ⌂ key to call the main menu. The corresponding submenus are displayed in the menu bar.

In order to go to a submenu, press the corresponding ▲ key. The corresponding function groups are now displayed in the menu bar, with the first function group being highlighted. The corresponding functions may be seen to the right of the A-scan.

☞ **Note:**

You can easily recognize whether you're in the main menu or in a submenu. If you have selected a submenu, one of the function groups is always highlighted in the menu bar. If the main menu is selected, nothing is highlighted in the menu bar.

Go to the required function group by selecting it using the ▲ key. The selected function group is highlighted, and the corresponding functions are shown to the right of the A-scan.

To select the individual functions, use the corresponding ◧ keys. The selected function is now highlighted.

The USN 60 offers you two options for setting highlighted functions. Using the right-hand rotary knob, you can set any highlighted function. You can also set many functions by repeatedly pressing the corresponding ◧ key.

In the case of functions for setting numerical values, an additional bar having a vertical line is displayed below the value. The position of the line in the bar indicates the current setting relatively to the setting range available. You can exclusively set these functions using the right-hand rotary knob.

Coarse and fine setting of functions

Some functions allow you to choose between coarse and fine setting.

The fine setting is identified by the function spelling using small letters, the coarse setting accordingly by capital letters.

In order to toggle between coarse and fine setting, press the corresponding ◧ key several times.

A choice between coarse and fine setting is available for the following functions:

Function	Function group
RANGE	**RANGE**
GATE START	**POSITION, SETUP**
GATE WIDTH	**POSITION**
PROBE ANGLE	**SETUP**
THICKNESS	**SETUP**
VELOCITY	**RANGE, READING**

For setting options, please refer to chapter 5.

Operating functions in the test menu

You have a quick access to six functions in the test menu.

To call the test menu, press the ⊞ key once. The functions of the test menu are shown in the menu bar.

You can operate the functions pressing the corresponding ⏏ key. The function is immediately carried out.

Using the text editor

The USN 60 makes it possible to you to key in your own texts. The texts are displayed in a specific text box and can be edited using an Editor menu and the rotary knobs.

The Editor menu

The Editor menu is displayed in the menu bar for editing texts. The Editor menu consists of the following functions:

<CURSOR NEXT BCKSPC INS/OVR DELETE CLR FLDS CURSOR>

- **<CURSOR**
  Moves the cursor to the left by one position.
- **NEXT**
  Moves the cursor to the next line.
- **BCKSPC**
  Deletes the character to the left of the cursor position, and moves the remaining text to the left by one position.

- **INS/OVR**
  Toggles between insert and overwrite mode, with the selected mode being displayed in the top right-hand corner of the text box.
- **DELETE**
  Deletes the highlighted character.
- **CLR FLDS**
  Clears all fields.
- **CURSOR>**
  Moves the cursor to the right by one position.

You can operate the functions by pressing the corresponding ⏏ key. The function is immediately carried out.

The rotary knobs

Besides the Editor menu, you also need the two rotary knobs for editing texts.

Use the left-hand rotary knob to move the cursor to the left or right within a line.

Use the right-hand rotary knob to select the character that you want to insert at the cursor position.

Function fields

There are additional functions available to you in some function groups for the purpose of editing texts. For more details on this, please read the description of the corresponding function group in chapter 5.

Example: Editing file header

This example explains the procedure of editing texts. Proceed as follows in order to edit the file header:

– If necessary, go to the main menu.

– Go to the submenu **FILES**.

– Select the function group **REP HEAD**. The A-scan is displayed in reduced mode, and the text box for editing file headers is located below the A-scan. The text box contains 9 lines with one title and one data field each.

– Go to the function **EDIT** and use the right-hand rotary knob to choose the option **ON**. The number of the first header line is highlighted, and the cursor is at the first position in the corresponding data field. The display in the menu bar changes to the Editor menu.

– Use the right-hand rotary knob to choose a character to be inserted at the cursor position.

– Move the cursor to the right by one position using **CURSOR>**, or use the left-hand rotary knob to move the cursor.

– Use the right-hand rotary knob to choose a character to be inserted at the cursor position.

– Move the cursor to the right by one position using **CURSOR>**, or use the left-hand rotary knob to move the cursor.

– Use the right-hand rotary knob to choose a character to be inserted at the cursor position.

– Move the cursor to the left by one position using **<CURSOR**, or use the left-hand rotary knob to move the cursor.

– Use **DELETE** if you want to delete the character at the cursor position.

– Use **BCKSPC** if you want to delete the character located to the left of the cursor.

– If necessary, edit other characters in the same way.

– Use **NEXT** to go to the next field in the file header.

– If necessary, edit the field as described previously.

– If necessary, use **NEXT** to go to other fields in order to edit them.

– If necessary, use **INS/OVR** in order to toggle between insert and overwrite mode. The selected mode is displayed next to the designation **INFORMATION**.

– To end the edit process, set the function **EDIT** to **OFF**.

☞ **Note:**

You can also use an external keyboard connected to the RS232 interface to edit text fields (please see also chapter 15).

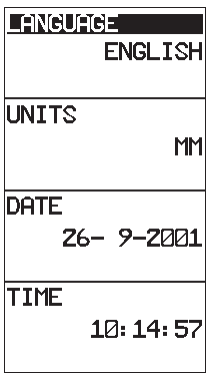
4.6 Important regional basic settings

Before using the USN 60, you must define a few regional basic settings. You can use the function group **REGIONAL** in the submenu **BASIC** to define language, date, time, and units of measurement.

– If necessary, go to the main menu.

– Select the submenu **BASIC**.

– Select the function group **REGIONAL**.



Selecting the language

The function **LANGUAGE** allows you to select the language in which the function names should appear on the display screen.

The following language options are available:

- English (default setting)
- German
- French
- Spanish
- Italian
- Portuguese
- Norwegian
- Danish
- Finnish
- Swedish
- Dutch
- Russian
- Czech
- Slovenian
- Romanian

– Select the function **LANGUAGE**.

– Use the right-hand rotary knob to select the required language.

Selecting the units of measurement

Use the function **UNITS** to choose the required units from mm, inch or µsec.

– Select the function **UNITS**.

– Use the right-hand rotary knob to select the required units.

Setting the date

You can use the function **DATE** to set the current date.

– Select the function **DATE**. The date is displayed in the format DD-MM-YYYY.

– Use ◧ to change between day, month, and year.

– Use the right-hand rotary knob to set the required date.

Setting the time

The function **TIME** serves for setting the current hour of time.

– Select the function **TIME**. The preset time is displayed in the 24-hour format.

– Use ◧ to toggle between hours and minutes.

– Use the right-hand rotary knob to set the required time.

⚠ **Attention:**

Remember to manually adjust the time changing between winter and summer time.

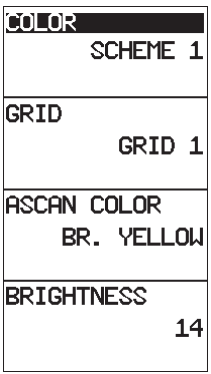
4.7 Basic settings of the display

The USN 60 is equipped with a high-resolution color display. You can optimize the display to your individual viewing habits. The USN 60 offers you four functions for this purpose by its function group **DISPLAY** in the submenu **BASIC**.

– If necessary, go to the main menu.

– Select the submenu **BASIC**.

– Select the function group **DISPLAY**.



Selecting the color scheme

You can choose one of four color schemes. The color scheme determines the color or all displays, the background, and the gates. You can separately set the color for the A-scan (please see next page).

☞ **Note:**

All color schemes are suitable for indoor use. We recommend the color schemes 3 and 4 for outdoor use.

– Select the function **COLOR**.

– Use the right-hand rotary knob to select the required color scheme.

Selecting the grid

The USN 60 offers you a choice between two grids:

- **OFF** – No grid
- **GRID1** – Five horizontal and vertical lines each
- **GRID2** – Ten horizontal and vertical lines each

– Select the function **GRID**.

– Use the right-hand rotary knob to select the required grid.

Selecting the A-scan color

You can separately select the color for the A-scan. When doing this, you have a choice between the following colors:

- **BLUE**
- **GREEN**
- **CYAN**
- **RED**
- **MAGENTA**
- **ORANGE**
- **WHITE**
- **BR. YELLOW**

– Select the function **ASCAN COLOR**.

– Use the right-hand rotary knob to select the required color.

Setting the brightness

You can set the brightness of the display from **0** ... **20**. The setting **0** corresponds to the lowest and **20** to the highest brightness in this connection.

☞ **Note:**

High brightness increases the power consumption and consequently reduces the operating time in battery operation.

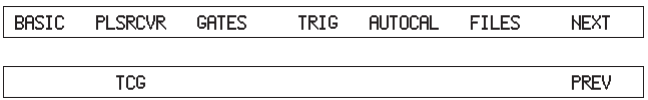
– Select the function **BRIGHTNESS**.

– Use the right-hand rotary knob to set the required brightness.

The main menu 5

5.1 Overview of the menu

You have several submenus for operating the USN 60 at your disposal in the main menu. Six submenus are visible. Other ones are displayed after selecting **NEXT**. You can go back by selecting **PREV**. Each submenu contains function groups with a maximum of four functions each.



– Press the [⌂] key to go to the main menu.

– Press a [▲] key to select the submenu appearing above it.

– Press a [▲] key to select the function group appearing above it.

– Press the [◀] key to select the function appearing next to it. After that, you can set the function.

5.2 The submenu BASIC

You can use the functions of this submenu to set the display range of the A-scan. Moreover, you can define the basic settings for the measurement here, e.g. sound velocity and calibration range.

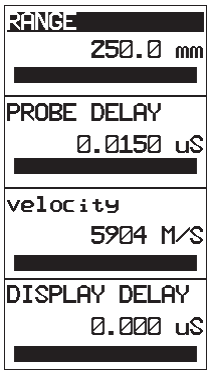
– If necessary, go to the main menu.

– Select the submenu **BASIC**.

The function group RANGE

You can use this function group to adjust the display range of the USN 60. You have to set the sound velocity and the calibration range according to the material and the dimensions of the test piece. The probe delay must likewise be set.

– Select the function group **RANGE**.



☞ **Note:**

In order to exactly set the sound velocity and the probe delay, read the section *7.3 Calibrating the USN 60* first.

RANGE

Set the display range to be shown on the display screen here.

- Coarse setting
  from 1 mm to 5000 mm in large steps
- Fine setting
  up to 99.99 mm in steps of 0.01 mm
  up to 999 mm in steps of 0.1 mm
  up to 5000 mm in steps of 1 mm

– Select the function **RANGE**.

– If necessary, use the ◧ key to toggle between coarse and fine setting.

– Use the right-hand rotary knob to set the required display range.

☞ **Note:**

The range limits also depend on the sound velocity setting: In the case of low sound velocities, the range limits move downward, in the case of high ones, they move upward.

PROBE DELAY

Every probe has a delay line between the transducer element and the coupling face. The ultrasonic pulse must therefore first pass through this delay line before it can enter the test piece. You can compensate for this influence of the delay line in the probe with the function **PROBE DELAY**.

– Select the function **PROBE DELAY**.

– Use the right-hand rotary knob to set the required probe delay.

☞ **Note:**

If the value for **PROBE DELAY** is not known, read the section *7.3 Calibrating the USN 60* first in order to determine this value.

VELOCITY

This is where you're free to set the sound velocity in the test piece. The USN 60 uses the sound velocity for calculating intervals and distances.

⚠ Attention:

The sound velocity must always be correctly set. Otherwise the USN 60 will calculate wrong intervals and distances.

☞ Note:

As an alternative, you can use the function **MATERIAL** to set a sound velocity stored in the instrument.

– Select the function **VELOCITY**.

– Press the ◧ key next to it another time in order to change to free setting. The function is now shown in small letters.

– Use the right-hand rotary knob to vary the sound velocity.

– If necessary, press the corresponding ◧ key to go back to a predefined sound velocity. A prompt to confirm appears.

– Confirm with ⌂. The predefined sound velocity is set again, and the function **VELOCITY** is shown in capital letters.

DISPLAY DELAY

This function enables you to move the display delay of the A-scan on the display screen, with the zero being maintained. This is useful if you only want to view a certain detail section of the test object.

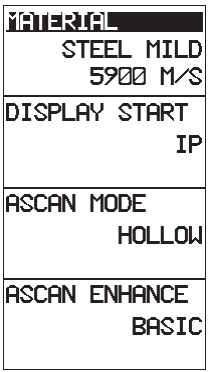
– Select the function **DISPLAY DELAY**.

– Use the right-hand rotary knob to move the A-scan to the left or to the right.

The function group CONFIG

This function group allows you to specify the sound velocity. In addition, you can use the functions of this group to adapt the A-scan display to the test requirements.

– Select the function group **CONFIG**.



MATERIAL

The USN 60 contains a stored list of frequently tested materials with the corresponding sound velocities. Select the material of your test piece from this list.

⚠ Attention:

If the function shows the setting **CUSTOM**, then the current setting is not part of the list. It is overwritten when you select a material.

The sound velocity must always be correctly set. Otherwise the USN 60 will calculate wrong intervals and distances.

☞ Note:

You can input an optional sound velocity by means of the function **VELOCITY**.

– Select the function **MATERIAL**.

– If necessary, confirm the overwriting of the current value by means of the ⌂ key.

– Use the right-hand rotary knob to select the required material.

DISPLAY START

In **DISPLAY START**, you can choose whether you want to display the set display range from the initial pulse (**IP**) or from the test piece surface (**IF**). In this way, you will move the complete A-scan with the display zero.

☞ **Note:**

This function is only available on instruments having an optional IF gate.

– Select the function **DISPLAY START**.

– Use the right-hand rotary knob to select the required display zero.

ASCAN MODE

The USN 60 offers you several options for the A-scan display. You can choose between four A-scan display modes:

- **HOLLOW**
  The A-scan only shows contour lines.
- **FILLED**
  The echoes are shown as filled areas.
- **SMART HOLLOW**
  As **HOLLOW** but only certain A-scans are taken into consideration.
- **SMART FILLED**
  As **FILLED** but only certain A-scans are taken into consideration.

☞ **Note:**

The USN 60 normally uses more cycles than can be represented using the specified A-scan update rate. The represented echoes are a random choice. If you choose the option **SMART HOLLOW** or **SMART FILLED**, the USN 60 filters the relevant echoes out of all echoes received, and displays them subsequently as an A-scan. The relevance of the echoes in this connection refers to the reading displayed in the large display box. For more details on this, please read section *7.5 Advanced functions*.

– Select the function **ASCAN MODE**.

– Use the right-hand rotary knob to select the required display mode.

ASCAN ENHANCE

This function allows you to set the display mode of the A-scan on the display screen. The setting options are as follows:

- **BASIC**
  A-scan in digital display mode.
- **SPARKLE**
  Display mode of the A-scan is related to an analog display, i.e. RF nodes and echo peaks are shown brighter.
- **BASELINE BREAK**
  In the rectified mode, the valley points of the half-waves are shown up to the baseline.
- **SPRKL+BSEBRK**
  Combination of **SPARKLE** and **BASELINE BREAK**.

– Select the function **ASCAN ENHANCE**.

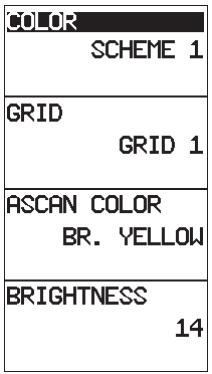
– Use the right-hand rotary knob to select the required option.

For more details on this function, please read section *7.5 Advanced functions*.

The function group DISPLAY

This function group allows you to set the screen display so that you can always easily read it. You can select the brightness, the color, and a grid if required.

– Select the function group **DISPLAY**.



COLOR

You can select one of four color schemes. The color scheme determines the color of all displays, of the background, and of the gates. You can separately set the color for the A-scan.

☞ **Note:**

All color schemes are suitable for indoor use. We recommend the color schemes 3 and 4 for outdoor use.

– Use ◧ to select the function **COLOR**.

– Use the right-hand rotary knob to select the required color scheme.

GRID

The USN 60 offers you a choice between two grids:

- **OFF** – No grid
- **GRID1** – Five horizontal and vertical lines each
- **GRID2** – Ten horizontal and vertical lines each

– Select the function **GRID**.

– Use the right-hand rotary knob to select the required grid.

ASCAN COLOR

You can separately select the color for the A-scan. When doing this, you have a choice between the following colors:

- **BLUE**
- **GREEN**
- **CYAN**
- **RED**
- **MAGENTA**
- **ORANGE**
- **WHITE**
- **BR.YELLOW**

– Select the function **ASCAN COLOR**.

– Use the right-hand rotary knob to select the required color.

BRIGHTNESS

You can set the brightness of the display screen from **0 ... 20**. In this connection, the setting **0** corresponds to minimum and **20** to maximum brightness.

☞ Note:

High degree of brightness increases the power consumption and consequently reduces the operating time in battery operation.

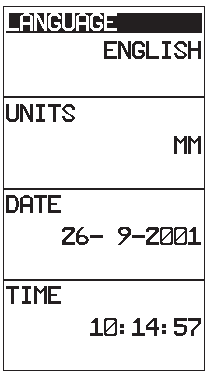
– Select the function **BRIGHTNESS**.

– Use the right-hand rotary knob to set the required brightness.

The function group REGIONAL

The functions of this group allow you to define the specific settings for each country.

– Select the function group **REGIONAL**.



LANGUAGE

Use the function **LANGUAGE** to select the language in which the function names appear on the display.

The following language options are available:

- English (default setting)
- German
- French
- Spanish
- Italian
- Portuguese
- Norwegian
- Danish
- Finnish
- Swedish
- Dutch
- Russian
- Czech
- Slovenian
- Romanian

– Select the function **LANGUAGE**.

– Use the right-hand rotary knob to select the required language.

UNITS

The function **UNITS** allows you to choose the required units from mm, inch, or µsec.

– Select the function **UNITS**.

– Use the right-hand rotary knob to select the required units.

DATE

You can set the current date in the function **DATE**.

– Select the function **DATE**. The date is shown in the format DD-MM-YYYY.

– Use ◧ to toggle between day, month, and year.

– Use the right-hand rotary knob to set the required date.

TIME

The function **TIME** serves for setting the current time.

– Select the function **TIME**. The preset hour of time is displayed in the 24-hour format.

– Use ◧ to toggle between hours and minutes.

– Use the right-hand rotary knob to set the required hour of time.

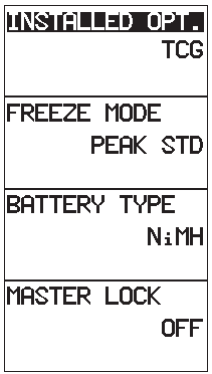
⚠ **Attention:**

Remember to manually adjust the hour of time when changing between winter and summer time.

The function group OPTIONS

The functions of this group serve for the display of installed special functions, for the setting of the ✱ key and for the locking of the instrument.

– Select the function group **OPTIONS**.



INSTALLED OPT.

The basic version of USN 60 can be retrofitted with versatile special functions (options). You can add these special functions to the basic version any time.

The function **INSTALLED OPT.** enables you to view the current range of functions of your USN 60.

☞ **Note:**

You can only use the function **INSTALLED OPT.** for viewing the range of functions of the USN 60 but not for changing it.

– Select the function **INSTALLED OPT.**

– Turn the right-hand rotary knob in order to scroll through the list of installed special functions.

FREEZE MODE

The USN 60 offers you various options for freezing the A-scan on the display. You can choose between four display options:

- **ALL**
  The current A-scan is frozen and displayed in the foreground.
- **PEAK STD**.
  The current A-scan is frozen and automatically overwritten with the following, higher A-scans.
- **COMPARE**
  The frozen A-scan is displayed in the background as a comparison scan while the current A-scan is at the same time visible in the foreground. To be better able to distinguish between the two A-scans, the comparison scan is shown in a weak color, and the current A-scan in a more intense color.
- **ENVELOPE**
  In addition to the current A-scan, the frozen A-scan is displayed as an envelope. Depending on the setting, the frozen A-scan is overwritten after a specified time, or in the case of certain events.

- **ENVELOPE .5S, 1S, 2S**
  The dynamic A-scan is automatically overwritten after the specified time (0.5s, 1s, or 2s).
- **ENVELOPE PEAK**
  The dynamic A-scan is automatically overwritten if higher echoes occur.

☞ **Note:**

If the option **ALL** is chosen, you can change some settings even with a frozen A-scan. The gain, the display range, and the gate position can be changed within certain limits. The changes are immediately taken into consideration when the reading is displayed.

– Select the function **FREEZE MODE**.

– Use the right-hand rotary knob to select the required display mode.

BATTERY TYPE

You can use different battery types to operate the USN 60. In order to obtain the best possible mode of functioning of the USN 60 in battery operation, you must set the battery type used. The USN 60 offers you the following setting options.

- **LITHIUM** – lithium-ion storage battery
- **NiMH** – metal-hybrid batteries
- **NiCAD** – nickel-cadmium batteries
- **ALKALINE** – alkaline batteries

⚠ **Attention:**

You should only use the batteries recommended in this manual to operate the USN 60. Make sure that the selected battery type is correctly set. The best possible mode of functioning of the USN 60 and the correct battery charge indication can only be ensured in this way.

– Select the function **BATTERY TYPE**.

– Use the right-hand rotary knob to select the required battery type.

MASTER LOCK

This function enables you to protect the current instrument settings against undesired changes. The function **MASTER LOCK** blocks all settings, except for the gain setting.

☞ **Note:**

If the function **MASTER LOCK** is activated, this is indicated with the icon in the status field.

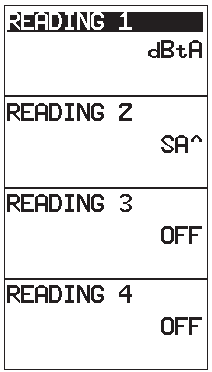
– Select the function **MASTER LOCK**.

– Use the right-hand rotary knob to selec the required option.

The function group RESULTS

The USN 60 offers you four display boxes for the display of readings. You can allocate a reading to each display box in the function group **RESULTS**.

– Select the function group **RESULTS**.



The USN 60 can display the following readings:

- **A%A**
  Amplitude in the A gate in % screen height
- **A%B**
  Amplitude in the B gate in % screen height
- **AdBt**
  dB-difference of amplitude in the A gate referred to the gate threshold (only if the function **AMPLITUDE** is set to **dB THRESHOLD**)
- **BdBt**
  dB-difference of amplitude in the B gate referred to the gate threshold (only if the function **AMPLITUDE** is set to **dB THRESHOLD**)
- **AdBR**
  dB difference of amplitude in the A gate referred to the reference echo (only if the function **AMPLITUDE** is set to **dB THRESHOLD** and the function **dB REF** is activated)
- **BdBR**
  dB difference of amplitude in the B gate referred to the reference echo (only if the function **AMPLITUDE** is set to **dB THRESHOLD** and the function **dB REF** is activated)

- **SA**
  Sound path of the echo in the A gate
- **SB**
  Sound path of the echo in the B gate
- **SAB**
  Sound path difference of the echoes in the gates A and B
- **DA**
  Reflector depth in the A gate
- **DB**
  Reflector depth in the B gate
- **PA**
  Projection distance of the echo in the A gate
- **PB**
  Projection distance of the echo in the B gate
- **RA**
  Reduced projection distance in the A gate
- **RB**
  Reduced projection distance in the B gate
- **LA**
  Number of legs in the A gate
- **LB**
  Number of legs in the B gate
- **OFF**
  No measured-value display

☞ **Note:**

If you select the readings of the categories S, D, P, or R, the corresponding detection point is indicated by an icon in the display box in question. **/** stands for flank detection, **^** means peak detection.

READING 1

This is where you can choose the measured value to be displayed in the small display box at the top left.

– Select the function **READING 1**.

– Use the right-hand rotary knob to select the required reading.

READING 2

This is where you can choose the measured value to be displayed in the small display box at the bottom left.

– Select the function **READING 2**.

– Use the right-hand rotary knob to select the required reading.

READING 3

This is where you can choose the measured value to be displayed in the small display box at the top right.

– Select the function **READING 3**.

– Use the right-hand rotary knob to select the required reading.

READING 4

This is where you can choose the measured value to be displayed in the small display box at the bottom right.

– Select the function **READING 4**.

– Use the right-hand rotary knob to select the required reading.

5.3 The submenu PLSRCVR

This submenu serves for setting pulser and receiver.

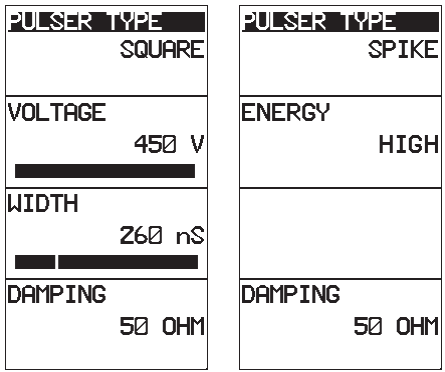
– If necessary, go to the main menu.

– Select the submenu **PLSRCVR**.

The function group PULSER

All functions for setting the pulser may be found in the function group **PULSER**.

– Select the function group **PULSER**.



PULSER TYPE

Pulser shape is generally selected based on penetration requirements and/or test standard specifications. Available types include square and spike.

– Select the function **PULSER TYPE**.

– Use the right-hand rotary knob to select between **SQUARE** and **SPIKE**.

☞ **Note:**

When a **SPIKE** type pulse is selected, the pulser **VOLTAGE** and **WIDTH** functions are disabled. When **SQUARE** type pulse is selected, the **EXTERNAL PRF MODE** setting is disabled.

VOLTAGE

You can use the function **VOLTAGE** to set the **SQUARE** pulser voltage. You can choose a value between 50 and 450 volts in steps of 10.

– Select the function **ENERGY**.

– Use the right-hand rotary knob to select the required pulser voltage.

WIDTH

You can use the function **WIDTH** to set the **SQUARE** pulser width. You can choose a value between 50 and 1000 nanoseconds (ns) in steps of 10.

A recommended starting point from which the width setting can be adjusted is found by the following equation:

Nominal width in nanoseconds
$= 10^9 : (2 \times \text{probe frequency in Hz})$

For example, if a 2.25 MHz probe is used, the equation becomes:

Nominal width in nanoseconds
$= 10^9 : (2 \times 2.25 \times 10^6) = 222$ nanoseconds

– Select the function **WIDTH**.

– Use the right-hand rotary knob to select the required pulser width.

☞ **Note:**

The pulser voltage and width settings may be automatically limited based on the user-selected **PRF VALUE** setting. This feature acts to limit signal dissipation.

ENERGY

You can use the function **ENERGY** to set the pulser voltage. You can choose between two settings:

- **HIGH** – high voltage
- **LOW** – low voltage

The **HIGH** setting is recommended for all tests requiring maximum sensitivity, e.g. for the detection of small flaws. Choose the **LOW** setting for broadband probes, or if narrow echoes are required (better lateral resolution).

– Select the function **ENERGY**.

– Use the right-hand rotary knob to select the required pulser voltage.

DAMPING

This function serves for matching the probe. You can use this function to set the damping of the probe oscillating circuit and to consequently vary the height, width, and resolution of the echo display.

You have a choice between the settings **50**, **75**, **150**, and **500** ohms. The setting **500** ohms has the lowest damping effect and results in higher and broader echoes, the setting **50** ohms reduces the echo height, however, it produces narrow echoes having a higher resolution.

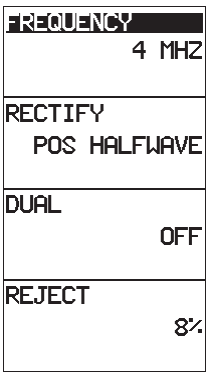
– Select the function **DAMPING**.

– Use the right-hand rotary knob to select the required damping.

The function group RECEIVER

All functions for setting the receiver may be found in the function group **RECEIVER**.

– Select the function group **RECEIVER**.



FREQUENCY

This is where you set the operating frequency. Please look up the corresponding frequency in the documentation of the probe. You can choose a fixed frequency or a frequency range.

The USN 60 offers a choice between the following frequencies:

- **1, 2, 2.25, 4, 10** or **15 MHZ**
- **0.25–2.25 MHz** – low range
- **10–25 MHz HP** – high range
- **2–25 MHz BB** – broadband

– Select the function **FREQUENCY**.

– Use the right-hand rotary knob to select the required frequency.

RECTIFY

The function **RECTIFY** enables you to choose the rectification mode of the echo pulses according to your application. You have the following options to choose from:

- **FULLWAVE**
  All half-waves are displayed above the baseline on the screen.
- **POS HALFWAVE**
  Only positive half-waves are displayed on the screen.
- **NEG HALFWAVE**
  Only negative half-waves are displayed on the screen.
- **RF**
  No rectification.

– Select the function **RECTIFY**.

– Use the right-hand rotary knob to select the required rectification mode.

DUAL

You can use this function to toggle between single-element and dual mode:

- **ON**
  Dual mode; the initial pulse is available at the lower socket, the upper socket is connected to the amplifier input.
- **OFF**
  Single-element mode; the probe connecting sockets are connected in parallel.
- **THROUGH**
  As **ON**, however, for through-transmission.

– Select the function **DUAL**.

– Use the right-hand rotary knob to select the required option.

☞ **Note:**

The status of **DUAL** function is indicated by an icon in the status field:

 **OFF**

 **ON**

 **THROUGH**

REJECT

You can use the function **REJECT** to suppress undesired echo indications, for example structural noise from the test piece.

The height in % indicates the minimum height that the echoes must reach in order to be displayed on the screen at all. The reject function cannot be set higher than the lowest gate threshold minus 1 %.

⚠ Attention:

Be cautious with this function since echoes from flaws may naturally likewise be suppressed. Many test specifications expressly prohibit the use of reject (suppression).

– Select the function **REJECT**.

– Use the right-hand rotary knob to set the required height in %.

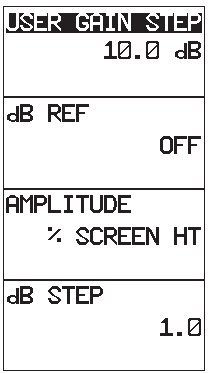
☞ Note:

The active function **REJECT** is indicated by the icon in the status field.

The function group GAIN

You can use this function group to set the gain for the reflector echoes. Moreover, you can determine whether the amplitude is shown in % screen height or as a difference with regard to a reference echo in dB.

– Select the function group **GAIN**.



USER GAIN STEP

The USN 60 enables you to vary the gain of the reflector echo. This variation is carried out step by step. You can use the function **USER GAIN STEP** to set an individual step size for the gain variation.

– Select the function **USER GAIN STEP**.

– Use the right-hand rotary knob to set the required step size.

dB REF

The function **dB REF** defines the current echo in the gate as reference echo. The amplitude of all other echoes in the gate is then indicated as dB difference with regard to the reference echo in the gain field.

– Select the function **dB REF** in order to store an echo as reference echo.

– Select the function **dB REF** in order to display the amplitude in % screen height again.

The activated function **dB REF** is displayed in the status field by the icon .

AMPLITUDE

The amplitude is typically displayed in % screen height. In this function, you can determine the display mode of the amplitude of the maximum echo in the gate. You have the following options to choose from:

- **% SCREEN HT**
  Percentage of screen height
- **dB THRESHOLD** (dB REF not active)
  dB difference with regard to the gate threshold
- **dB THRESHOLD** (dB REF active)
  dB difference with regard to the recorded reference echo amplitude

☞ **Note:**

Depending on the amplitude setting, the list of displayable readings in the function group **RESULTS** of the submenu **BASIC** varies.

– Select the function **AMPLITUDE**.

– Use the right-hand rotary knob to choose the required option.

dB STEP

Set the step size for the gain variation here. Six steps are available:

- **User-defined**
- **6.0 dB**
- **2.0 dB**
- **1.0 dB**
- **0.5 dB**
- **0.1 dB**
- **LOCK** (locked)

The current step size is indicated in the top right corner of the gain field.

☞ **Note:**

If the function is set to the option **LOCK**, you cannot vary the gain.

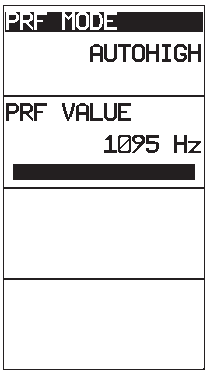
– Select the function **db STEP**.

– Use the right-hand rotary knob to set the required step size.

The function group PRF

The pulse repetition frequency (PRF) indicates the number of times an initial pulse is triggered. With this function group you determine the mode and the value of the pulse repetition frequency if necessary.

– Select the function group **PRF**.



PRF MODE

Make your choice whether the USN 60 should set the pulse repetition frequency automatically, whether you would like to set it manually, or whether you would like to use an external pulse generator. You have the following options to choose from:

- **AUTOLOW**
  The USN 60 automatically sets the PRF value to a low value (25 % of the maximum frequency).
- **AUTOHIGH**
  The USN 60 automatically sets a high PRF value (75 % of the maximum frequency).
- **MANUAL**
  You can set the PRF value manually from 15 ... 3715 Hz.
- **EXTERNAL**
  The USN 60 is externally triggered, e.g. for the setup of multichannel systems.

☞ **Note:**

If you select an automatic setting, the USN 60 takes the display range, the sound velocity, and the gate position settings into consideration when determining the variable PRF values.

– Select the function **PRF MODE**.

– Use the right-hand rotary knob to select the required mode for the PRF value.

☞ **Note:**

The option **EXTERNAL** is only available for the **SPIKE** pulser type.

If you have chose the option **EXTERNAL**, a corresponding icon is displayed in the status field.

PRF VALUE

If you have chosen the option **MANUAL** in the function **PRF MODE**, this is where you can set the pulse repetition frequency (PRF). Otherwise you can only read the pulse repetition frequency here but not vary it.

Make your choice whether you need a maximum PRF value, or whether you're satisfied with a lower value. The larger your workpiece the smaller PRF values are required in order to avoid phantom echoes. With smaller PRF values, however, the A-scan update rate becomes lower; high values are therefore required if a workpiece should be scanned quickly. The best way to determine the suitable PRF value is by experiment: Start from the highest level, and reduce the value until there are no more phantom echoes.

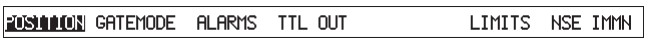
The setting is infinitely variable, the maximum possible PRF value setting depending on the test range setting. If you exceed the maximum PRF value, the USN 60 displays an error message.

– Select the function **PRF VALUE**.

– Use the right-hand rotary knob to set the required PRF value.

5.4 The submenu GATES

This submenu contains functions for setting the gate position and gate mode. In addition, this is where you will find functions for the configuration of gate logic and TTL outputs.



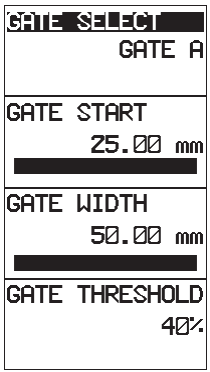
– If necessary, go to the main menu.

– Select the submenu **GATES**.

The function group POSITION

You will find all functions for the positioning of gates in the function group **POSITION**.

– Select the function group **POSITION**.



GATE SELECT

This is where you can select the gate whose position you want to set.

– Select the function **GATE SELECT**.

– Use the right-hand rotary knob to select the required gate.

GATE START

You can define the starting point of gate within the complete display range. When doing this, you can choose between coarse and fine setting.

– Select the function **GATE START**.

– If necessary, use the ◧ key to toggle between coarse and fine setting.

– Use the right-hand rotary knob to select the required gate start.

GATE WIDTH

You can define the width of the gate within the complete display range.

– Select the function **GATE WIDTH**.

– If necessary, use the ◧ key to toggle between coarse and fine setting.

– Use the right-hand rotary knob to set the required gate width.

GATE THRESHOLD

This is where you can set the gate threshold in % screen height. The gate threshold marks the tolerance range of the gate.

You can define the threshold value of the gate within the range of 5 ... 90 % screen height the violation of which triggers an alarm with a corresponding setting.

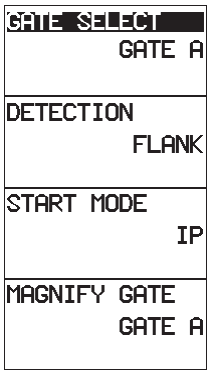
– Select the function **GATE THRESHOLD**.

– Use the right-hand rotary knob to set the required gate threshold.

The function group GATEMODE

You can define the basic settings of the gate in the function group **GATEMODE**.

– Select the function group **GATEMODE**.



GATE SELECT

Select the gate that you want to set.

– Select the function **GATE SELECT**.

– Use the right-hand rotary knob to select the required gate.

DETECTION

The sound path measurement depends on the choice of the measuring or detection point that you can set in the USN 60.

In principle, peak measurement should be preferred because the measured distances do not depend on the echo height in this case. However, there are application cases in which flank measurement is either specified or must be applied for technical reasons, e.g. in many tests using dual-element probes.

You have the following setting options:

- **PEAK** – peak detection
- **FLANK** – flank detection

⚠ **Attention:**

In any case, the setting of the detection point **must** always be identical for the calibration and for the subsequent test application. Otherwise measuring errors might occur.

– Select the function **DETECTION**.

– Use the right-hand rotary knob to choose the required option.

☞ Note:

The selected detection point is displayed as an icon next to the reading in the display box:

^ PEAK

/ FLANK

START MODE

This is where you can select a point as reference point for the gate position.

- **IP**
  The position of gate start is measured from the initial pulse.
- **IF**
  The position of gate start is measured from the interface echo (only with installed option IF Gate).

– Select the function **START MODE**.

– Use the right-hand rotary knob to choose the required option.

MAGNIFY GATE

When carrying out tests, you can zoom the display of the active A-scan range situated within the selected gate. In this connection, the magnification factor depends on the width of the corresponding gate The range is magnified until the gate width corresponds to the display width.

This is where you select the gate to be used for the zoomed A-scan display.

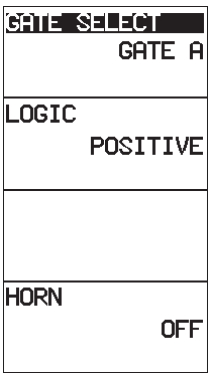
– Select the function **MAGNIFY GATE**.

– Use the right-hand rotary knob to select the required gate.

The function group ALARMS

You can set all alarm functions in the function group **ALARMS**.

– Select the function group **ALARMS**.



GATE SELECT

This is where you can select the gate that you want to set.

– Select the function **GATE SELECT**.

– Use the right-hand rotary knob to select the required gate.

LOGIC

In this function, you can define the criteria according to which the gate alarm should be triggered. The following settings are available:

- **OFF**
  Alarm option and measurement functions are switched off; the gate is no longer visible.
- **POSITIVE**
  The alarm is output if the gate is exceeded.
- **NEGATIVE**
  The alarm is output if the gate is not reached.
- **MEASURE**
  The corresponding alarm LED is not lit with alarm, and a possibly assigned switching output remains inactive.

⚠ Attention:

The gates only evaluate within the visible display range. This means that if there are gates or parts of gates outside the visible display range, no gate evaluation takes place there.

– Select the function **LOGIC**.

– Use the right-hand rotary knob to select the required option.

HORN

The USN 60 can output an alarm signal via a horn in the case of an alarm. This is where you switch the horn on or off.

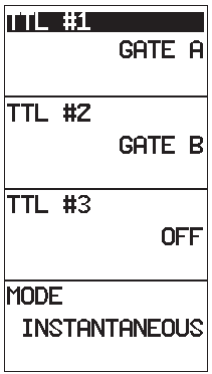
– Select the function **HORN**.

– Use the right-hand rotary knob to switch the horn on or off.

The function group TTL OUT

The USN 60 has a corresponding TTL output for each LED. The function group **TTL OUT** enables you to select the events triggering an alarm. In addition, you can set the functions of the alarm outputs there.

– Select the function group **TTL OUT**.



TTL#1, TTL#2, TTL#3

This is where you can assign an alarm event to the corresponding alarm output and to the pertinent LED. If the alarm event occurs, a signal is output via the alarm output, and the corresponding LED at the front panel of the instrument is lit.

The TTL outputs can indicate the following alarm events:

- **GATE A**
  Alarm in the A gate.
- **GATE B**
  Alarm in the B gate.
- **HIGH LIMIT**
  The measured material thickness is too large.
- **LOW LIMIT**
  The measured material thickness is too small.
- **OFF**
  The TTL output and the corresponding LED are deactivated.

☞ **Note:**

The corresponding LED is not lit in the case of an alarm if the option **MEASURE** is chosen for the function **LOGIC**.

– Select the alarm output and the LED to which you want to assign an event (**TTL#1**, **TTL#2** or **TTL#3**).

– Use the right-hand rotary knob to assign the required alarm event to the alarm output.

– If necessary, select the next alarm output and assign an alarm event to that output.

MODE

This is where you can define the duration of an alarm signal output in the case of an alarm.

The following settings are available:

- **LATCHED**
  The alarm signal is output until it's manually acknowledged.
- **TIMED 0.25 SEC**
  The alarm signal is output 0.25 seconds longer than the alarm period.

- **TIMED 0.5 SEC**
  The alarm signal is output 0.5 seconds longer than the alarm period.
- **TIMED 1.00 SEC**
  The alarm signal is output 1 second longer than the alarm period.
- **TIMED 2.00 SEC**
  The alarm signal is output 2 seconds longer than the alarm period.
- **INSTANTANEOUS**
  The alarm signal is output for as long as the alarm condition is given.

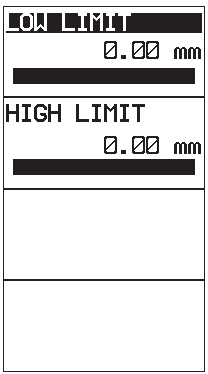
– Select the function **MODE**.

– Use the right-hand rotary knob to select the required alarm period.

The function group LIMITS

In this function group, you can define the minimum and maximum material thickness. If the measured value exceeds or falls below the specified material thickness, an alarm is triggered with a corresponding setting.

– Select the function group **LIMITS**.



LOW LIMIT

This is where you can define the minimum material thickness.

– Select the function **LOW LIMIT**.

– Use the right-hand rotary knob to define the required thickness.

HIGH LIMIT

This is where you can define the maximum material thickness.

– Select the function **HIGH LIMIT**.

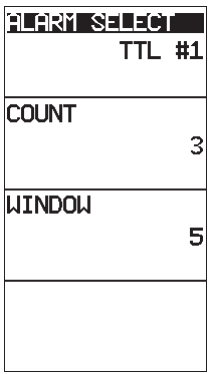
– Use the right-hand rotary knob to define the required thickness.

The function group NSE IMMN

You can use the functions of this group to define the noise suppression for the TTL switching outputs. You can do this by indicating the number of echoes that have to exceed a gate before the alarm is displayed. In this way, you will avoid any false alarms.

For more details on the function group **NSE IMMN**, please read chapter *7.5 Advanced functions*.

– Select the function group **NSE IMMN**.



ALARM SELECT

This is where you select the TTL output for which you want to set the noise suppression.

– Select the function **ALARM SELECT**.

– Use the right-hand rotary knob to select the required TTL output.

COUNT

This is where you can define the number of echoes that have to exceed the gate in order to trigger an alarm.

– Select the function **COUNT**.

– Use the right-hand rotary knob to select the required number.

WINDOW

This is where you can define the number of transmitter cycles in which the flaw echoes must occur before an alarm is output. The USN 60 can monitor 2 to 16 transmitter cycles.

– Select the function **WINDOW**.

– Use the right-hand rotary knob to set the required number.

5.5 The submenu TRIG

In the submenu **TRIG**, you will find all the functions for setting the flaw position calculation when using angle-beam probes. Moreover, you will find the functions for the rating of weld flaws according to AWS D1.1 and for the coloring of sound path sections here.

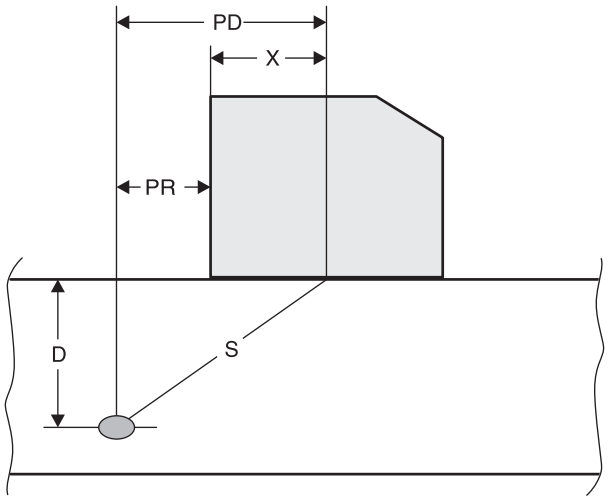
SETUP	AWS D1.1	A POS.	COLORING

– If necessary, go to the main menu.

– Select the submenu **TRIG**.

When using angle-beam probes, you can effect automatic calculation of flaw positions. The following values are displayed in the measured-value box:

- **Sound path S**
- **Projection distance P**
- **Reduced projection distance PR**
  Distance from the probe's front edge to the flaw position, projected onto the surface.
- **Depth position D**
  Distance between flaw position and surface.

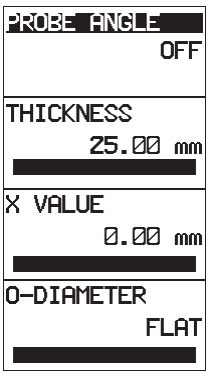


P Projection distance
PR reduced projection distance
X distance between probe edge and probe index
s actual sound path
d distance between flaw position and surface

The function group SETUP

These functions serve for adapting the USN 60 to the angle-beam probe used and to the test piece.

– Select the function group **SETUP**.



PROBE ANGLE

You have to adjust the angle of incidence of the probe used in order to activate the automatic flaw position calculation.

Adjustment range: 0° ... 90°

– Select the function **PROBE ANGLE**.

– Use the right-hand rotary knob to define the required setting.

THICKNESS

You can use this function **THICKNESS** to set the wall thickness of the material. This value is required for the automatic calculation of true depth.

Setting range: 0 ... 9999 mm

– Select the function **THICKNESS**.

– Use the right-hand rotary knob to set the required value.

X VALUE

In this function, you can set the distance between the probe index and the probe's front edge. You can determine this mechanically by means of a ruler. The setting of the X value is necessary if the instrument is meant to calculate the reduced projection distance.

Setting range: 0 ... 999 mm

– Select the function **X VALUE**.

– Use the right-hand rotary knob to set the required value.

O-DIAMETER

You need the function **O-DIAMETER** if you are working on circular curved surfaces, e.g. when testing longitudinally welded tubes. To make it possible for the USN 60 to compensate for the (reduced) projection distance and depth accordingly, you have to input the outside diameter of the workpiece here.

☞ Notes:

If you want to calculate the flaw positions of plane-parallel workpieces, the function **O-DIAMETER** must be set to **FLAT**.

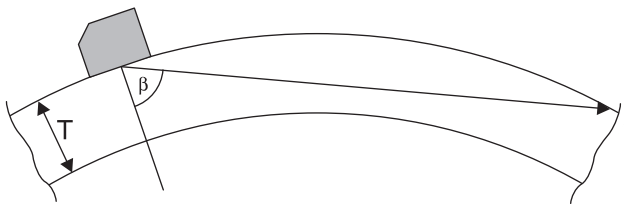
If **O-DIAMETER** is set to a different value from **FLAT**, this is indicated by an icon in the status field.

– Select the function **O-DIAMETER**.

– Use the right-hand rotary knob to set the required value.

☞ Note:

If the soundwave does not hit the inside surface of the workpiece for geometrical reasons, no values are displayed for **P**, **PR**, and **D**.



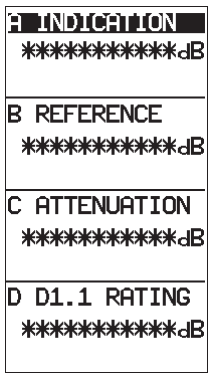
The function group AWS D1.1

The functions of this group are used for the rating of flaws in welds according to AWS D1.1.

Note:

You have to enable the AWS function in the function group **GATE A** using the function **AWS MODE** (please see the section below).

– Select the function group **AWS D1.1**.



A INDICATION

This function saves the current gain with which the flaw echo reaches 50 % screen height.

– Select the function **A INDICATION**.

– Press the corresponding key ◧ in order to save the current instrument gain.

B REFERENCE

This function saves the current gain with which the reference echo reaches 50 % screen height.

– Select the function **B REFERENCE**.

– Press the corresponding key ◧ in order to save the current instrument gain.

C ATTENUATION

This function indicates the sound attenuation factor. It is automatically calculated and displayed by the instrument.

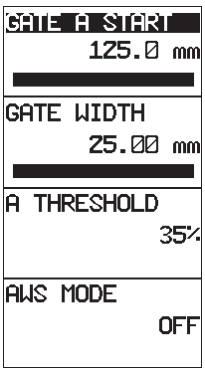
D D1.1 RATING

This is where the result of the evaluation according to AWS is displayed. The result is automatically calculated by the instrument.

The function group A POS.

This function group contains all positioning functions for the gate A in order to be able to use it for flaw evaluations.

– Select the function group **A POS**.



GATE A START

You can define the starting point of gate within the complete display range. When doing this, you can choose between coarse and fine setting.

– Select the function **GATE A START**.

– If necessary, use the ◧ key to toggle between coarse and fine setting.

– Use the right-hand rotary knob to select the required gate start.

GATE WIDTH

You can define the width of the gate within the complete display range.

– Select the function **GATE WIDTH**.

– If necessary, use the ◧ key to toggle between coarse and fine setting.

– Use the right-hand rotary knob to set the required gate width.

A THRESHOLD

This is where you can set the gate threshold in % screen height. The gate threshold marks the tolerance range of the gate.

You can define the threshold value of the gate within the range of 5 ... 90 % screen height the violation of which triggers an alarm with a corresponding setting.

– Select the function **A THRESHOLD**.

– Use the right-hand rotary knob to set the required gate threshold.

AWS MODE

You can use this function to enable or disable the classification of flaws in welds according to AWS D1.1.

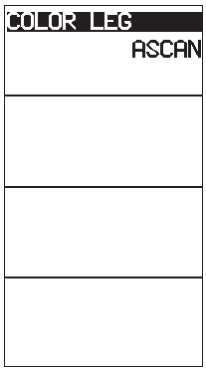
– Select the funktion **AWS MODE**.

– Use the right-hand rotary knob to switch the AWS function **ON** or **OFF**.

The function group COLORING

This function group contains all functions for a special color coding in the A-scan.

– Select the function group **COLORING**.



COLOR LEG

For better orientation, the USN 60 can indicate the different legs in different colors. In this connection, you can choose between the color coding of the A-scan and the color coding of the background grid.

The following options are available:

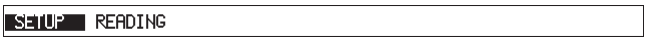
- **ASCAN**
  The A-scan is color coded
- **GRID**
  The background grid is color coded
- **OFF**
  The legs are not color coded.

– Select the function **COLOR LEG**.

– Use the right-hand rotary knob to choose the required option.

5.6 The submenu AUTOCAL

You always have to calibrate the USN 60 together with the connected probe. The submenu **AUTOCAL** offers you the possibility of an automatic calibration of the USN 60. The instrument calibrates itself automatically by means of two known echoes.



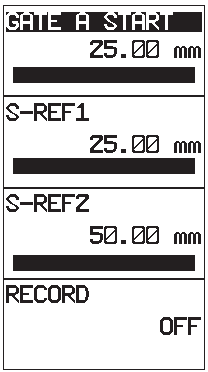
– If necessary, go to the main menu.

– Select the submenu **AUTOCAL**.

The function group SETUP

You can use the function group **SETUP** to configure the automatic calibration of the USN 60. You have to input the distance between two calibration echoes as a default value. The USN 60 will then carry out a validity check after recording the two calibration echoes, and automatically set the sound velocity and the probe delay.

– Select the function group **SETUP**.



GATE A START

This function serves for positioning the gate on the calibration echo.

– Select the function **GATE A START**.

– If necessary, use the ◧ key to toggle between coarse and fine setting.

– Use the right-hand rotary knob to position the gate.

S-REF1

Set the material thickness of the thinner calibration block here.

– Select the function **S-REF1**.

– Use the right-hand rotary knob to set the required value.

S-REF2

Set the material thickness of the thicker calibration block here.

– Select the function **S-REF2**.

– Use the right-hand rotary knob to set the required value.

RECORD

This function serves for recording the current calibration echo in the A gate.

– Select the function **RECORD**, the display will change from **OFF** to **S-REF1?**.

– Press the ◧ key next to **RECORD** in order to record the echo in the A gate as calibration echo. The display changes to **S-REF2?**.

– If necessary, generate the 2nd calibration echo.

– Move the gate to the 2nd calibration echo.

– Press the ◧ key next to **RECORD** again in order to record the 2nd calibration echo, **OFF** is displayed.

An automatic calibration is carried out after the USN 60 has calculated the input parameters and checked the validity.

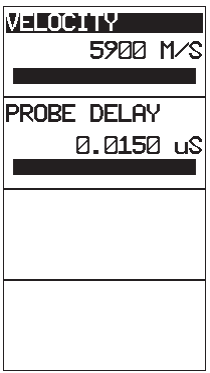
☞ Note:

Check the correct calibration by means of another echo, not used for the calibration but having a known sound path.

The function group READING

The functions of this group serve for checking the automatic calibration.

– Select the function group **READING**.



VELOCITY

Read the calculated sound velocity here.

PROBE DELAY

Read the probe delay here.

5.7 The submenu FILES

This submenu contains functions for file operations. Moreover, you can select a printer here, and configure the serial interface.

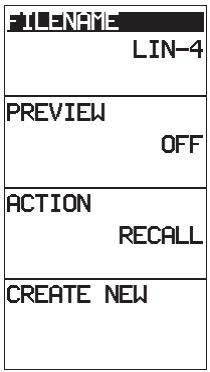
– If necessary, go to the main menu.

– Select the submenu **FILES**.

The function group FILENAME

This group contains functions for file operations. You can load, save, or delete existing files, and create new files.

– Select the function group **FILENAME**.



FILENAME

This is where you can select the files that you want to edit.

– Select the function **FILENAME**.

– Use the right-hand rotary knob to select the required file.

PREVIEW

You can use this function to activate the file preview. In the file preview, additional information, saved together with the file, is displayed on the screen.

☞ **Note:**

If the file preview is active, you have no access to other functions.

– Select the function **PREVIEW**.

– Use the right-hand rotary knob to choose the option **ON** in order to activate the preview.

ACTION

This function serves for loading, deleting, and editing saved files. This is where you can select an action that you would like to carry out with the file. You have a choice between the following options:

- **RECALL**
  For loading a saved file.
- **SAVE EDITS**
  For editing a file.
- **CLEAR**
  For deleting a saved file.

– Select the function **ACTION**.

– Use the right-hand rotary knob to select the required action.

– Press the corresponding ◧ key in order to carry out the action. A message in the menu bar prompts you to confirm the selected action.

– Press the ⌂ key in order to confirm the action.

☞ **Note:**

You have to confirm the selected action within five seconds. Otherwise the selection becomes invalid.

CREATE NEW

This function serves for creating new files. If you create a new file, you can choose between different file types:

- **LINEAR**
  The saved measured values are arranged in a row and consecutively numbered.
- **GRID**
  The saved measured values are arranged in tabular form. The columns and rows are identified either by numbers or by letters.
- **CUSTOM LINEAR**
  The saved measured values are arranged in a row and can be given alphanumerical names.

– Select the function **CREATE NEW**.

– Activate the function using the ◧ key next to it. The box for creating files appears.

– Select the required file type, and configure it.

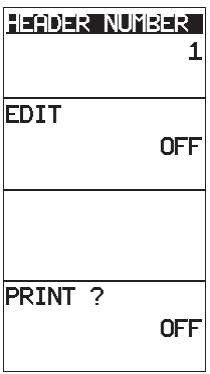
– Select the function **STORE** to save the new file.

For information about saving files, please read chapter 8.

The function group REP HEAD

The USN 60 offers you the possibility of saving a file header with header information on each file. The file header is displayed in the preview mode together with the A-scan and can optionally be printed out as a part of the test report. Unlike the user-editable text, a file header is structured and consists of individual fields in which additional information is entered by hand. You can create and manage the additional information by means of the functions in the group **REP HEAD**.

– Select the function group **REP HEAD**.



The A-scan is displayed in reduced mode, and a text box showing the file header appears below the A-scan. The file header consists of 9 header lines that you can edit.

HEADER NUMBER

This is where you can select the number of the header line that you would like to edit. You can choose between the numbers 1 ... 9.

– Select the function **HEADER NUMBER**.

– Use the right-hand rotary knob to select the required number.

EDIT

Set this function to **ON** in order to edit the selected header line.

– Select the function **EDIT**.

– Use the right-hand rotary knob to choose the required option.

PRINT ?

Set this function to **ON** in order to record the file header in the test report.

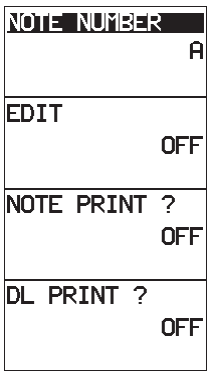
– Select the function **PRINT ?**.

– Use the right-hand rotary knob to choose the required option.

The function group NOTE

The USN 60 offers you the possibility of saving notes together with a file. To do this, you have to first create them in the function group **NOTE**. You can then recall the created notes during a test and save them together with the test data.

– Select the function group **NOTE**.



The A-scan is displayed in reduced mode, and a text box showing the notes appears below the A-scan. You can create a maximum of seven notes.

NOTE NUMBER

This is where you can select the note that you would like to edit. You can choose between the notes A ... G.

– Select the function **NOTE NUMBER**.

– Use the right-hand rotary knob to select the required note.

EDIT

Set this function to **ON** in order to edit the selected note.

– Select the function **EDIT**.

– Use the right-hand rotary knob to choose the required option.

NOTE PRINT ?

Set this function to **ON** in order to record the list with the notes in the test report.

– Select the function **NOTE PRINT ?**.

– Use the right-hand rotary knob to choose the required option.

DL PRINT ?

Set this function to **ON** in order to record the Data Logger file in the test report.

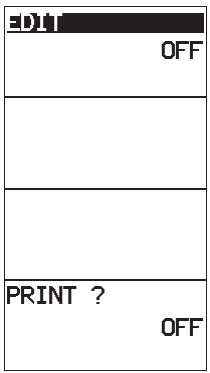
– Select the function **DL PRINT ?**.

– Use the right-hand rotary knob to choose the required option.

The function group MEMO

The function group MEMO offers other possibilities for an improved documentation of test data (files). You can key in a text for each file (max. 80 alphanumerical characters), and save it. Memo texts can be further edited even after saving.

– Select the function group **MEMO**.



The A-scan is displayed in reduced mode, and a text box appears below the A-scan where you can create a memo.

EDIT

Set this function to **ON** in order to create a memo.

– Select the function **EDIT**.

– Use the right-hand rotary knob to choose the required option.

PRINT ?

Set this function to **ON** in order to record the memo in the test report.

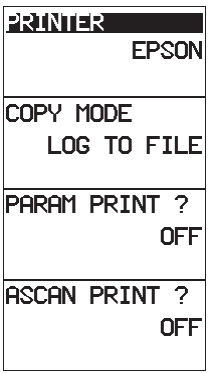
– Select the function **PRINT ?**.

– Use the right-hand rotary knob to choose the required option.

The function group PRINTER

The USN 60 has a print function that you can trigger by means of the COPY key. The print function serves for saving readings to files, and for the output of various data to external units, for example printers or computers.

– Select the function group **PRINTER**.



PRINTER

This is where you can choose the printer for printing out the data. You have a choice between the following printers:

- **EPSON**
- **HP LASERJET**
- **HP DESKJET**
- **SEIKO DPU-4XX**

– Select the function **PRINTER**.

– Choose the required printer.

COPY MODE

This is where you can set the function of the COPY key. The following setting options are available.

- **REPORT**
  A complete test report is output via the RS232 port.
- **PARADUMP**
  A list of all functions and settings is output via the RS232 port.
- **LOG TO FILE**
  The reading in the large display box is saved to the active file provided it represents a wall thickness value.
- **LOG TO PORT**
  The reading from the large display box is output via the RS232 port.

– Select the function **COPY MODE**.

– Choose the required option.

PARAM PRINT ?

Set this function to **ON** in order to record instrument settings in the test report.

– Select the function **PARAM PRINT ?**.

– Choose the required option.

ASCAN PRINT ?

Set this function to **ON** in order to record the A-scan in the test report.

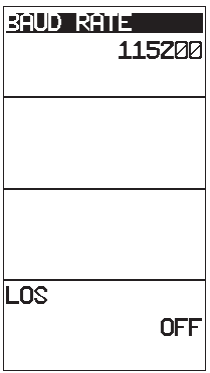
– Select the function **ASCAN PRINT ?**.

– Choose the required option.

The function group SER COMM

You can use this function group to configure the serial RS232 port.

– Go to the function group **SER COMM**.



BAUD RATE

This is where you can set the data transmission rate of the serial interface. The following settings are possible:

- **300**
- **600**
- **1200**
- **2400**
- **4800**
- **9600**
- **19200**
- **38400**
- **57600**
- **115200**

– Select the function **BAUD RATE**.

– Select the required data transmission rate.

Loss of Signal

This is where you can set the behavior of the analog output in case the USN 60 does not receive any currently active signal. Choose the option **ON** in order to set the level of the analog output to 0 with loss of signal. Choose **OFF** in order to maintain the level of the signal that was last measured with loss of signal.

– Select the function **LOS**.

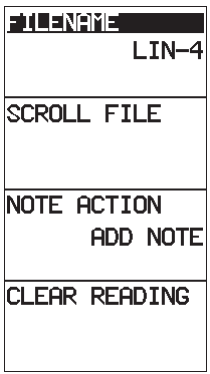
– Choose the required option.

The function group DL DATA

The functions of this group serve for recording readings and notes in Data Logger files.

– Go to the function group **DL DATA**, and the USN 60 will change to the Data Logger view. If no Data Logger file is active, this is indicated by an error message in the menu bar.

– If necessary, start by opening a Data Logger file, and call the function group **DL DATA** again.



FILENAME

This is where you select a previously created Data Logger file in order to edit it.

– Select the function **FILENAME**.

– Select the required file.

SCROLL FILE

You can use this function to select a measuring point of the Data Logger file in order to edit it.

– Select the function **SCROLL FILE**.

– Select the required measuring point.

NOTE ACTION

You need the function **NOTE ACTION** in order to save notes on the measuring point. It presents the following options:

- **ADD NOTE**
  For inserting a note on a measuring point.
- **DISPLAY NOTES**
  Displays the texts of all notes that are available.
- **DELETE NOTE**
  For deleting notes on a measuring point.

– Select the function **NOTE ACTION**.

– Select the required action.

CLEAR READING

This function serves for clearing a saved reading.

– Select the function **CLEAR READING**.

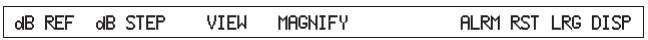
– Activate the function using the corresponding ◧ key.

– Use the ⌂ key to confirm the clearing of the reading.

The test menu 6

6.1 Overview

The test menu enables you to quickly access six functions that you can operate directly. When you call the test menu using the ⊞ key, the functions of the test menu are displayed in the menu bar. The functions of the last function group used from the main menu are visible in the function fields to the right of the A-scan.



– Press the ⊞ key once in order to go to the test menu.

– Press a ▲ key in order to carry out the function named above it.

6.2 The functions

db REF

You can choose whether the amplitude of an echo is indicated in % screen height or as a difference in dB with regard to a reference echo. You can use the function **dB REF** to define the current echo in the gate as reference echo. The amplitude of all other echoes of the gate is then indicated as dB difference with regard to the reference echo in the gain field.

– Select the function **dB REF** in order to store an echo as reference echo.

– Select the function **dB REF** again in order to display the amplitude in % screen height again.

dB STEP

You can set the gain by means of a certain step size that you can select by means of the function **dB STEP**. There are six steps available:

- **User-defined**
- **6.0 dB**
- **2.0 dB**
- **1.0 dB**
- **0.5 dB**
- **0.1 dB**
- **LOCK** (locked)

The current step size is indicated in the top right corner of the gain field.

☞ **Note:**

For information on how to set the user-defined step size, please read chapter 5.3.

☞ **Note:**

If the option **LOCK** is set, you cannot vary the gain.

– Press the ⏏ key below the function **dB STEP** repeatedly in order to select the required step size. The current choice is indicated in the top right corner of the gain field.

VIEW

The USN 60 enables you to change between different display views. Information about data memory allocation and Data Logger may also be displayed next to the A-scan.

– Press the ⏏ key below the function **VIEW** once in order to obtain information about the data memory allocation.

– Press the ⏏ key once again in order to go to the Data Logger view.

☞ **Note:**

For information on how to use the Data Logger, please read chapter 8.

MAGNIFY

This function serves for the zoomed representation of a selected gate. The range is expanded until the gate fills covers the complete display width.

If the function **MAGNIFY** is activated, a magnifier icon is displayed in the status field.

– Select the function **MAGNIFY** for the zoomed representation of a gate.

ALARM RST

You can acknowledge alarms by hand. The alarm signal is switched off and is available for indicating new alarms.

☞ **Note:**

You can acknowledge the alarm by hand only if the setting **LATCHED** is selected for the function **MODE**.

– Press the ⏏ key below the function **ALARM RST** in order to acknowledge the alarm.

LRG DISP

You can zoom the display of one of the four readings from the small display boxes in the large display box. The value in the large display box can then be recorded in the Data Logger, or be output to a peripheral unit.

– Press the ⏏ key below the function **LRG DISP** repeatedly until the required value is displayed in the large display box.

Operation 7

7.1 Setting the gain

You can amplify echoes in order to display them at the required height on the screen. To do this, you can use the left-hand rotary knob to set the required gain. The setting is carried out step by step according to the step selected in the function **db STEP**. The current gain is displayed in the top left-hand corner of the gain field.

☞ **Note:**

You cannot vary the gain of the echoes if you have chosen the option **LOCK** for the function **dB STEP**. The current choice for the function **dB STEP** may be seen at the top right of the gain field.

– Use the left-hand rotary knob to set the required gain.

7.2 Displaying the screen scale

If required, the A-scan can be provided with a scale. The scale is displayed in the X-axis of the A-scan and gives you in this way an overview of the echo positions. You have a choice between a dimensionless ten-division scale and a scale showing the actual position of the echoes. You can set the units of this scale by means of the function **UNITS** in the function group **REGIONAL** from the submenu **BASIC**.

– Press the ⊞ key twice in order to display the dimensionless scale.

– Press the ⊞ key a third time in order to display the scale with the selected units.

7.3 Calibrating the USN 60

Calibrating the display range

Before using the USN 60, the instrument has to be calibrated: The sound velocity and the calibration range have to be set and the probe delay taken into consideration depending on the material and dimensions of the test piece. In addition, the test sensitivity must be set according to the specified requirements.

⚠ Attention:

In order to be able to operate the USN 60 safely and effectively, adequate training in ultrasonic test technology is required.

The calibration ensures that

- the complete thickness of the test piece is displayed,
- the distance from the flaw or from the backwall of the test piece can be determined by means of the horizontal echo position or displayed digitally,
- all flaws are indicated that have to be detected according to the test specifications,
- a flaw evaluation can be carried out by way of comparison with known reflectors.

☞ Note:

Use a calibration block made of the same material and having the same temperature as your test piece for all calibration procedures.

The following examples show three main methods of ultrasonic testing:

- Scanning with a straight-beam probe,
- Vertical scanning with a dual-element probe,
- Inclined scanning with an angle-beam probe (transverse waves).

In all calibration procedures, you have to

- set pulser and receiver according to the test job and
- decide before calibrating on whether the measurement should be carried out in the flank or in the peak mode (function **DETECTION**).

As long as the echoes to be evaluated show a clear maximum amplitude, select the peak mode.

Basic setting

Before calibrating the USN 60, you have to define the following basic settings:

Function	Setting
PROBE DELAY	0.000 µs
DISPLAY DELAY	0.000 µs
MASTER LOCK	OFF
PRF MODE	AUTO LOW
DUAL	ON
REJECT	0 %
TCG MODE	OFF

Calibration with straight-beam probes

Sound velocity is known, no delay line

– Set the sound velocity on by means of the function **VELOCITY**, or use the function **MATERIAL** to select a corresponding test material.

– Position the A gate on one of the echoes.

– Set the function **PROBE DELAY** so that the correct value for **SA** is indicated in the display box.

Example:

Carry out the calibration for the calibration range of 100 mm on the calibration block K1 (thickness 25 mm) lying flatwise.

– Set the function **RANGE** to 100 mm.

– Use the function **VELOCITY** to set the known sound velocity (5920 m/s) .

– Position the gate on the first calibration echo from 25 mm.

– Set the function **PROBE DELAY** so that **SA = 25mm** is displayed in the display box.

The display range is now calibrated for the described task setting.

Sound velocity is unknown, no delay line

⚠ **Attention:**

Beware of node errors with flank setting!

– Set the gates so that the first echo in the A gate and the second echo in the B gate are evaluated.

– Set the four display boxes for readings so that you can read the sound path in the gates A and B, as well as the sound path difference between the gates A and B.

– Vary the sound velocity by means of the function **VELOCITY** until the displayed sound path difference corresponds to the actual thickness of the test piece. The gate parameters may possibly have to be readjusted.

– Increase the function **PROBE DELAY** until the correct sound path is displayed for the echo in the A gate.

Example:

Carry out the calibration on a 25 mm thick calibration block for a calibration range of 100 mm.

– Set the function **RANGE** to 100 mm.

– Set the function **DISPLAY DELAY** to 0.000 µs.

– If possible, use the function **VELOCITY** to set an approximative value for the sound velocity.

– Set the gate so that the first echo in the A gate and the second echo in the B gate are evaluated.

– Set the sound velocity by means of the function **VELOCITY** so that the sound path difference of **SA = 25mm** is displayed.

– Increase the function **PROBE DELAY** until the correct sound path for the echo is displayed in the A gate.

Straight-beam probe with fixed delay line

Calibration using straight-beam probes equipped with a larger delay line corresponds largely to the calibration for straight-beam probes having only the protection layer as delay line, as described above.

Other than the procedure described above, you have to define the following settings at first:

– Set the functions **DISPLAY DELAY** and **PROBE DELAY** to 0 µs.

– Set the function **PROBE DELAY** so that the first interface echo is at the scale zero.

– Set the function **RANGE** so that the first interface echo and at least also the first backwall echo appear before the second interface echo with known sound velocity, or that at least two backwall echoes appear before the second interface echo with unknown sound velocity.

– Continue in this case as in the case described previously.

Calibration with angle-beam probes

Sound velocity is known

In this case, it's only necessary to have the echo from a known reflector with a known distance available, e.g. the circular arc of the calibration block K1, K2.

– Set the sound velocity by means of the function **VELOCITY**, or use the function **MATERIAL** to select a corresponding test material.

– Position the A gate on the first echo.

– Set the function **PROBE DELAY** so that the correct value for **SA** is displayed in the display box.

Example:

Calibration of the100mm range for steel$_{trans}$ on the calibration block K2.

– Set the sound velocity (3255 m/s) by means of the function **VELOCITY**, or select **STEEL MILD S** in the function **MATERIAL**.

– Set the function **RANGE** to 100 mm.

– Set the functions **DISPLAY DELAY** and **PROBE DELAY** to 0 µs.

– Couple the probe, and peak the first echo from the 25mm radius of K2.

– Set the A gate on the first quadrant echo.

– Set the function **PROBE DELAY** so that **SA = 25mm** is displayed in the display box.

The display range is now calibrated. You can now enter the values for **PROBE ANGLE**, **THICKNESS** and **X VALUE** for the measurement.

Sound velocity is unknown

In this case, you need a calibration block made of the same material as the test piece for the calibration. A semi-cylinder is suitable for this.

Couple the probe to the plane of section of the semi-cylinder having the radius R, and peak the first echo from the semi-circle. This produces an echo sequence from the sound paths R, 3R, 5R, etc.

Use these echoes for the calibration just like the back-wall echoes from a plane-parallel calibration block in the vertical scanning described above.

Example:

Calibration on a semi-cylinder having the radius R = 50 mm to a test range of 200 mm.

– Set the function **RANGE** to 200 mm.

– Set the functions **DISPLAY DELAY** and **PROBE DELAY** to 0 µs.

– Couple the probe, and peak the echoes.

– Set the gate in such a way that the first quadrant echo (50 mm sound path) is evaluated in the A gate and the second quadrant echo (150 mm sound path) in the B gate.

– Set the sound velocity by means of the function **VELOCITY** so that **SAB = 100mm** is displayed in the display box.

– Position the A gate on an echo.

– Set the function **PROBE DELAY** so that **SA = 50mm** is displayed in the display box.

The calibration is now completed.

Calibration with dual-element probes

Dual-element probes are mainly used for wall thickness measurements. When using these probes, please observe the following special aspects:

Detection mode flank

Most dual-element probes have a roof angle (transducer elements orientated at an angle to the test surface). This produces mode conversions at the sound entry and at reflections from the backwall that may lead to very rugged and broad echoes. You should therefore always select **FLANK** as **DETECTION**.

In order to obtain a maximum rate of rise of the flank, which allows for an increased measuring accuracy, you can use the reject function if necessary. Please observe the notes on the functions **ENERGY**, **VOLTAGE** and **WIDTH** in this regard.

V-path error

There is a v-shaped sound path from the pulser via the reflection from the backwall to the receiving transducer element with dual-element probes. This V-path error affects the measuring accuracy. You should therefore select two wall thicknesses that cover the expected wall thickness measuring range for the calibration. This enables to largely compensate for the V-path error.

Higher sound velocity

Due to the V-path error, a higher sound velocity than that of the test material results especially when calibrating on small thicknesses. This is typical of dual-element probes and serves for the compensation of the V-path error.

Because of the effect described above, there is a drop in the echo amplitude with small wall thicknesses that has to be taken into account, especially in cases where thickness is < 2 mm .

A stepped block showing different wall thicknesses is required for the calibration. The wall thicknesses must be selected in such a way that they cover the measured values to be expected.

– Set the function **DUAL** to **ON**.

– Set the function **RANGE** according to the test job and the probe used.

– Set the function **DETECTION** to **FLANK**.

– Couple the probe to the thinner calibration block, and peak the echoes.

– Set the flank as steep as possible by varying the gain.

– Position the A gate on the first echo.

– Set the function **PROBE DELAY** so that the correct value is displayed for **SA** in the display box.

– Couple the probe to the thicker calibration block, and peak the echoes.

– Set the flank as steep as possible by varying the gain.

– Position the A gate on the first echo.

– Set the sound velocity by means of the function **VELOCITY** so that the correct value is displayed for **SA** in the display box.

– Repeat these two steps until the two calibration steps are correctly displayed.

Automatic calibration

With its submenu **AUTOCAL**, the USN 60 enables you to carry out an automatic two-step calibration. To do this, you have to record two calibration echoes from known calibration steps. After this, the USN 60 uses the two calibration echoes to determine the current probe delay and the sound velocity in the test material.

– If necessary, go to the main menu and then to the submenu **AUTOCAL**.

– Select the function group **SETUP**.

Setting the calibration steps

– Select the function **S-REF1**.

– Use the right-hand rotary knob to set the material thickness of the thinner calibration block.

– Go to the function **S-REF2**.

– Use the right-hand rotary knob to set the material thickness of the thicker calibration block.

Recording the calibration echo

– Couple the probe to a calibration block having a known material thickness.

– Select the function **GATE A START**, and position the A gate on the first echo.

– Go to the function **RECORD**, and choose the option **S-REF1?**.

– Press the ◧ key next to the function **RECORD** in order to record the calibration echo for the first calibration step. The option **S-REF2?** appears.

– Select the function **GATE A START**, and position the A gate on the second echo.

– Go to the function **RECORD**.

– Press the ◧ key next to the function **RECORD** in order to record the calibration echo for the second calibration step. **OFF** appears, which means that the calibration is completed.

Checking the calibration

– Select the function group **READING**.

– Read the determined sound velocity in the test material in the function **VELOCITY**.

– Read the determined probe delay in the function **PROBE DELAY**.

☞ Note:

Check the correct calibration by means of another echo, not used for the calibration but having a known sound path.

Preparing for the wall thickness measurement

The USN 60 must be calibrated for the material to be tested in order to produce correct readings.

☞ **Note:**

Use a calibration block having a known thickness, made of the same material, and having the same temperature as your test piece for all calibration procedures.

Start by calibrating the A-scan display as shown in the preceding section. Carry out the following basic settings:

- **LOGIC**: **POSITIVE**, **NEGATIVE** or **MEASURE**
- **DETECTION**: depending on the application.

Calibrating the sensitivity (dB REF)

The function **dB REF** is of great help for the sensitivity calibration. The function **dB REF** allows you to store a reference echo as a basis for your measurements and the amplitude evaluation. dB differences between the amplitudes of any chosen echo and the stored echo are directly digitally displayed as **AdBR** in the display box.

– Couple the probe and peak the reference echo.

– Vary the gain so that the echo reaches the required height.

– Position the A gate on the reference echo. It must be the highest echo in the gate.

– If necessary, go to the test menu, and press the ⏏ key below **dB REF**. This stores the reference echo. Press the key one more time in order to reset the value again.

Reading the dB difference

– Set the function **AMPLITUDE** to **dB THRESHOLD**.

– Position the gate on the required echo

The difference value is displayed in the display box. It indicates the amount of dB by which the flaw echo is inferior or superior to the reference echo.

7.4 Wall thickness measurement

The USN 60 enables you to measure wall thicknesses or distances in the easiest way. The measured value is directly displayed. Depending on the task setting, one of the two following methods of measurement is applied:

- Measurement up to the first echo, e.g. with corrosion mapping using a dual-element probe.
- Measurement of the multi-echo sequence using a single-element probe with good test surfaces on either side of the test piece.

Preparations

– Select the probe.

– Set the function **READING** to on.

– Use the function **DETECTION** to select the measurement mode.

– Calibrate the A-scan display.

– Calibrate the USN 60 for the selected probe and the measurement mode (please see preceding section).

Wall thickness measurement

– Clean the test piece surface from any dirt and loose parts.

– Apply couplant to the surface of the test piece.

– Place the probe on the surface applying uniform, slight pressure.

– Observe the A-scan display and the reading **SA**, and wait until the measured-value display is stable.

– Set the maximum echo amplitude.

– Read the measured value.

☞ **Note:**

You can save the displayed reading to Data Logger or transfer it to other units via the RS232 port.

7.5 Advanced functions

The USN 60 is equipped with a number of advanced functions. These functions enable the proficient inspector to use the USN 60 for demanding applications.

Noise suppression (NSE IMMN)

During automatic scanning of test pieces, gate alarms are often triggered by interference pulses or reflectors having an uncritical size. To avoid such false alarms, the USN 60 provides you with the noise suppression function.

With an active noise suppression, not every gate violation triggers an alarm. An alarm is only triggered if a certain number of gate violations occurs within a specified number of transmitter cycles. Other than real flaws, most interference pulses do not meet this requirement and do not therefore trigger any gate alarm.

You can define for yourself both the number of the necessary gate violations and the number of the transmitter cycles observed.

☞ **Note:**

The gate violations do not have to follow immediately after one another, they only have to take place within the transmitter cycles observed.

– If necessary, go to the main menu and, after that, to the submenu **GATES**.

– Select the function group **NSE IMMN**.

– Select the function **ALARM SELECT**.

– Use the right-hand rotary knob to select a TTL output in order to set its noise suppression.

– Select the function **WINDOW**.

– Use the right-hand rotary knob to set the total number of transmitter cylces observed. You can set the number of transmitter cycles from 2 to 16 cycles.

– Select the function **COUNT**.

– Use the right-hand rotary knob to set the number of gate violations.

Using Smart View

The USN 60 generates usually more A-scans than can be displayed on the unit. The choice of the displayed A-scans from the raw data is made at random in this connection. With an active function Smart View, the USN 60 analyzes the raw data and displays the A-scans showing the highest echo indications. In this regard, the relevance of the echoes refers to the reading displayed in the large display box.

– If necessary, go to the main menu and, after that, to the submenu **BASIC**.

– Select the function group **CONFIG**.

– Select the function **ASCAN MODE**.

– Use the right-hand rotary knob to select the required display mode.

Example:

The value **A%A** (amplitude in the A gate in % screen height) is displayed in the large display box, and an option **SMARTVIEW** is selected. The USN 60 will now filter the A-scan showing the highest amplitude in the A gate out of the raw data. This A-scan is displayed.

☞ **Note:**

If the value of an amplitude is displayed in the large display box, the USN 60 takes the highest amplitude into consideration for the option **SMARTVIEW**. If a wall thickness is displayed in the large display box, then the USN 60 takes the smallest wall thickness into consideration for the option **SMARTVIEW**.

Analog display mode

In spite of a digital screen display, the USN 60 offers you the possibility of utilizing well-proven advantages of the analog display. The function **ASCAN ENHANCE** enables you to select an echo display mode on the screen so that analog effects are simulated.

The option **SPARKLE** enables to represent intensity variations the way they occur with an analog display due to different speeds of the electron beam, e.g. at RF nodes or echo peaks, as well as on the baseline.

If the option **BASELINE BREAK** is chosen, the valleys between the half-waves of an echo are drawn up to the baseline.

– If necessary, go to the main menu and, after that, to the submenu **BASIC**.

– Select the function group **CONFIG**.

– Select the function **ASCAN ENHANC**E.

– Use the right-hand rotary knob to select the required display mode.

7.6 Rating of welds according to AWS D1.1

The rating of flaws in welds according to the AWS D1.1 specifications is based on an evaluation of the signal amplitude. In this process, the echo amplitude of the flaw echo is compared with the echo amplitude of a known reference reflector. In addition, the sound attenuation in the workpiece is also taken into consideration. The result is a dB value which is called flaw rating. The flaw rating D is calculated according to the formula:

D = A - B - C

with:

- **A = Indication (in dB)**
  Absolute instrument gain with which the maximum flaw echo is at 50 % (± 5 %) echo height.
- **B = Reference (in dB)**
  Absolute instrument gain with which the maximum reference echo (1.5 mm side-drilled hole from the reference block 1) is at 50 % (± 5 %) echo height.

- **C = Attenuation (in dB)**
  This value is calculated according to the formula C = 0.079 dB/mm (s – 25.4 mm). With s = sound path of the flaw echo.

  The sound attenuation correction is automatically calculated and displayed by the instrument. For sound paths smaller than or equal to 25.4 mm (1 inch), the value is set to zero.

- **D = D 1.1 Rating (in dB)**
  This is the result of the evaluation according to AWS. The evaluation is carried out in the USN 60 according to the formula indicated above.

☞ **Notes:**

Make sure that all instrument options for the special test are calibrated before starting with the rating according to AWS D1.1.

The dB value of **A-INDICATION** will be automatically adjusted to match the amplitude of the **B-REFERENCE** upon performing the **D D1.1 RATING** calculation.

Pay attention to peaking an echo with an amplitude between 45 % and 55 % screen height. A rating is not possible with other amplitudes.

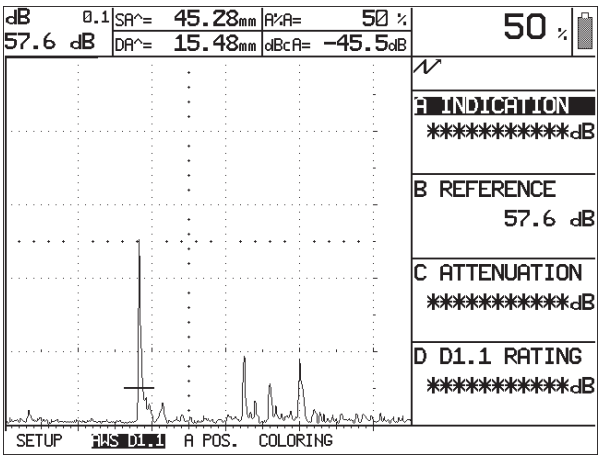
– Apply couplant, and couple the probe to the reference block 1. Peak the echo from the 1.5 mm side-drilled hole.

– Enable the AWS function using the function **AWS MODE** in the function group **A POS.**

– Select the function group **A POS.**, and set up the A gate on the reference echo.

– Vary the gain so that the reference echo is displayed at 50 % screen height.

– Select the function group **AWS D1.1**.



– Choose the function **B REFERENCE**, and confirm the choice in order to save the reference gain.

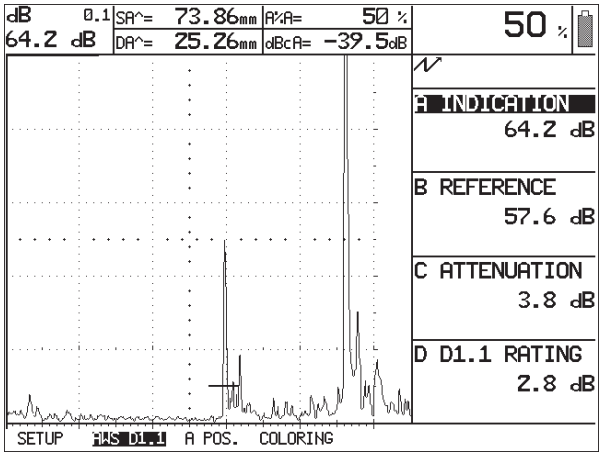
– Couple the probe to the test object in order to evaluate a flaw echo.

– Select the function group **A POS.**, and set up the A gate on the flaw echo.

– Vary the gain so that the flaw echo is displayed at 50 % screen height.

– Go to the function group **AWS D1.1**.

– Save the current gain using the function **A INDICATION**. The current gain is saved. The USN 60 will automatically determine the values of the AWS variables C and D. You can then evaluate the rating D using the corresponding requirements from AWS D1.1.



Saving data 8

8.1 Data sets, Data Logger

The USN 60 provides convenient ways of saving and managing data. It offers you two types of data storage, viz. data set files and Data Logger files.

Data sets serve for saving A-scans and for recording the pertinent instrument settings. The Data Logger enables you to save a reading for every measurement location of a test job.

Additional information is stored for the two file types in the form of file header and memo text. This additional information is displayed in the preview mode consequently allowing you to specifically select the required file. You should create the additional information before saving a file. You can nevertheless edit the additional information later on.

All data saved to the USN 60 are maintained even if you interrupt the unit's power supply.

You can :

- save the files,
- delete them,
- load them,
- selectively transfer them to peripheral units,
- output them via a PC or a printer.

8.2 Using data sets

Data sets serve for saving A-scans and the pertinent instrument settings. They enable you to use instrument settings that you have once saved for several test jobs.

You can load but not edit A-scans and instrument settings that you have saved. When loading a saved data set, the USN 60 applies the corresponding instrument settings. The loaded instrument settings can then be used for other test jobs.

Saving instrument settings

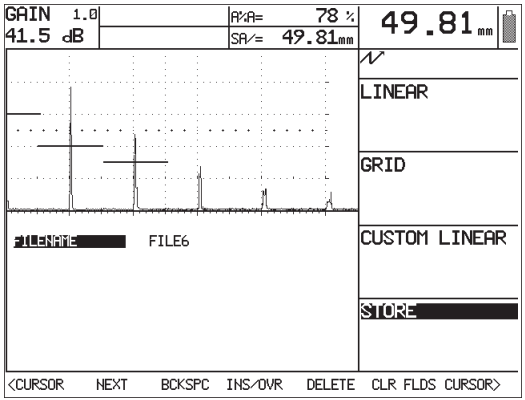
Note:

You cannot edit the A-scans and instrument setting saved to data sets later on.

– If necessary, go to the main menu.

– Select the submenu **FILES** and the function group **FILENAME**.

– Select the function **CREATE NEW**, the text box for creating files appears.



– Key in a name for the file in the field **FILENAME**.

– Select the function **STORE** in order to save the data set.

If you don’t change the file name, new files are saved using the default name FILE with a number appended to it (e.g. FILE1). The number is automatically increased when saving other data sets. If you change the default file name, a number is likewise automatically appended to it and likewise automatically increased when saving other data sets.

8.3 Using the Data Logger

The Data Logger helps you to save and manage your readings. You can define different test jobs and save numerous readings at defined measurement locations to the Data Logger. The Data Logger file therefore represents the test job and helps you to quickly orientate within the test job.

In addition, the Data Logger enables you to save several notes on every reading. You can create the notes yourself according to your individual requirements and use them for evaluating the measurement results.

You can save the following by means of the Data Logger:

- the current readings,
- the current instrument settings,
- the position of the measurement location,
- evaluating notes on every measurement result.

Creating a Data Logger file

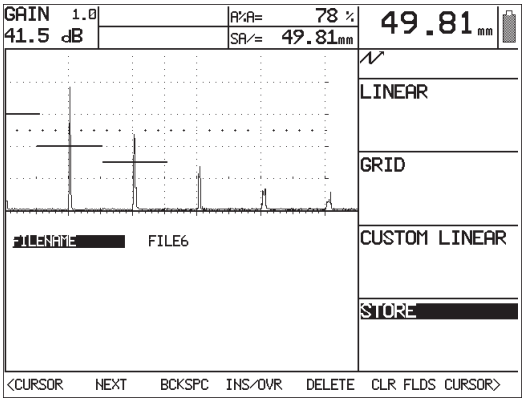
Before you're able to save readings by means of the Data Logger, you have to create a corresponding file first, and save it to the instrument. Saved files can be loaded, edited, or deleted at a later date.

– If necessary, go to the main menu.

– Select the submenu **FILES** and the function group **FILENAME**.

– Set the function **ACTION** to **SAVE EDITS**.

– Select the function **CREATE NEW**. The text box and the functions for creating files appear.



The Data Logger enables you to define different test jobs. To do this, you have to select a corresponding file type for the Data Logger. The following options are available:

- **LINEAR**
  The readings are organized in linear mode. In this mode, the measurement locations are consecutively numbered, with exactly one measurement point being allocated to each location. The number of measuring points is defined when creating the file. A maximum of 99,999 readings can be saved to linear files.

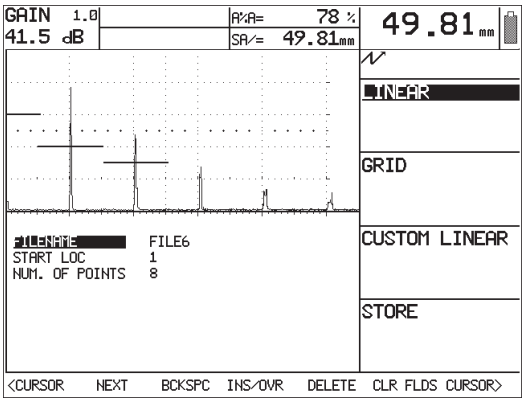
- **GRID**
  The measuring points of a test job are arranged in two-dimensional mode. For this purpose, the USN 60 offers you a matrix consisting of 702 rows and the same number of columns that you can identify alphanumerically. You can save up to four readings per each measuring point to a grid file. To achieve this, you have to create a matrix having the corresponding number of columns.

- **CUSTOM LINEAR**
  This file type has 2 structural elements (measurement location and point). Measurement locations have to have a name assigned to them, measurement points are consecutively numbered. You can create a maximum of 999 locations and assign each of them 999 points. The number of measurement points is defined when creating the file.

Creating a linear file

If you select this function, you have to specify the first measurement point and the number of points.

– Select the function **LINEAR**. The text box for creating files appears.



– Specify the name of the file in the field **FILENAME**.

– Specify the number of the first measurement point in the field **START LOC**.

– Specify the number of points belonging to the test job in the field **NUM. OF POINTS**.

– Finally, use the function **STORE** to save the new file that you have just created. The successful saving is confirmed by a message in the menu bar.

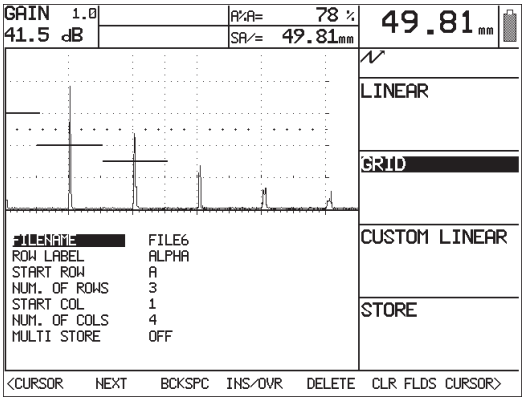
Creating a grid file

In order to create a grid file, you have to first enter the matrix parameters. The rows or the columns are optionally marked with letters. Moreover, you have to define the size of the matrix and the label of the first row or column in each case.

☞ **Note:**

A grid file allows you to save the readings displayed in all display boxes for one measurement point. In this regard, pay attention to the corresponding number of columns when creating the matrix.

– Select the function **GRID**. The text box for creating files appears.



– Specify the name of the file in the field **FILENAME**.

– Use the right-hand rotary knob to set the required labeling in the field **ROW LABEL**.

– Select the label of the first row in the field **START ROW**.

– Select the required number of rows in the field **NUM. OF ROWS**.

– Select the label of the first column in the field **START COL**.

– Select the required number of columns in the field **NUM. OF COLS**.

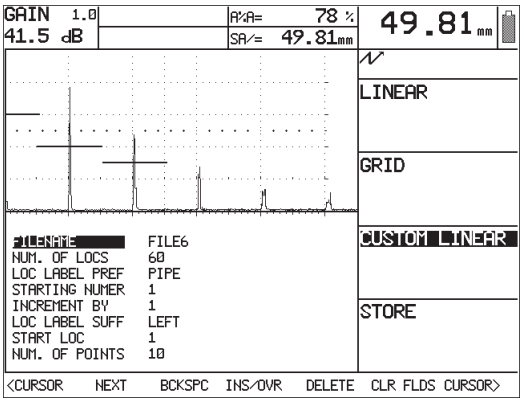
– Select **MULTI STORE** in order to save all displayed readings of the measurement point later on, otherwise select **OFF**.

– Finally, use the function **STORE** in order to save the new file that you have just created. The successful saving is confirmed by a message in the menu bar.

Creating a custom linear file

In order to create custom linear files, you have to set the number and labeling of measurement locations and select the first measurement point.

– Select the function **CUSTOM LINEAR**. The text box for creating files appears.



– Specify the name of the file in the field **FILENAME**.

– Select the required number of locations in the field **NUM. OF LOCS**.

– Specify the first label for the measurement location in the field **LOC LABEL PREF**. This label is maintained for all measurement points.

– Select the first measurement point in the field **STARTING NUMBER**.

– Select the incrementation for numbering the measurement points in the field **INCREMENT BY**.

– Specify a second label for the measurement location in the field **LOC LABEL SUFF**. This label is maintained for all measurement points.

– Select the first measurement point in the field **START LOC**.

– Select the required number of measurement points in the field **NUM. OF POINTS**.

– Finally, use the function **STORE** in order to save the new file that you have just created. The successful saving is confirmed by a message in the menu bar.

Creating notes

You can save evaluating notes from a list for every reading. To do this, you have to create a list of notes at first. The notes are saved to the Data Logger file and can be edited until they are assigned to a reading.

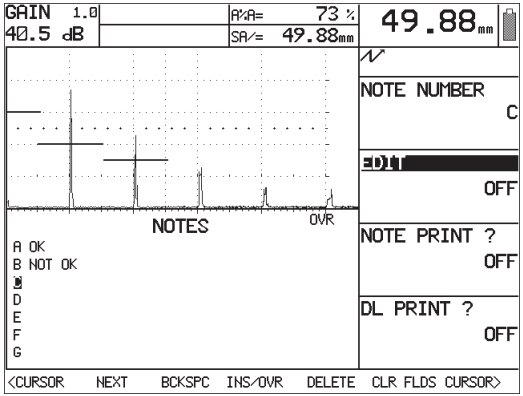
You have the possibility of recording the texts of all notes in the test report. The letters of the assigned notes are displayed in any case.

The Data Logger has a capacity for a maximum of 7 notes with 16 characters each. The notes are identified by the letters A ... G.

– If necessary, go to the main menu.

– Select the submenu **FILES**.

– Go to the function group **NOTES**. The A-scan is displayed in reduced mode, and there is a text input box below the A-scan.



– Use the function **NOTE NUMBER** to select a note in order to edit it.

– Set the function **EDIT** to **ON**. The cursor is at the first position of the selected note, and the Editor menu is displayed in the menu bar.

– Edit the notes.

– To close the process of editing, set the function **EDIT** to **OFF**. The notes are now created and saved to the Data Logger file.

– If necessary, set the function **NOTE PRINT ?** to **ON** in order to record the texts of all notes in the test report.

– If necessary, set the function **DL PRINT ?** to **ON** in order to record the readings of the Data Logger file in the test report.

Saving readings

Readings are only saved if they are not equal to 0. You can only save the reading displayed in the large display box.

⚠ **Attention:**

Only use free measurement locations for saving readings. Otherwise readings that are already saved will be overwritten without notice.

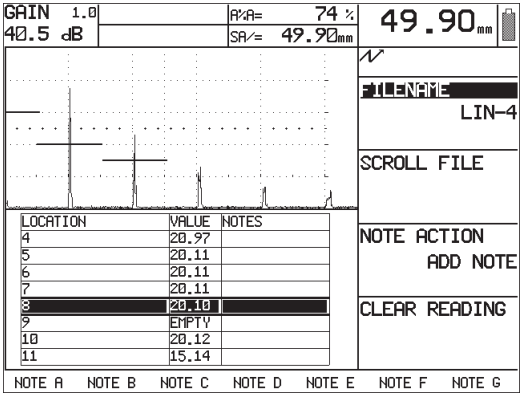
☞ **Note:**

You can only save readings to files if the setting **LOG TO FILE** is selected for the function **COPY MODE**.

– If necessary, go to the test menu.

– Use the function **VIEW** to change to the reduced A-scan display. A field for data management appears below the A-scan.

– Select the function **VIEW** again in order to change to the Data Logger view. You will then see the active Data Logger file in the topmost function field.



The status and, if necessary, the saved notes are displayed for all measurement locations of the file. The following displays are possible for the status of a location:

- **EMPTY**:
  no measurement saved.
- **x.xx**:
  the value saved here in the currently selected units.
- **ERROR**:
  reading is incorrect, measurement has to be repeated.

– If necessary, go to the function **FILENAME** and use the right-hand rotary knob to select a file in order to save readings there.

– Go to the function **SCROLL FILE**.

– Use the right-hand rotary knob to select a measurement location in order to save the reading.

– Press the COPY key in order to save the reading to the location. The successful saving of the reading is shown in the display.

– Go to the function **NOTE ACTION**.

– Select the option **DISPLAY NOTES**, the list of all notes is displayed.

– Select the option **ADD NOTE** in order to save notes on the reading.

– Use the functions **NOTE N** in order to save the previously created notes together with the reading.

– If necessary, go to another measurement location in order to save other readings.

⚠ Attention:

After a reading has been saved, the USN 60 automatically goes to the next measurement location. Make sure that you only save the readings to vacant measurement locations. Otherwise readings that are already saved will then be overwritten without notice.

☞ Note:

In order to permanently save data, you should transfer them to a PC. The software required for this can be ordered from GE InspectionTechnologies (please see chapter 2).

8.4 File management

The USN 60 enables you to easily manage your files. The functions available to you for this purpose show only irrelevant differences between dataset and Data Logger and are therefore described jointly for both file types in the following.

Creating file header

The USN 60 saves a file header to every file. The file header is displayed in the preview mode and can be optionally printed out as a part of the test report. Unlike the user-editable text, a file header is structured and consists of individual fields that can be completed with information by hand. Use the file header for the input of basic test information, e.g. name of the inspector, probe used, and test temperature.

The file header consists of 9 lines with a title and a data field each. The title field has a capacity for 13 characters, the data field for 16 characters. Enter the title for the corresponding header line in the the title field, and the current data in the data field.

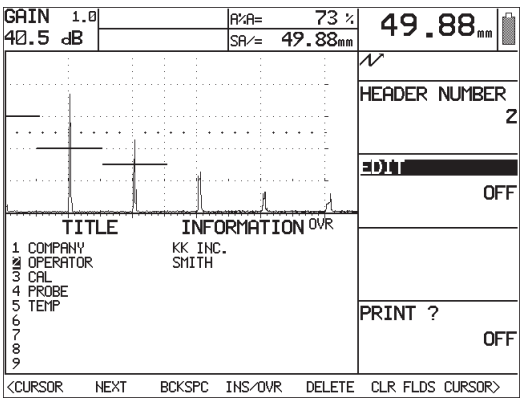
Note:

The file header is stored unchanged with all files until you edit it or turn off the instrument.

– If necessary, go to the main menu.

– Go to the submenu **FILES**.

– Go to the function group **REP HEAD**. The A-scan is displayed in reduced mode, and there is a text input box below the A-scan.



– Use the function **HEADER NUMBER** to select a header line in order to edit it.

– Set the function **EDIT** to **ON**. The number of the selected header line is marked, and the cursor is located in the corresponding data field. The Editor menu is displayed in the menu bar.

– Edit the file header.

– To close the process of editing, set the function **EDIT** to **OFF**. The file header is now created and saved in this form with every file.

– If necessary, set the function **PRINT ?** to **ON** in order to record the file header in the test report.

Creating memo texts

The USN 60 saves a memo text to every file. The memo text is displayed in the preview mode and therefore makes the data management easier. Memo texts comprise a maximum of 80 characters that you are free to input. If required, memo texts can also be recorded in the test report.

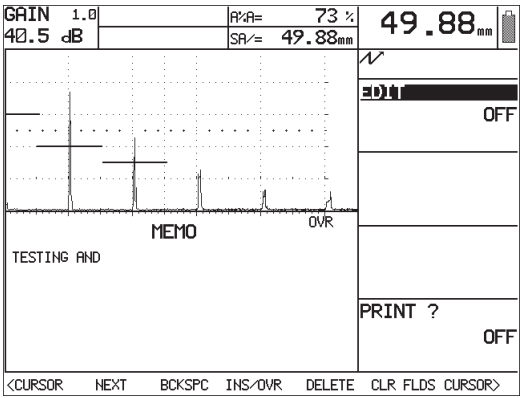
☞ **Note:**

A memo text is saved unchanged with all files until you edit it or turn off the instrument.

– If necessary, go to the main menu.

– Select the submenu **FILES**.

– Go to the function group **MEMO**. The A-scan is displayed in reduced mode, and there is a text input box below the A-scan.



– Set the function **EDIT** to **ON**. The cursor is at the first free position of the memo text, and the Editor menu is displayed in the menu bar.

– Key in the memo text.

– To close the process of editing, set the function **EDIT** to **OFF**. The memo text is now created and will be saved in this form with each file.

– If necessary, set the function **PRINT ?** to **ON** in order to record the memo text in the test report.

Loading saved files

You can load previously saved files with the USN 60. When loading a saved file, the USN 60 applies all the instrument settings saved to that file. If you load a Data Logger file, you can edit the readings. Loaded data sets cannot be edited.

– If necessary, go to the main menu.

– Select the submenu **FILES**.

– Go to the function group **FILENAME**.

– Use the function **FILENAME** to select a file to be loaded.

– Use the function **PREVIEW** to check the file.

– Select the option **RECALL** for the function **ACTION** in order to load the selected file.

– Confirm the action with the key. The file is loaded, and the corresponding A-scan is displayed.

– If necessary, go to the corresponding functions in order to edit the file.

Editing saved files

Files can be edited even after saving. You can subsequently edit the memo texts and header data of all files. Moreover, if you're using Data Logger files, you can subsequently create notes, record new readings, and evaluate them.

– Load a saved file in order to edit it.

– Edit as required.

– Select the option **SAVE EDITS** for the function **ACTION** in order to save the edited data.

– Confirm the action with the ⌂ key. The edited file is now saved.

Deleting saved files

You can delete any file saved.

⚠ **Attention**:

If you delete a file, the file is deleted including all the saved readings and the additional information.

– Load the file that you want to delete.

– Use the function **PREVIEW** to check the file.

– Select the option **CLEAR** for the function **ACTION** in order to delete the selected file.

– Confirm the action with the ⌂ key. The successful file deletion is indicated by a message in the menu bar.

DAC/TCG option 9

9.1 TCG/DAC

Because of the aperture angle of the sound beam and of the sound attenuation in the material, the echo height of reflectors of identical size depends on the distance from the probe.

A Distance-Amplitude Curve (DAC), recorded using defined reference reflectors, represents these effects graphically.

The TCG/DAC option in the USN 60 can compensate for these effects.

In this connection, the gain is varied depending on the time of flight in such a way that the echoes appear at the same level on the screen, regardless of their distance. In consequence of this, the echo amplitude only depends on the reflection behavior of the reflector.

If you use a reference block containing artificial reflectors corresponding to the natural flaws of your test object in order to record a DAC, you can use the echo amplitude of a flaw echo for evaluation without any further corrections. The reference block should be made of the same material as the test object.

Every artificial reflector is scanned, the echo peaked and then recorded.

The TCG/DAC function brings all reference echoes to 80% screen height.

The maximum dynamic range is 40 dB;
the maximum curve slope is 12 dB/µs;
the maximum number of curve points is 16.

The function **DAC/TCG** enables you to:

- record a Distance-Amplitude Curve and to store it as an integral part of the current data set.
- display the Distance-Amplitude Curve (DAC) of the reference echoes.
- activate the TCG (Time-Corrected Gain) to increase the gain in distance-dependent mode so that all reference echoes reach the same screen height. The amplitude evaluation of echo indications is carried out in relation to the first reference echo in this case.
- activate the TCG as described above, however, with a simultaneous display of the TCG/DAC function.

9.2 The submenu TCG

The submenu **TCG** includes all functions for the setup and operation of DAC and TCG.

– If necessary, go to the main menu.

– Select the function **NEXT** in order to go to the second page of the main menu.

– Select the submenu **TCG**.

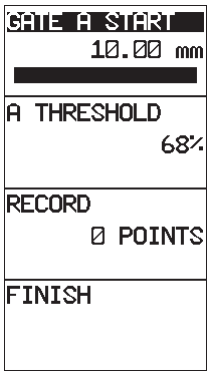
The function group RECORD

You can find all functions for recording a Distance-Amplitude Curve in this group.

Attention:

A curve that might already exist is deleted when a new curve is recorded.

– Select the function group **RECORD**.



☞ Note:

The recording of reference echoes for a DAC must always be carried out by means of the A gate.

GATE A START

This function allows you to position the A gate on the reference echo.

– Select the function **GATE A START**.

– If necessary, use the ◧ key to toggle between coarse and fine setting.

– Use the right-hand rotary knob to position the gate.

A THRESHOLD

This is where you set the threshold of the A gate.

– Select the function **A THRESHOLD**

– If necessary, use the ◧ key to toggle between coarse and fine setting.

– Use the right-hand rotary knob to set the gate threshold.

RECORD

This function allows you to record the echo in the A gate as reference echo.

☞ Note:

The highest echo in the gate is always recorded as reference echo.

– Select the function **RECORD**.

– Use the ◧ key to record the reference echo. The counter **POINTS** is incremented step by step from 0 ... 16 during this.

FINISH

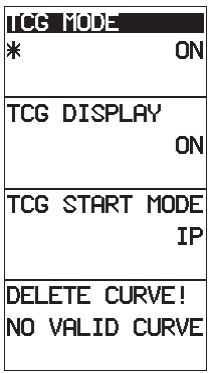
This is where you finish the recording of a Distance-Amplitude Curve.

– Select the function **FINISH**. The recording of the Distance-Amplitude Curve stops immediately, and the function group **SETUP 1** appears.

The function group SETUP 1

The functions of this group enable you to configure the mode and the display of the TCG/DAC.

– Select the function group **SETUP 1**.



TCG MODE

This function allows you to determine the TCG/DAC mode:

- **OFF**
  No TCG/DAC is active.
- **DAC**
  The already stored Distance-Amplitude Curve is displayed on the screen.
- **TCG**
  A time-corrected gain is calculated on the basis of the stored curve so that all reference echoes reach the same screen height. Echoes from the test object are now evaluated in relation to a reference echo.

☞ **Notes:**

The icon ✳ below the function **TCG MODE** indicates that a Distance-Amplitude Curve is already stored in the USN 60.

If the **DAC** is active, the icon **T** is displayed in the status bar.

– Select the function **TCG MODE**.

– Use the right-hand rotary knob to select the required mode.

TCG DISPLAY

This function serves for the display of the Distance-Amplitude Curve. The gain rise is graphically displayed.

– Select the function **TCG DISPLAY**.

– Use the right-hand rotary knob to choose the required option.

TCG START MODE

Choose whether you want to display the TCG/DAC from the initial pulse (**IP**) or from the surface of the test piece (**IF**).

– Select the function **TCG START MODE**.

– Use the right-hand rotary knob to choose the required option.

DELETE CURVE !

This function enables you to delete an already existing Distance-Amplitude Curve.

⚠ **Attention:**

Without a Distance-Amplitude Curve, the USN 60 can calculate no TCG.

– Select the function **DELETE CURVE !**

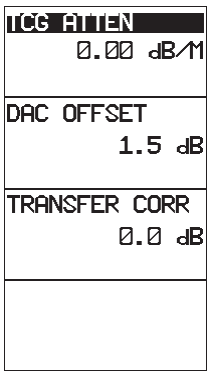
– Press the corresponding ◧ key in order to delete the curve.

– Confirm the deletion of curve by means of the ⌂ key.

The function group SETUP 2

The functions of this group serve for the adaptation of the Distance-Amplitude Curve.

– Select the function group **SETUP 2**.



TCG ATTEN

You can use this function to compensate for sound attenuation losses in the test material. This correction is required if the test object and the reference block have different sound attenuation coefficients.

You have to determine the difference of the sound attenuation coefficients by experiment. To do this, identical reflectors in the reference block and in the test object can be used. Please refer to the corresponding specialized technical literature issued by the national training centers for nondestructive testing on this subject.

☞ **Note:**

The correction is carried out automatically for all reference echoes.

– Select the function **TCG ATTEN**.

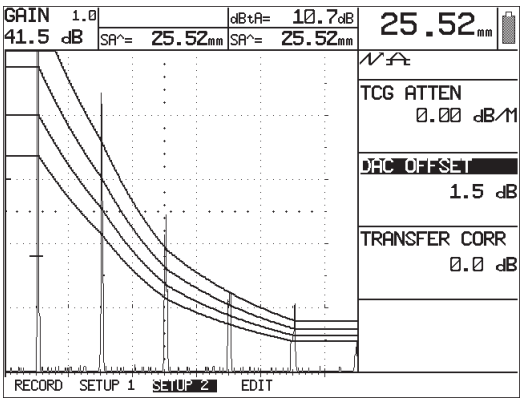
– Use the right-hand rotary knob to set the required sound attenuation value.

DAC OFFSET

You can activate a multiple DAC and define the distance with regard to the original curve at the same time. The setting 0 does not generate any multiple DAC, however, every setting not equal to 0 generates three other curves at a defined distance from the original curve, viz. one of the additional curves below the original curve, and two above it at the same distance each.

– Select the function **DAC OFFSET**.

– Use the right-hand rotary knob to set the required offset value.



TRANSFER CORR

This function corrects the instrument sensitivity (gain setting). This may become necessary if the DAC was recorded on a reference block having a smooth surface but the test object has a rough surface.

– Select the function **TRANSFER CORR**.

– Use the right-hand rotary knob to set the required gain variation.

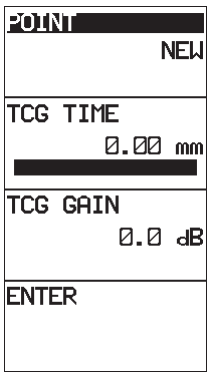
Function group EDIT

The functions of this group allow to record DAC points manually, or to edit existing DAC points. This enables you to correct, improve, or extend the DAC curve.

☞ Note:

You can only add or edit DAC points. No deletion of selected DAC points is possible.

– Go to the function group **EDIT**.



POINT

Select a point of the DAC here in order to edit it, or add a new point.

– Select the function **POINT**.

– Use the right-hand rotary knob to select the required point.

TCG TIME

Set the spacing (time of flight in µs or distance in mm or inches) of the points here.

– Select the function **TCG TIME**.

– Use the right-hand rotary knob to set the required position.

TCG GAIN

This is where you can set the gain of the reference echo for the selected point.

– Select the function **TCG GAIN**.

– Use the right-hand rotary knob to set the required gain.

ENTER

This function enables you to record the changes in the Distance-Amplitude Curve.

– Select the function **ENTER**.

– Use the corresponding ◧ key to save the changes.

9.3 Recording a Distance-Amplitude Curve

The Distance-Amplitude Curve represents the distance law of a specified, artificial reflector in the present reference block. It is practically determined by means of a reference block containing artificial reflectors at varying depths. In this connection, the echo amplitudes of the reflectors form the evaluation threshold for the natural reflector echoes from the test object. If the echoes of reflectors exceed this threshold, they are considered as recordable.

In order to use the TCG/DAC function of the USN 60, you have to first record a Distance-Amplitude Curve. To do this, use a reference block made of the same material as the test object. The artificial flaws should show the same reflection behavior as the expected flaws.

⚠ Attention:

The recording of a new curve deletes a curve that may already exist. If necessary, ensure that the old curve is stored in a free data set before you start recording a new curve!

☞ Note:

Before starting to record a reference curve, the instrument has to be correctly calibrated. This applies especially to the function groups **PULSER**, **RECEIVER**, **RANGE** and **CONFIG** because these functions can no longer be changed if the **DAC** or **TCG** is active.

– If necessary, go to the main menu.

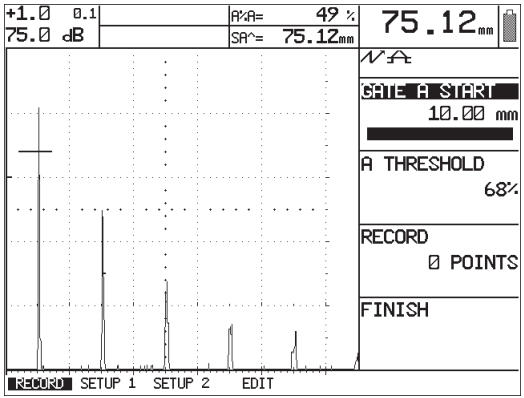
– Select the function **NEXT** in order to go to the second page of the main menu.

– Select the submenu **TCG**.

– Select the function group **RECORD**.

– Couple the probe to the reference block, and peak the first reference echo. Amplify the echo to approx. 80% screen height.

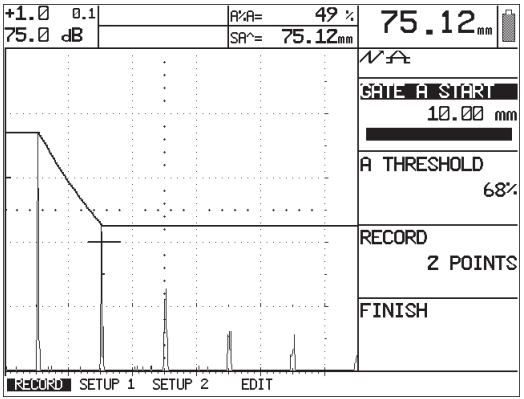
– Use the functions **GATE A START** and **A THRESHOLD** to move the A gate on the first echo. The gate threshold must be set in such a way that the echo exceeds it.



– Select the function **RECORD**, and use the corresponding ◧ key to store the reference echo data (sound path, amplitude and gain setting). The function **RECORD** now shows **1 POINT**, and the function **GATE A START** is activated.

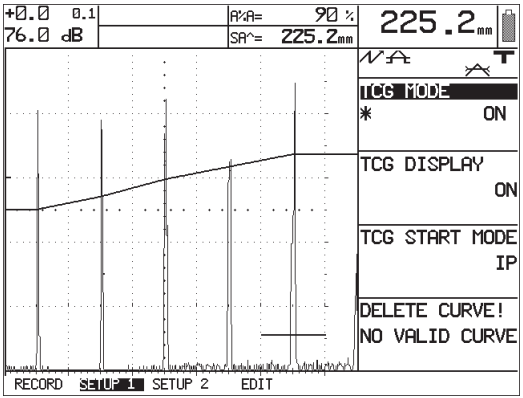
– Position the gate on the next echo, and readjust the threshold or the instrument gain if necessary until the echo exceeds the threshold.

– Select the function **RECORD**, and store the reference echo data (sound path, amplitude and gain setting) using the corresponding ◧ key. The function **RECORD** now shows **2 POINTS**, and the function **GATE A START** is activated. A curve is generated between the amplitude of the first and the second echo.



– Continue in this way until all reference echoes available have been recorded.

– Close the recording of reference echoes by means of the function **FINISH**. The recording mode is automatically switched off, and the USN 60 goes to the function group **SETUP 1**. The TCG mode is switched on and indicated by the icon **T** in the status field. The DAC curve (TCG display) is displayed with all reference echoes now reaching approx. 80% screen height.



From now on, all echoes are evaluated in relation to the reference height; that means the height of the first reference echo.

– If necessary, select the function group **SETUP 2** in order to correct the DAC.

– To be on the safe side, store this setting in a free data set.

9.4 Creating a theoretical Distance-Amplitude Curve

If it's not possible for you to record a Distance-Amplitude Curve by means of a reference block containing known flaws, the USN 60 enables you to alternatively create a theoretical Distance-Amplitude Curve. You can derive the data regarding spacing and gain of several points of a Distance-Amplitude Curve from the corresponding DGS diagram.

You can subsequently enter the derived data in the USN 60 using the function group **RECORD** in order to generate a Distance-Amplitude Curve.

☞ **Note:**

You can only add or edit DAC points. No deletion of selected DAC points is possible.

– If necessary, go to the main menu.

– Select the function **NEXT** in order to go to the second page of the main menu.

– Select the submenu **TCG**.

– Select the function group **EDIT**.

– Choose the option **NEW** for the function **POINT**.

– Use the function **TCG TIME** to set the spacing of the new DAC point.

– Use the function **TCG GAIN** to set the gain of the new DAC point.

– Go to the function **ENTER**, and confirm the data of the new DAC point using the corresponding ◧ key.

– Add other DAC points as described above.

9.5 Echo evaluation with TCG/DAC

To be able to evaluate a flaw indication by means of the TCG/DAC function, certain requirements have to be met:

- The Distance-Amplitude Curve must already be recorded.
- It only applies to the same probe that was used for recording the curve. Even another probe of the same type must not be used!
- The curve and the TCG only apply to the material corresponding to the material of the reference block.
- All functions affecting the echo amplitude must be set in the same way as they were when the curve was recorded. This applies in particular to the following function groups: **PULSER**, **RECEIVER**, **RANGE** and **CONFIG**.
- **DETECTION** is set to **PEAK**.
- **AMPLITUDE** is set to **dB THRESHOLD**.

– Select the echo amplitude (as dB difference with regard to the curve) for the display in the large display box.

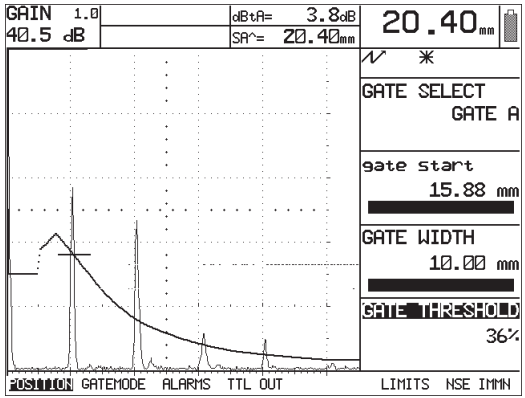
DAC mode

– Peak the echo of a probable flaw, and move the gate so that the echo data are evaluated.

– Determine the sound path in the display boxes for readings and, in addition, the (reduced) projection distance as well as the flaw depth if you are using angle-beam probes. Whether or not the echo is recordable, can be immediately seen from the A-scan.

You can also easily determine the dB amount by which the response threshold is exceeded:

– Adjust the gate threshold exactly to the intersection point of the curve with the probable flaw indication. The value dBtA in the corresponding display box indicates the amount of dB by which the flaw echo exceeds the curve, i.e. to what extent the echo indication exceeds the reference echo.



TCG mode

⚠ **Attention:**

An echo amplitude evaluation as measurement of the difference relative to the reference echo is only possible if the reference height stored during the recording of the reference echo (height of the first reference echo) still applies. If another echo is stored as reference echo with **dB REF** after recording the curve, the original reference echo is lost.

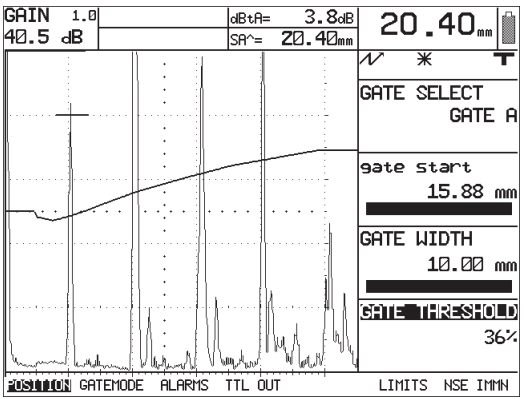
If this is the case, then you will again need the reference block used for recording the Distance-Amplitude Curve for the flaw evaluation.

After switching on the TCG mode, all echoes of the reference reflectors reach the height of the first reference echo. Moreover, you can position the gate over the entire evaluation range so that every echo is directly measured.

– Peak the echo of a probable flaw. If necessary, increase the gain until the echo exceeds the gate threshold.

– Determine the sound path in the display boxes for readings and, in addition, the (reduced) projection distance as well as the flaw depth if you are using angle-beam probes. The reading dBtA indicates the amount of dB by which the flaw echo exceeds or falls below the reference height (in this case 80% SH).

The result of an amplitude evaluation is not affected by a gain variation, i.e. the displayed gain difference dBR is always the difference between the flaw echo and the reference echo.



DGS option 10

10.1 The DGS method

The DGS (Distance – Gain – Size) function enables you to compare the reflectivity of a natural flaw in the test object with the reflectivity of a theoretical flaw (circular disk reflector) at the same depth.

⚠ **Attention:**

You are comparing the reflectivity of a natural flaw with that of a theoretical flaw. No definite conclusions with regard to the natural flaw (roughness, inclination, etc.) are allowed.

This comparison of the reflectivity is based on the so-called DGS diagram. This diagram consists of a set of curves showing the interrelationship of three influencing factors:

- distance **D** between the probe and the circular disk reflector/flaw
- relative gain **G** for backwall echoes and echoes from circular disks having different diameters
- size **S** of the circular disk reflector (diameter). The influencing factor **S** remains constant for each curve of the set of curves.

The advantage of the DGS method lies in the fact that you can have reproducible evaluations of small discontinuities. The reproducibility is most of all important whenever you want to carry out for example an acceptance test.

Besides the influencing factors already mentioned above, there are other factors that determine the curve shape:

- Sound attenuation
- Transfer losses
- Amplitude correction value
- Probe

The following parameters of the probe have an effect on the curve shape:

- Element diameter
- Transducer frequency
- Delay line length
- Sound velocity in the delay line

You can adapt these parameters in the USN 60 so that you are able to use the DGS method with many different probes and on various materials.

10.2 The submenu DGS

The submenu **DGS** includes all setup and operation functions for the DGS method.

– If necessary, go to the main menu.

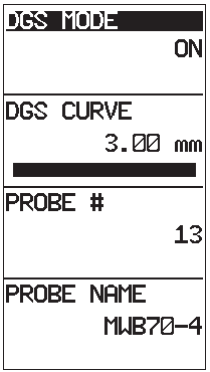
– Select the function **NEXT** in order to change to the second page of the main menu.

– Choose the submenu **DGS**.

The function group SETUP

You need the functions of this group to prepare and to start an echo evaluation using the DGS.

– Select the function group **SETUP**.



DGS MODE

Use this function to switch the DGS mode on or off.

– Select the function **DGS MODE**.

– Use the right-hand rotary knob to switch the DGS mode on or off.

DGS CURVE

This is where you set the circular disk diameter to be used for displaying the DGS curve. It is also used as recording threshold for the echo evaluations.

☞ Note:

You can always change the circular disk diameter for the DGS curve.

– Select the function **DGS CURVE**.

– Use the right-hand rotary knob to set the required circular disk diameter.

PROBE

Use this function to choose the probe used.There are 24 probes with their corresponding parameters stored in the instrument. The instrument takes the probe parameters into account when generating the DGS diagram.

You will find an overview of the stored probes and their corresponding parameters on the next page.

☞ Note:

You will find a user-programmable probe at the probe number **1**. Use this probe number if the probe that you're using is not stored in the instrument.

– Select the function **PROBE #**.

– Use the right-hand rotary knob to choose the required probe.

No.	DGS probe (name)	Frequency [MHz]	Eff. diameter [mm]	Delay velocity [m/s]
1	–	–	–	–
2	B1S	1	23.2	2500
3	B2S	2	23.1	2500
4	B4S	4	22.8	2500
5	MB2S	2	9.7	2500
6	MB4S	4	9.6	2500
7	MB5S	5	9.6	2500
8	MWB45-2	2	9.8	2730
9	MWB60-2	2	9.8	2730
10	MWB70-2	2	9.8	2730
11	MWB45-4	4	9.8	2730
12	MWB60-4	4	9.8	2730
13	MWB70-4	4	9.8	2730
14	SWB45-2	2	15.9	2730
15	SWB60-2	2	15.9	2730
16	SWB70-2	2	15.9	2730
17	SWB45-5	5	16.0	2730
18	SWB60-5	5	16.0	2730
19	SWB70-5	5	16.0	2730
20	WB45-1	1	24.2	2730
21	WB60-1	1	24.2	2730
22	WB70-1	1	24.2	2730
23	WB45-2	2	24.2	2730
24	WB60-2	2	24.2	2730
25	WB70-2	2	24.2	2730

PROBE NAME

This function shows the name of a stored probe. If you use the probe number 1, you can enter a name for the probe here. The name may contain a maximum of 14 alphanumerical characters. You cannot edit the names of the stored probes.

– Select the function **PROBE NAME**.

– Use the left-hand and the right-hand rotary knob to enter a name for your probe.

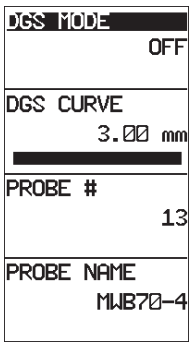
The function group DGS PROBE

The functions of this group show the parameters and the names of the selected probe. If you are using the probe number 1, you can set the required parameters here.

☞ Note:

You can only edit the name and the parameters of a probe if you have selected the option **1** in the function **PROBE #**.

– Select the function group **DGS PROBE**.



XTAL FREQUENCY

This is where you can set the frequency of the transducer element.

– Select the function **XTAL FREQUENCY**.

– Use the right-hand rotary knob to set the required frequency.

EFF. DIAMETER

This is where you can set the effective element diameter of the probe.

– Select the function **EFF. DIAMETER**.

– Use the right-hand rotary knob to set the required value.

DELAY VELOCITY

This is where you can set the sound velocity in the probe's delay line.

– Select the function **DELAY VELOCITY**.

– Use the right-hand rotary knob to set the required value.

PROBE NAME

This is where you can enter a name for the probe used. The name may contain a maximum of 14 alpha-numerical characters.

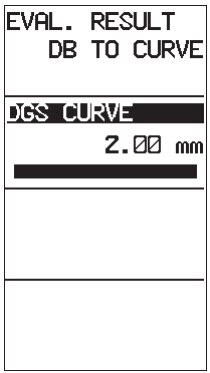
– Select the function **PROBE NAME**.

– Use the left-hand and the right-hand rotary knob to enter a name for your probe.

The function group EVALUATE

The functions of this group are used for flaw evaluation by means of the DGS curve.

– Select the function group **EVALUATE**.



EVAL. RESULT

USN 60 has two options available to you for the flaw evaluation by means of the DGS curve. The evaluation result can be displayed either as dB to curve or as the equivalent reflector size. The following settings are possible:

- **DB TO CURVE**
  indicates the difference between the echo height and the DGS curve in dB (only if the option **dB THRESHOLD** has been chosen for the function **AMPLITUDE**)
- **ERS**
  indicates the equivalent reflector size of a flaw echo, i.e. calculated on the basis of the echo amplitude

– Select the function **EVAL. RESULT**.

– Use the right-hand rotray knob to choose the required display option.

DGS CURVE

This is where you can set the circular disk diameter to be used for displaying the DGS curve. It is also used as recording threshold for the echo evaluations.

☞ **Note:**

You can always change the circular disk diameter for the DGS curve.

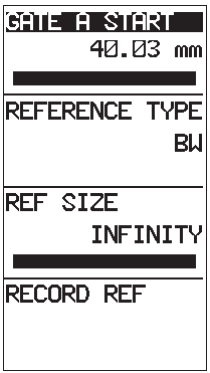
– Select the function **DGS CURVE**.

– Use the right-hand rotary knob to set the required circular disk diameter.

The function group REF ECHO

The functions of this group are used for recording the reference echo.

– Select the function group **REF ECHO**.



GATE A START

The recording of a reference echo is always carried out in the A gate. This is where you set the gate start for the A gate.

– Select the function **GATE A START**.

– Use the right-hand rotary knob to set the gate start.

REFERENCE TYPE

This is where you choose the type of the reference reflector used. You can use a backwall, a circular disk or, with limitations, even a side-drilled hole as a reference reflector. It must have a diameter corresponding to at least 1.5 times the wavelength used, and the distance must be 1.5 times the near field length.

The table on the next page shows these minimum data for the existing probes in steel. It shows the conditions for using side-drilled holes as reference reflectors in steel. The values must be converted accordingly for other materials.

The following settings are possible:

- **BW**
- **SDH**
- **FBH** (circular disk)

– Select the function **REFERENCE TYPE**.

– Use the right-hand rotary knob to choose the reference reflector.

Probe	Wavelength in steel [mm]	Minimum diameter of side-drilled hole [mm]	Near field length in steel [mm]	Minimum distance in steel [mm]
B 1 S	6.0	9.0	23	35
B 2 S	3.0	4.5	45	68
B 4 S	1.5	2.3	90	135
MB 2 S	3.0	4.5	8	12
MB 4 S	1.5	2.3	15	23
MB 5 S	1.2	1.8	20	30
MWB ...-2	1.6	2.4	15	23
MWB ...-4	0.8	1.2	30	45
SWB ...-2	1.6	2.4	39	59
SWB ...-5	0.7	1.1	98	147
WB ...-1	3.3	5.0	45	68
WB ...-2	1.6	2.4	90	135

REF SIZE

This is where you set the diameter of the reference reflector. The setting depends on the reflector type used. The only possible setting for a backwall is **INFINITY**. If you are using a circular disk or a side-drilled hole, you have to set a numerical value.

– Select the function **REF SIZE**.

– Use the right-hand rotary knob to set the diameter.

RECORD REF

You can use this function to record the reference echo.

Attention:

A reference echo that has already been recorded is deleted if a new reference echo is recorded.

– Select the function **RECORD REF**.

– Press the corresponding key ◧ in order to record the reference echo. If a reference echo already exists, a warning message is displayed.

– Use the key ⌂ to confirm the message and to record the reference echo.

The successful recording of a reference echo is indicated by an icon in the status field.

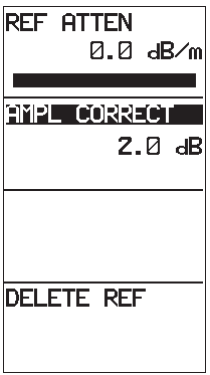
The function group REF CORR

The functions of this group are used in order to compensate for the sound attenuation effects caused by the nature of the reference reflector. The DGS curve is calculated according to the corrections made here.

☞ **Note:**

You should define all correction settings before recording a reference echo. You can no longer change the settings after recording a reference echo.

– Select the function group **REF CORR**.



REF ATTEN.

You can use this function to compensate for the sound attenuation in the reference block. The sound attenuation is then taken into consideration when calculating the DGS curve.

You can determine the value for the sound attenuation by experiment. For more details on this, please read the corresponding technical literature issued by the national training centers for nondestructive testing.

When using the reference blocks K1 or K2, you can consider the following values for the sound attenuation in the reference block:

- 0 dB/m with longitudinal waves and 2 MHz/2.25 MHz
- 6 dB/m with longitudinal waves and 4 MHz/5 MHz
- 8 dB/m with transverse waves and 2 MHz/2.25 MHz
- 25 dB/m with transverse waves and 4 MHz/5 MHz

☞ **Note:**

When using miniature angle-beam probes, you can neglect the sound attenuation in the reference block.

– Select the function **REF ATTEN**.

– Use the right-hand rotary knob to set the required value.

AMPL CORRECT

This function is used for the amplitude correction. You need the amplitude correction if you are using an angle-beam probe and the quadrant echo from the reference blocks K1 or K2 as a reference reflector.

The values for the amplitude correction were determined by experiment for every angle-beam probe. You will find the values in your probe's data sheet under the heading ΔV_{K1} or ΔV_{K2}, depending on the reference block used.

– Select the function **AMPL CORRECT**.

– Use the right-hand rotary knob to set the indicated value.

DELETE REF

You can use this function to delete the current reference echo.

– Select the function **DELETE REF**.

– Use the right-hand rotary knob to activate the function and to delete the reference echo.

– Use the key ⌂ to confirm the deletion.

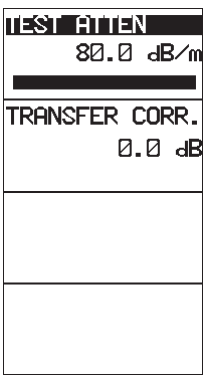
The function group MAT ATTN

The functions of this group are used in order to compensate for the sound attenuation effects caused by the nature of the test object. The DGS curve is adjusted to the settings defined here.

☞ **Note:**

The adjustment of the DGS curve to a test object may possibly take a bit longer. You should therefore define the settings for the adjustment before you switch on the DGS mode.

– Select the function group **MAT ATTN**.



TEST ATTEN

If required, the DGS curve can take the effective sound attenuation in the test object into consideration. This is necessary if the sound attenuation in the test object is not negligible. The value set here is used in order to recalculate the curve shape so that the sound attenuation effect is then taken into account when evaluating reflectors.

You can determine the value for the sound attenuation in the test object by experiment. For more details on this, please read the corresponding technical literature issued by the national training centers for nondestructive testing.

– Select the function **TEST ATTEN**.

– Use the right-hand rotary knob to set the required value.

TRANSFER CORR.

This function is used for the transfer correction. The test sensitivity is varied by this value without recalculating the curve. This correction is necessary if the test object has another surface quality than the reference block.

You can determine the value for the transfer correction by experiment. For more details on this, please read the corresponding technical literature of the national training centers for nondestructive testing.

– Select the function **TRANSFER CORR**.

– Use the right-hand rotary knob to set the required value.

10.3 Using the DGS

☞ **Note:**

In order to use the DGS option, the instrument must already be calibrated because all functions affecting the DGS evaluation can no longer be changed after recording the reference echo. This applies in particular to the functions in the submenus **PLSRCVR** and **TRIG.** Please refer to the section 7.3 *Calibrating the USN 60*.

Choosing the probe

The probe used is an important influencing factor for the shape of the DGS curve. You must therefore choose the probe before carrying out a flaw evaluation by means of the DGS method. There are 24 probes with their corresponding parameters stored in the instrument. If you have chosen a probe, the instrument automatically displays the corresponding probe name and the parameters of the probe. The instrument takes the probe's parameters into account when calculating the DGS curve.

☞ **Note:**

You will find a user-programmable probe at the probe number **1**. Use this probe number if the probe that you are using is not stored in the instrument.

– Choose the probe used in the function **PROBE #**. The function **PROBE NAME** will then display the name of the probe used.The corresponding parameters are displayed in the function group **DGS PROBE**.

– If necessary, change the name and the parameters of the user-programmable probe with the probe number **1**.

Configuring the reference echo

In order to carry out a flaw evaluation by means of a DGS curve, you must first define the reference echo to be used as a basis for a DGS curve. After that, you can compensate for the sound attenuation effects in the reference block.

☞ **Note:**

You should define all correction settings before recording a reference echo. You can no longer change the settings after recording a reference echo.

– Choose the echo type in the function **REFERENCE TYPE**.

– Set the diameter of the reference echo in the function **REF SIZE** (**INFINITY** if you are using a backwall echo as reference echo).

– If necessary, set a value for the sound attenuation in the reference block in the function **REF ATTEN.**

– Set a value for the amplitude correction of the reference echo in the function **AMPL CORRECT.**

Recording a reference echo

After defining all configuration settings as required, you can now record the reference echo. The DGS curve can then be calculated by means of the reference echo.

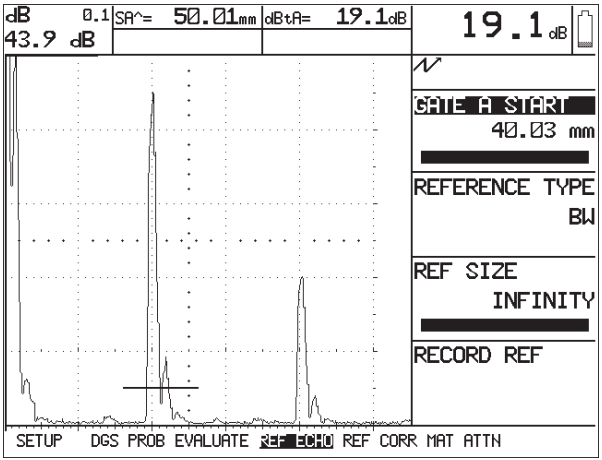
The instrument takes the general DGS diagram as a basis to calculate the required test sensitivity for displaying the curve with its maximum at 80% SH, and defines the setting. In this connection, the curve corresponds to the circular disk diameter set in the function **DGS CURVE**. The current gain is interlocked. The curve is then automatically traced along with the subsequent gain variations of the gain increase.

⚠ Attention:

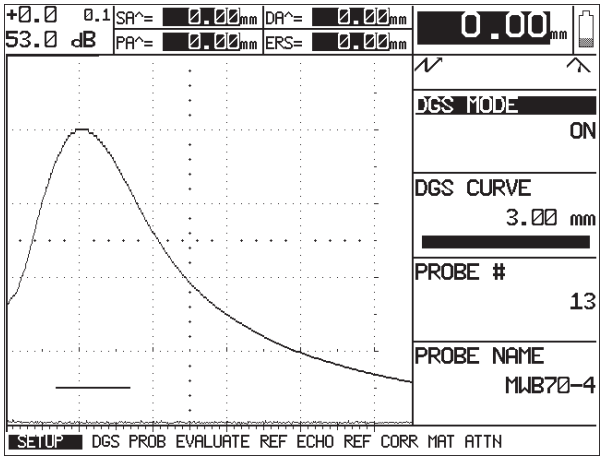
A reference echo that has already been recorded is overwritten if a new reference echo is recorded.

– Couple the probe to the reference block and peak the reference echo. Amplify the echo to approx. 80% screen height.

– Position the A gate on the echo using the function **GATE A START**.



– Press the key ◧ next to the function **RECORD REF.** The successful recording of the reference echo is indicated by an icon in the status field.



Correcting influencing factors in the test object

If necessary, the sound attenuation effects in the test object must be taken into consideration.

☞ **Note:**

The adjustment of the DGS curve to a test object may take a bit longer. You should therefore define the settings for the adjustment before starting the DGS mode.

– If necessary, set a value for the sound attenuation in the test object in the function **TEST ATTEN**.

– If necessary, set a value for the transfer loss in the test object in the function **TRANSFER CORR**.

Flaw evaluation using DGS

You can use the DGS curve to compare the reflectivity of a natural flaw in the test object with the reflectivity of a theoretical flaw in the reference block. To do this, compare the echo amplitude from the test object with the DGS curve.

USN 60 has two additional options available to you for displaying the results. The evaluation result can be displayed either as dB to curve or as equivalent reflector size.

⚠ Attention:

You are comparing the reflectivity of a natural flaw with that of a theoretical flaw. No definite conclusions with regard to the natural flaw (roughness, inclination, etc.) are allowed.

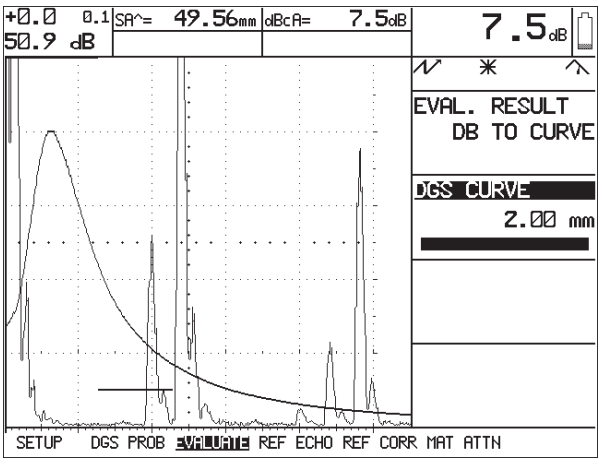
– Use the function **DGS MODE** to switch the DGS curve on. The DGS curve is displayed on the screen.

– Couple the probe to the test object, and peak the echo.

– Optimize the echo, and freeze the A-scan. You can now recognize at once whether the echo amplitude exceeds the DGS curve or not.

– Position the A gate on the echo.

– Choose the required evaluation result in the function **EVAL. RESULT.** The evaluation result is indicated in one of the measured-value boxes selected beforehand.



Interface echo gate option 11

11.1 The interface echo gate

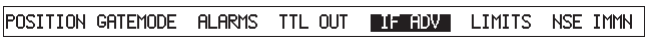
The USN 60 is available provided with the interface echo gate option (IF GATE). The interface echo gate is normally used for immersion testing. It enables measurements to be carried out from the interface between the medium (mostly water) and the test object. The interface echo gate monitors the time of flight between the initial pulse and the test object's surface.

The interface echo gate is defined and positioned exactly the same way as the gates A and B. You can use the intersecting point of the echo with the interface echo gate as a starting point for all sound path measurements. This point of intersection can also be determined as display zero. With the option DAC/TCG installed, you can use either the initial pulse or the intersecting point with the interface echo gate as a reference point for the entry of data points.

Apart from this, you can define the interface echo gate as start mode for the gates A and B in order to achieve an automatic gate tracking.

11.2 The submenu GATES

The submenu **GATES** contains all functions for setting the gate position and gate mode. With the option Interface Echo Gate installed, you will find the additional function group **IF ADV** here.



– If necessary, go to the main menu.

– Choose the submenu **GATES**.

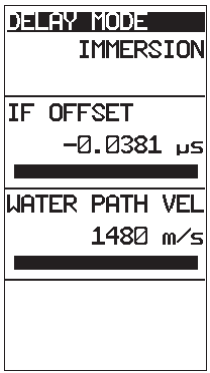
☞ **Note:**

With the option Interface Echo Gate installed, the ranges of settings of the functions **GATE SELECT** and **START MODE** are extended by the value **IF GATE**.

The function group IF ADV

You can find all functions for immersion testing with the interface echo gate in this function group.

– Select the function group **IF ADV**.



IF DELAY MODE

The interface echo gate option enables you to test according to two different methods:

- **CONTACT**
  The probe is in direct contact with the test object, if necessary, using a fixed delay line.
- **IMMERSION**
  The sound wave is led from the probe to the test object through a medium (usually water).

If you choose **IMMERSION**, you can subsequently enter a value for the sound velocity in the medium. The instrument will then calculate the length of the delay line and the position of the interface echo gate on the basis of the sound velocity in the medium.

☞ **Note:**

If **IMMERSION** is chosen, the instrument will take the sound velocity in the medium into account in all calculations based on the time of flight between the initial pulse and the interface echo. If **CONTACT** is chosen, the calculation of all sound paths uses the sound velocity in the test object. You should therefore pay attention to choosing the corresponding test method here.

– Select the function **IF DELAY MODE.**

– Use the right-hand rotary knob to set the required method.

IF OFFSET

This function is used for the exact calibration for the distance measurements between the interface echo and the echo in the A gate. Every non-zero value varies the sound path to the point of measurement in the interface echo gate.

You can determine the correction value by experiment using a calibration standard having a known thickness. Please also refer to section 7.3 *Calibrating the USN 60*.

☞ **Note:**

The correction value affects all sound path measurements based on the interface echo. You should therefore only use this function if you are familiar with the effects of the variation on the measured values.

– Select the function **IF OFFSET**.

– Use the right-hand rotary knob to set the required correction value.

DELAY VELOCITY

This is where you can enter the sound velocity in the delay line. The sound velocity depends on the medium used. The sound velocity in water (1480 m/s) is factory-preset in this case.

☞ **Note:**

You can only vary the sound velocity if the option **IMMERSION** is chosen for the function **IF DELAY MODE**. Otherwise the function is disabled.

– Select the function **DELAY VELOCITY**.

– Use the right-hand rotary knob to set the sound velocity.

11.3 Using the interface echo gate

The interface echo gate option makes an additional gate available to you for the echo monitoring. You can set up and use this gate exactly the same way as the gates A and B. You can define the interface echo gate as start mode for the gates A and B and in this way achieve an automatic gate tracking. Apart from that, you can define the intersecting point of the echo with the interface echo gate as display zero for the A-scan.

Setting up the interface echo gate

The interface echo gate is set up and positioned exactly the same way as the gates A and B. The function **START MODE** is an exception from this. You can only use the initial pulse as start mode of the interface echo gate.

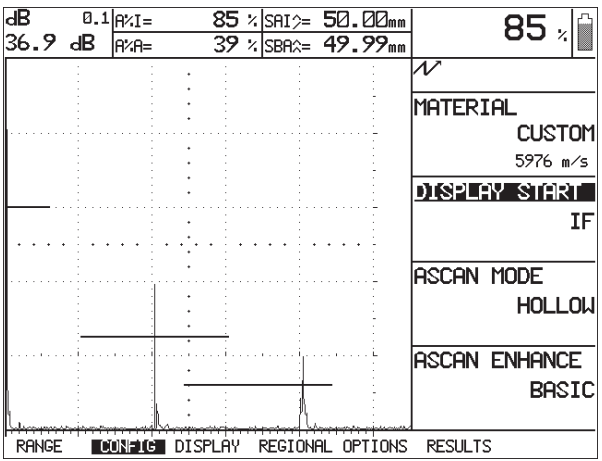
You will find all functions for setting up the gates in the submenu **GATES**. They are described in chapter 5.4.

– Go to the submenu **GATES**.

– Set up the interface echo gate as required.

Defining interface echo gate as display zero

You can use either the initial pulse or the intersecting point of the echo with the interface echo gate as display zero. If you define the interface echo gate as display zero, the interface echo is automatically fixed at display start. This means that the surface of the test object is always displayed at the left screen edge, and the delay line is not displayed at all. This is especially beneficial if the delay line varies during the test, e.g. in immersion testing.



☞ Note:

If there is no intersecting point of the echo with the interface echo gate, the instrument will automatically use the initial pulse as display zero.

– Go to the submenu **BASIC**.

– Select the function group **DISPLAY**.

– Choose the option **IF GATE** for the function **DISPLAY START**.

Automatic gate tracking

The start of measurement for the gates A and B is normally positioned on the basis of the initial pulse. As an alternative, you can also specify the start of measurement of a gate relatively to another gate. This function is called Automatic Gate Tracking.

With the interface echo gate option installed, you can also specify the start of measurement for every gate on the basis of the intersecting point of the echo with the interface echo gate. In that case, a shift of the interface echo will lead to a shift of the tracking gates.

☞ **Note:**

With the automatic gate tracking, a shift of the master gate always leads to a shift of the following gate.

– Select the submenu **GATES**.

– Select the function group **GATEMODE**.

– Set the required gate in the function**GATE SELECT**.

– Use the right-hand rotary knob to choose the required start mode in the function **START MODE**.

Additional measured values

With the interface echo gate option installed, the instrument can display additional measured values:

- **SI**
  Sound path of the echo in the interface echo gate.
- **SAI**
  Sound path difference of the echo in the A gate with reference to the interface echo.
- **SBI**
  Sound path difference of the echo in the B gate with reference to the interface echo.
- **A%I**
  Amplitude in the interface echo gate in % screen height.

11.4 Immersion testing

The interface echo gate is normally used in immersion testing. It enables measurements on the basis of the interface between the medium (mostly water) and the test object. The instrument takes the sound velocity in the medium into account in all calculations based on the time of flight between the initial pulse and the interface echo.

The multi-echo test between two gates (e.g. SAI) is only possible if the start of measurement of the following gate (in this case gate A) tracks the master gate (in this case the interface echo gate). This applies likewise to other multi-echo tests, viz. SBI and SBA.

☞ **Note:**

A prerequisite for immersion testing is a correctly calibrated instrument. Please refer to section 7.3 *Calibrating the USN 60*.

Preparation

– Calibrate the instrument.

– Set up the gates.

– Activate the automatic gate tracking for the gates A and B with the interface echo gate.

– If necessary, define the interface echo gate as display start.

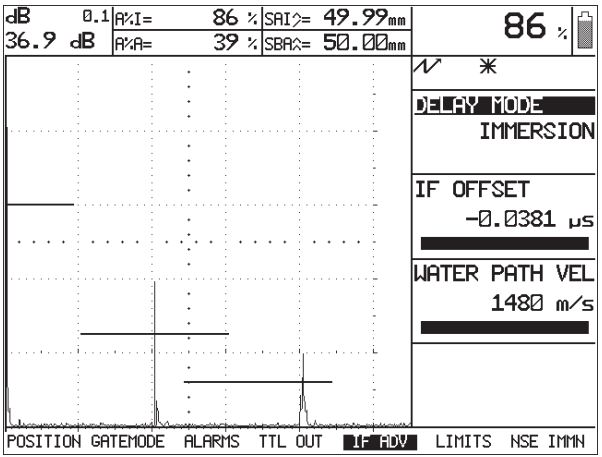
Immersion testing

– Immerse the probe on the test object in the medium, and peak an echo. In this connection, please pay attention to the limitations of the test mechanics used (angle, etc.).

– Position the interface echo gate on the first echo reflected from the test object's surface.

– Go to the function group **IF ADV** in the submenu **GATES**.

– Choose the option **IMMERSION** for the function **IF DELAY MODE**. The USN 60 will now use the sound velocity in the delay medium to calculate the length of the delay line, the position and the width of the interface echo gate.



Corrections

You can vary the sound velocity in the delay line by means of the function **DELAY VELOCITY**. You can correct the time-of-flight measurements based on the point of measurement in the interface echo gate by means of the function **IF OFFSET**.

☞ Note:

If you use the function **IF OFFSET**, you will vary all sound paths based on the point of measurement of the interface echo gate. You should therefore only vary this setting if you are familiar with the effects of the variation on the measured values.

– If necessary, use the function **DELAY VELOCITY** to vary the sound velocity in the medium.

– If necessary, correct the time-of-flight measurement by means of the function **IF OFFSET**.

– Read the measured values.

Backwall Echo Attenuation option 12

12.1 Backwall Echo Attenuation

The USN 60 can be provided with the Backwall Echo Attenuation option. This option enables the operator to set a separate gain for the gate range of gate B. This gain is independent of the gain for the rest of the test range. The Backwall Echo Attenuation therefore enables a selective attenuation or peaking of the echoes in the B gate.

A typical application case for the Backwall Echo Attenuation is forging testing. In this application case, the gain is reduced in gate B until the backwall echo is completely displayed in the A-scan. This allows to selectively integrate the backwall echo into the flaw evaluation.

However, the Backwall Echo Attenuation option also allows to systematically increase the gain. The operator can in this way for example only increase the gain within the flaw expectancy range in order to peak the echo in this range.

☞ **Note:**

The Backwall Echo Attenuation has no effect on the evaluation of the echoes in the B gate. The echo evaluation continues to refer to the actually measured signals. All other gate-related functions, such as gate alarm or TTL assignment are not affected by this either.

12.2 The submenu PLSRCVR

The submenu **PLSRCVR** is used for setting pulser and receiver. With the Backwall Echo Attenuation option installed, you will find the additional function group **BCK ATTN** here.

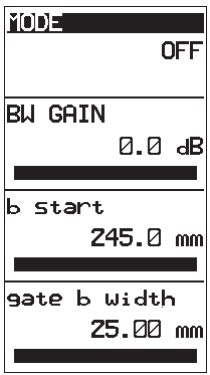
– If necessary, go to the main menu.

– Select the submenu **PLSRCVR**.

The function group BCK ATTN.

You will find all the functions for the attenuation of the backwall echo in this function group.

– Select the function group **BCK ATTN**.



MODE

This function serves for activating the Backwall Echo Attenuation. If this function is active, all echoes in the B gate are shown with a separate gain.

– Select the function **MODE**.

– Activate the Backwall Echo Attenuation using the right-hand rotary knob.

BW GAIN

You can set the separate gain for the echoes in gate B in this function. The gain may be situated both above and below the gain in the rest of the test range. The setting range for the gain is between 0.0 and 110.0 dB.

☞ **Note:**

The gain set here does not affect the evaluation of the echoes in the B gate. The echo evaluation refers to the effective signals.

– Select the function **BW GAIN**.

– Use the right-hand rotary knob to set the required gain.

B START

This function serves for positioning the B gate.

☞ Note:

When using the Backwall Echo Attenuation, the start mode for gate B can only be set to the initial pulse or the interface echo, but not to the A gate.

– Select the function **B START**.

– Position the B gate using the right-hand rotary knob.

GATE B WIDTH

You can use this function to set the width of the B gate.

☞ Note:

The gain variation applies to the entire range of the B gate. This also includes overlapping areas with other gates.

– Select the function **GATE B WIDTH**.

– Use the right-hand rotary knob to set the required width.

12.3 Using the Backwall Echo Attenuation

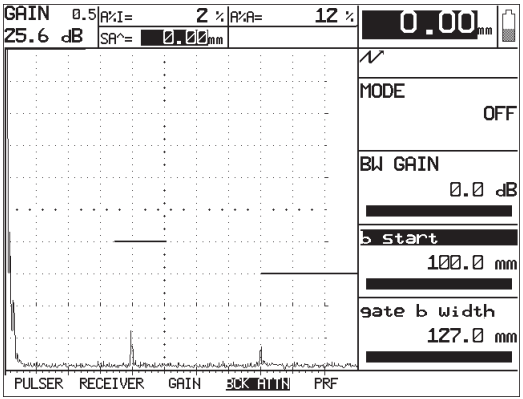
You can use the Backwall Echo Attenuation to set a separate gain for the gate range of gate B. This gain is independent of the gain for the rest of the test range. The gain variation affects the entire range of the B gate. This also includes overlapping areas with other gates.

The evaluation of all echoes in gate B refers to the signals actually displayed, viz. without taking the gain variation into consideration.

– Select the submenu **PLSRCVR**.

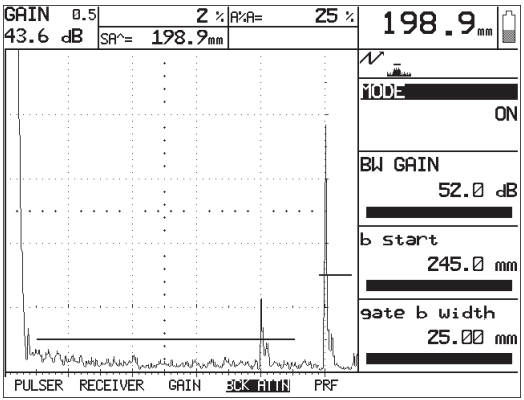
– Select the function group **BCK ATTN**.

– Position the B gate over the required range using the functions **B START** and **GATE B WIDTH**.



– Set the required gain in the function **BW GAIN**.

– Activate the Backwall Echo Attenuation using the function **MODE**.



The echoes in gate B are now shown with a different gain from that of the echoes in the rest of the test range. You can read the gain for the test range in the gain box. The gain for gate B is indicated in the function **BW GAIN**.

Documentation 13

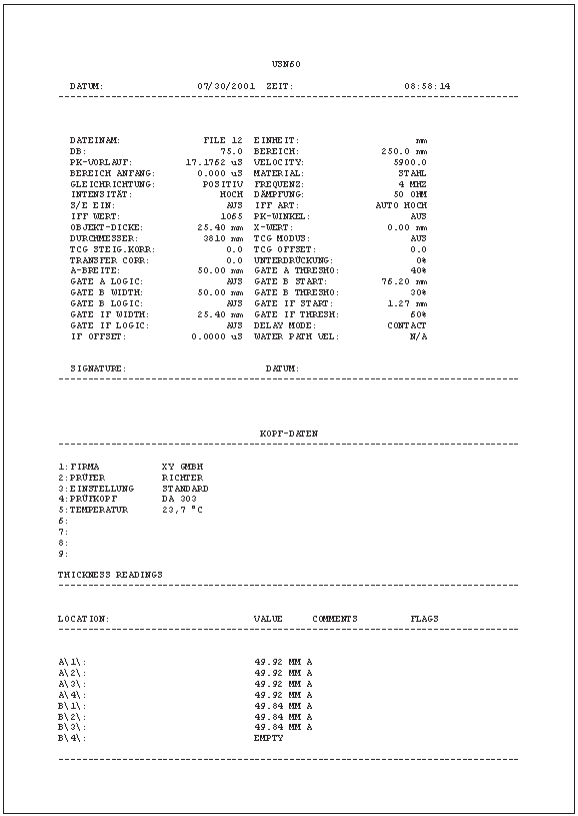
13.1 Printing a report

When combined with the printers EPSON FX/LX, Seiko DPU, or a compatible printer, the USN 60 makes it possible to print out a report. Given the corresponding setting, the report contains the following information:

- all instrument settings of the current file
- the file header
- the memo text
- the A-scan (only with data sets)
- the readings including the corresponding codes for notes (only with Data Logger files)
- the stored notes (only with Data Logger files)

Required for printing are:

- a printer with serial RS232C port
- a TGDL/PC cable for data transmission
- an adaptor (gender changer) GCH1 or GCH2 (ref. to chapter 2)



USN60

DATUM: 07/30/2001 ZEIT: 08:58:14

DATEINAM:	FILE 12	EINHEIT:	mm
DB:	75.0	BEREICH:	250.0 mm
PK-VORLAUF:	17.1762 us	VELOCITY:	5900.0
BEREICH ANFANG:	0.000 us	MATERIAL:	STAHL
GLEICHRICHTUNG:	POSITIV	FREQUENZ:	4 MHZ
INTENSITÄT:	HOCH	DÄMPFUNG:	50 OHM
S/E EIN:	AUS	IFF ART:	AUTO HOCH
IFF WERT:	1065	PK-WINKEL:	AUS
OBJEKT-DICKE:	25.40 mm	X-WERT:	0.00 mm
DURCHMESSER:	3810 mm	TCG MODUS:	AUS
TCG STEIG.KORR:	0.0	TCG OFFSET:	0.0
TRANSFER CORR:	0.0	UNTERDRÜCKUNG:	0%
A-BREITE:	50.00 mm	GATE A THRESHO:	40%
GATE A LOGIC:	AUS	GATE B START:	75.20 mm
GATE B WIDTH:	50.00 mm	GATE B THRESHO:	20%
GATE B LOGIC:	AUS	GATE IF START:	1.27 mm
GATE IF WIDTH:	25.40 mm	GATE IF THRESH:	60%
GATE IF LOGIC:	AUS	DELAY MODE:	CONTACT
IF OFFSET:	0.0000 us	WATER PATH VEL:	N/A

SIGNATURE: DATUM:

KOPF-DATEN

1:FIRMA	XY GMBH
2:PRÜFER	RICHTER
3:EINSTELLUNG	STANDARD
4:PRÜFKOPF	DA 309
5:TEMPERATUR	23,7 °C
6:	
7:	
8:	
9:	

THICKNESS READINGS

LOCATION:	VALUE	COMMENTS	FLAGS
A\1\:	49.92 MM A		
A\2\:	49.92 MM A		
A\3\:	49.92 MM A		
A\4\:	49.92 MM A		
B\1\:	49.84 MM A		
B\2\:	49.84 MM A		
B\3\:	49.84 MM A		
B\4\:	EMPTY		

Preparing for printing

Before you can print out a report, you have to select a printer and set the data transfer rate (baud rate) accordingly.

– Select the function group **PRINTER** in the submenu **FILES**.

– Use the function **PRINTER** to select the connected printer.

– Go to the function group **SER COMM** in order to set the baud rate of the RS232 port.

– Select the function **BAUD RATE**.

– Use the right-hand rotary knob to set the required baud rate.

☞ **Note:**

If you have any doubts, go by the technical data of the connected unit. This is the only way to ensure an error-free communication.

Configuring the COPY key

To print out a report, you have to the set the function of the COPY key in such a way that the required data are output via the RS232 port.

– Select the function group **PRINTER** in the submenu **FILES**.

– Use the function **PRINTER** to select the connected printer.

– Set the function **COPY MODE** to **REPORT** in order to output the report via the RS232 port according to the settings.

Printing

After connecting, preparing and activating the printer, just press the COPY key.

The report is printed out.

Care and maintenance 14

14.1 Care of the instrument

Clean the instrument and its accessories using a moist cloth. Use water or a mild household cleaner.

⚠ **Attention:**

Do not use any solvents! The plastic parts can be damaged or embrittled by this.

14.2 Maintaining batteries

Charging the Lithium-Ion storage battery

To charge the Lithium-Ion storage battery LIA 60, you need the special power supply/charger unit UN 670.

The standard package of the charger unit includes a brief operating manual describing the charging procedure. Please read this description before connecting the charger unit.

☞ **Note:**

You can charge the Lithium-Ion storage battery during normal operation. You don't have to remove the battery lid for this purpose but only connect the charger unit with the connection on the battery lid.

You can charge a separate Lithium-Ion storage battery by connecting it (or the battery lid) to the charger unit. The battery lid does not have to be installed on the USN 60 for this purpose.

Charging NiMH storage batteries

You can use the charger unit UN 665 to charge NiMH storage batteries.

⚠ Attention:

Do only use batteries and battery charger recommended by us. Any improper handling of batteries and charger may cause an explosion hazard.

Charging of partially discharged NiMH batteries

If batteries are only partially discharged (less than 50 % of operating time), the full capacity is not reached by normal charging.

– Start by fully discharging the batteries.
  You can use the discharging function of the battery charger for this. For more details, please read the notes on the operation of the battery charger.
– The batteries are automatically charged after that.

Charging of exhausted NiMH batteries

If batteries are exhausted, e.g. after a prolonged storage time in empty state, they often reach their full capacity only after repeated discharge/charge cycles.

The charger identifies defective batteries. In that case, replace the batteries by a new set. Otherwise there is the danger that individual cells have different capacities so that you will no longer obtain the normal operating time with the instrument in battery operation.

Care of NiMH batteries

Capacity and life of batteries mainly depend on the correct handling. Please therefore observe the tips below.

You should charge batteries in the following cases:

- before the initial startup
- after a storage time of 3 months or longer
- after frequent partial discharge

How to handle alkaline batteries

– Please remove the batteries from the instrument if it has not been operated for a longer time.

⚠ Attention:

Leaking batteries may cause severe damages to the instrument! You should always only use leak-proof batteries and remove them from the instrument after turning it off.

☞ Note:

Used batteries are special waste and have to be disposed of according to legal requirements!

In the interest of environmental protection, we recommend that you only use rechargeable batteries.

14.3 Maintenance

The USN 60 requires basically no maintenance.

⚠ Attention:

Repair work may only be carried out by members of authorized GE Inspection Technologies Service staff.

Interfaces and peripherals 15

15.1 Interfaces

Serial RS232 port

The 7-pin connector socket on the rear panel of the USN 60 is the bidirectional RS232 port. It serves for the data transmission to an external unit, e.g. to a printer or PC.

The USN 60 can also receive data transferred from a PC. All key controls and functions are accessible.

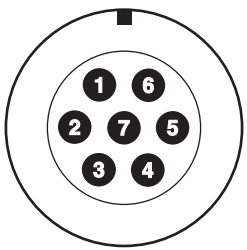
Test reports and other data are transferred by means of the COPY key. The **COPY MODE** function defines the way the USN 60 reacts when a key is pressed.

This table gives an overview of the RS232 output options of the USN 60.

COPY MODE	Output
REPORT	A complete test report including all data according to the selected settings.
PARADUMP	A list including all functions available, as well as parameters and remote control codes that can be set.
LOG TO PORT	The reading displayed in the large display box.

Pin assignment of the RS232 port

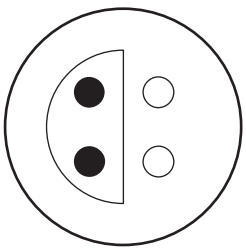
Contact pin	Designation	Signal direction	Level
1	Ground	–	–
2	+5 V	–	–
3	TxD (transmission)	Output	TTL
4	CTS (ready for transmission)	Input	TTL
5	RxD (receive)	Input	TTL
6	Ground	–	–
7	External request	Output	–



View of the RS232 port

4-pin power supply socket

Contact pin	Designation	Signal direction	Level
1	Ground	–	–
2	–	–	–
3	Mains	Input	9 ... 10 VDC
4	–	–	–



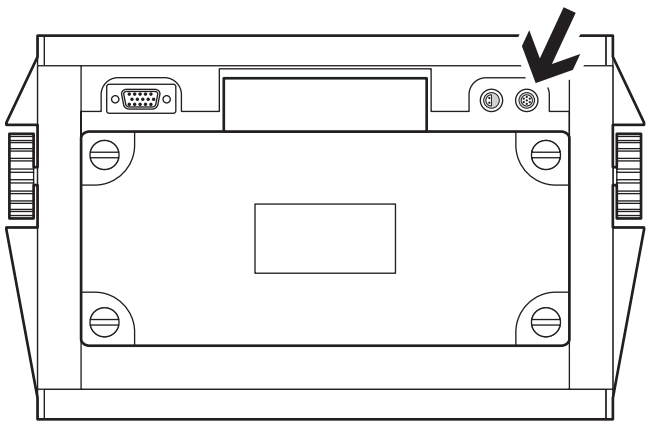
View of the 4-pin power supply socket

Optional VGA connection

The USN 60 can be equipped with aVGA connection in the form of a 15-pin Sub-D socket. It is used for the connection to a monitor or a projector. The VGA connection is located on the instrument rear panel, underneath the handle.

15.2 Connecting peripherals

Peripherals are connected to the USN 60 via the RS232 interface. The connecting cable required in each case is specified in chapter 2.



To ensure the functioning of data communication between the USN 60 and the peripheral, the parameters of the interface and of the peripheral must match.

The necessary settings are given in the operating manual of your peripheral unit.

The factory-set default interface configuration is as follows:

- Baud rate: 9600
- Length: 8 data bits
- Parity: none
- Handshake: hardware-controlled

If you want to change these default settings, please read chapter 5 to inform yourself about the required operation steps. If you use the software UltraDoc 4.0, you don't have to change the data transfer rate.

☞ Note:

Make sure that you use the correct connecting cable for every peripheral unit. Please refer to chapter 2 on this.

15.3 Data transfer

Transferring data to a PC

The USN 60 enables you to transfer data to a PC via the RS232 interface. You can select the data to be transferred by means of the function **COPY MODE**. The data are automatically formatted and transferred as ASCII text.

The optional utility program **UltraDOC 4.0** makes the data transfer to a PC easier (please see chapter 2).

– Connect the RS232 interface of the USN 60 with the serial port of your PC by means of a suitable cable.

– Use the function **COPY MODE** to select the data to be transferred.

– Press the [COPY] key to start the data transfer.

The keyboard remains disabled till the end of the data transfer.

Transfer formats

Please find an overview of the data formats for transferring single readings on the following page. The data format depends on the selected units and on the resolution:

X.XXX IN: Units INCH,
1 place before,
2 places after the decimal point

XX.XX IN: Units INCH,
2 places before,
2 places after the decimal point

XX.XX MM: Units MM
2 places before,
2 places after the decimal point

XXX.X MM: Units MM
3 places before,
1 place after the decimal point

Byte-No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Data Format X.XXX IN	blank	X	.	X	X	X	blank	I	N	blank	blank	CR	LF
Data Format XX.XX IN	blank	X	X	.	X	X	blank	I	N	blank	blank	CR	LF
Data Format XX.XX MM	blank	X	X	.	X	X	blank	M	M	blank	blank	CR	LF
Data Format XX.XX MM	blank	X	X	X	.	X	blank	M	M	blank	blank	CR	LF

Space	Blank space
X	digits 0-9
.	decimal point
IN	Units INCH
MM	Units MM
CR	Carriage Return
LF	Line Feed

15.4 Remote control

You can remotely control the USN 60 by means of a connected PC.

The data transfer is carried out by means of a terminal program and the corresponding remote control codes. These commands represent instructions referring to the individual functions of the USN 60.

The possible terminal programs used under DOS include e.g. the Crosstalk program. You can use for example the program HyperTerminal under Windows.

The commands are input via computer keyboard after starting the remote control program and after configuring the program interface. In this process, a difference should be made between:

- Inquiry of the value or status of a function by means of the command structure:

  <ESC><COMMAND><RETURN>

  The USN 60 will then send the value of the current setting.

- Input of a new value or status of a function by means of the command structure:
  <ESC><COMMAND><SPACE><VALUE><RETURN>

All values are input or sent by the USN 60 without a decimal point. It is therefore necessary to observe the resolution of the function in question with all values. The resolution of a function applies to the complete value range of the function.

A resolution of 0.01 means:

The USN 60 sends the value of a function multiplied by the factor of 100. When a value is input, it must be multiplied by the factor of 100.

Examples:

- Setting of the display delay to 72.39 mm:

  <ESC>dd 7239<RETURN>

- Setting of the display width to 72.3 mm:

  <ESC>dw 7230<RETURN>

- Setting of the display width to 192 mm:

  <ESC>dw 19200<RETURN>

A resolution of 0.1 means:

The USN 60 sends the value of a function multiplied by the factor of 10. When a value is input, it must be multiplied by the factor of 10.

Example:

- Setting of the gain to 51.5 dB

  <ESC>db 515<RETURN>

A resolution of 1 means:

The USN 60 sends the value of a function without any multiplication. A value must be input without multiplication.

Example:

- Setting of the threshold of the A gate to 41 %:

  <ESC>at 41<RETURN>

Functions and remote control codes

Default settings are in bold-face type. You will find a brief description of all functions in chapter 16.1 *Function directory*.

All values refer to steel, C = 5920 m/s, unless stated otherwise.

Code	Parameter	Range	Resolution
ALARM RESET	AX	1 = reset (write only)	
AMPL CORRECT	AV	–20 ... 20 dB	
AMPLITUDE	SA	0 = % screen height 1 = dB threshold	
ANAOUT	OS	0 = 0 V 1 = 5 V	
ASCAN MODE	FI	0 = hollow 1 = filled 2 = smart hollow 3 = smart filled	
ASCAN PRINT?	A?	0 = off 1 = on	
AWS MODE	WS	0 = off 1 = on	
A-START	AD	0 ... 27990 mm	
B START	BD	0 ... 27990 mm	

Code	Parameter	Range	Resolution
BAUD RATE	BR	0 = 1200 1 = 2400 2 = 4800 3 = 9600 4 = 19200 5 = 38400 6 = 57600 7 = 115200	
BRIGHTNESS	CX	1 ... 20	
BW GAIN	BG	0.0 ... 110.0 dB	
CLEAR READING	CD		
COLOR	CR	0 ... 3	
COLOR LEG	AC	0 = off 1 = ascan 2 = grid	
COPY MODE	CM	0 = report 1 = paradump 2 = log to file 3 = log to port	
COUNT	NC	1 ... 16	
CREATE NEW	SD	0 = off 1 = on	

Code	Parameter	Range	Resolution
DAMPING	PG	0 = 50 ohm 1 = 75 ohm 2 = 150 ohm 3 = 500 ohm	
DATE	DT	read only	
dB STEP	ST	0 = lock 1 = 0.1 2 = 0.5 3 = 1.0 4 = 2.0 5 = 6.0 6 = user selectable	
DELAY VELOCITY	DV	250 ... 16000 m/sec (for probes with delay line for calculation of DGS data)	
DELETE CURVE	CC	0 = off 1 = on	
DELETE DGS REFERENCE	XR	0 = off 1 = on	
DELETE FILE	DF	0 = off 1 = on	
DGS CURVE	ES	0.3 mm ... effective diameter	

Code	Parameter	Range	Resolution
DGS MODE	MD	0 = off 1 = on	
DGS RECORD	RR	0 = off 1 = on	
DGS REFERENCE ECHO	RE	0 = SDH 1 = FBH 2 = BW	
DGS XTAL DIAMETER	XD	20 ... 3809 mm (flat)	
DIAMETER	OD	max. 3810 mm (flat)	
DIRECTORY ENTRIES	DE	N/A	
DISPLAY DELAY	DD	–20 ... 3500 µs	
DISPLAY START	TR	0 = IP 1 = IF	
DUAL	DM	0 = off 1 = on 2 = through	
ENERGY	PI	0 = low 1 = high	
EVAL. RESULT	ER	0 = dB to curve 1 = ERS	
FILE DIRECTORY	DR	read only	
FILE UPLOAD	FU	N/A	
FILENAME	FN	read only	
FREEZE MODE	PC	0 = all 1 = peak 2 = compare 3 = envelope 0.5 s 4 = envelope 1 s 5 = envelope 2 s 6 = envelope peak	
FREQUENCY	FR	0 = 1 MHz 1 = 2 MHz 2 = 2.25 MHz 3 = 4 MHz 4 = 5 MHz 5 = 10 MHz 6 = 15 MHz 7 = 0.25 ... 2 MHz 8 = 10 ... 25 MHz 9 = 2 ... 25 MHz	
GAIN	DB	1 ... 110.0	

Code	Parameter	Range	Resolution
GATE A LOGIC	AM	0 = off 1 = positive 2 = negative 3 = measure	
GATE A START MODE	AS	0 = IP 1 = IF	
GATE A THRESHOLD.	AT	5 ... 90	
GATE A WIDTH	AW	0.25 ... 28000 mm	
GATE B LOGIC	BM	0 = off 1 = positive 2 = negative 3 = measure	
GATE B START MODE	BS	0 = IP 1 = IF 2 = gate A	
GATE B THRESHOLD.	BT	5 ... 90	
GATE B WIDTH	BW	0.25 ... 28000 mm	

Code	Parameter	Range	Resolution
GATE SELECT	GS	0 = gate A 1 = gate B 2 = IF gate	
GRID	GR	0 = off 1 = cross 2 = grat	
HEADER #	H#	1 ... 9	
HEADER PRINT?	H?	0 = off 1 = on	
HEADER TITLE	HT	read only	
HEADER INFORMATION	HI	read only	
HIGH LIMIT	HL	0 ... 28 m	
HORN	AH	0 = on 1 = off	
IF DELAY MODE	MI	0 = contact 1 = immersion	
IF LOGIC	IM	0 = off 1 = positive 2 = negative 3 = measure	

Code	Parameter	Range	Resolution
IF OFFSET	OF	–999.9997 ... 999.9997 µsec	
IF START	IS	0 ... 28000 mm	
IF THRESHOLD	IT	5 ... 90	
IF WIDTH	IW	0.25 ... 28000 mm	
INST IDENT	ID	read only	
LANGUAGE	DG	0 = English 1 = German 2 = French 3 = Spanish 4 = Italian 5 = Portuguese 6 = Norwegian 7 = Swedish 8 = Finnish 9 = Danish 10 = Dutch 11 = Russian 12 = Czech 13 = Slovenian 14 = Romanian	
LOSS OF SIGNAL	OS	0 = OFF/LOW 1 = OFF/HIGH	

Code	Parameter	Range	Resolution
LOW LIMIT	LL	0 ... 28 m	
LRG DISP.	LC	0 = off 1 = reading 1 2 = reading 2 3 = reading 3 4 = reading 4	
MAGNIFY GATE	MG	0 = gate A 1 = gate B 2 = IF Gate	
MAGNIFY	MA	0 = off 1 = on	
MASTER LOCK	ML	0 = off 1 = on	
MATERIAL	MV	0 = Custom 1 = Aluminium Oxide 2 = Aluminium Oxide Shear 3 = Aluminium 4 = Aluminium Shear 5 = Beryllium 6 = Beryllium Shear 7 = Brass 8 = Brass Shear 9 = Cadmium 10 = Cadmium Shear 11 = Copper 12 = Copper Shear 13 = Glass 14 = Glass Shear 15 = Glycerin	

Code	Parameter	Range	Resolution
		16 = Gold	
		17 = Ice	
		18 = Ice Shear	
		19 = Iconel	
		20 = Iconel Shear	
		21 = Iron	
		22 = Iron Shear	
		23 = Iron Cast	
		24 = Iron Cast Shear	
		25 = Lead	
		26 = Magnesium	
		27 = Magnesium Shear	
		28 = Mercury	
		29 = Molybdenum	
		30 = Molybdenum Shear	
		31 = Monel	
		32 = Monel Shear	
		33 = Neoprene	
		34 = Nickel	
		35 = Nickel Shear	
		36 = Nylon. 6-6	
		37 = Oil (SAE-30)	
		38 = Platinum	
		39 = Platinum Shear	
		40 = Plexiglass	
		41 = Polyethylene	
		42 = Polystyrene	
		43 = Polyurethane	
		44 = Quartz	
		45 = Quartz Shear	
		46 = Rubber. Butyl	
		47 = Silver	
		48 = Silver Shear	
		49 = Steel, mild	
		50 = Steel, mild Shear	
		51 = Steel, stainless	
		52 = Steel, stainless Shear	
		53 = Teflon	
		54 = Tin	
		55 = Tin Shear	
		56 = Titanium	
		57 = Titanium Shear	
		58 = Tungsten	
		59 = Tungsten Shear	
		60 = Uranium	
		61 = Uranium Shear	
		62 = Water	
		63 = Zinc	
		64 = Zinc Shear	
MEASUREMENT R1 INDEX READING 1		0 = Off	1 = A%I
		2 = dBtI	3 = dBrI
		4 = A%A	5 = c%A
		6 = dBtA	7 = dBrA
		8 = dBcA	9 = A%B
		10 = dBtB	11 = dBrB
		12 = SI/	13 = SI^
		14 = SIz	15 = SA/
		16 = SA^	17 = SAz
		18 = SB/	19 = SB^

Code	Parameter	Range	Resolution
		20 = SBz	21 = SA/I/
		22 = SA^I/	23 = SAzI/
		24 = SA/I^	25 = SA^I^
		26 = SAzI^	27 = SA/Iz
		28 = SA^Iz	29 = SAzIz
		30 = SB/I/	31 = SB^I/
		32 = SBzI/	33 = SB/I^
		34 = SB^I^	35 = SBzI^
		36 = SB/Iz	37 = SB^Iz
		38 = SBzIz	39 = SB/A/
		40 = SB/A^	41 = SB/Az
		42 = SB^A/	43 = SB^A^
		44 = SB^Az	45 = SBzA/
		46 = SBzA^	47 = SBzAz
		48 = DI/	49 = DI^
		50 = DIz	51 = DA/
		52 = DA^	53 = DAz
		54 = DB/	55 = DB^
		56 = DBz	57 = DA/I/
		58 = DA^I/	59 = DAzI/
		60 = DA/I^	61 = DA^I^
		62 = DAzI^	63 = DA/Iz
		64 = DA^Iz	65 = DAzIz
		66 = DB/I/	67 = DB^I/
		68 = DBzI/	69 = DB/I^
		70 = DB^I^	71 = DBzI^
		72 = DB/Iz	73 = DB^Iz
		74 = DBzIz	75 = DB/A/
		76 = DB/A^	77 = DB/Az
		78 = DB^A/	79 = DB^A^
		80 = DB^Az	81 = DBzA/

Code	Parameter	Range	Resolution
		82 = DBzA^	83 = DBzAz
		84 = PI/	85 = PI^
		86 = PIz	87 = PA/
		88 = PA^	89 = PAz
		90 = PB/	91 = PB^
		92 = PBz	93 = PA/I/
		94 = PA^I/	95 = PAzI/
		96 = PA/I^	97 = PA^I^
		98 = PAzI^	99 = PA/Iz
		100 = PA^Iz	101 = PAzIz
		102 = PB/I/	103 = PB^I/
		104 = PBzI/	105 = PB/I^
		106 = PB^I^	107 = PBzI^
		108 = PB/Iz	109 = PB^Iz
		110 = PBzIz	111 = PB/A/
		112 = PB/A^	113 = PB/Az
		114 = PB^A/	115 = PB^A^
		116 = PB^Az	117 = PBzA/
		118 = PBzA^	119 = PBzAz
		120 = RI/	121 = RI^
		122 = RIz	123 = RA/
		124 = RA^	125 = RAz
		126 = RB/	127 = RB^
		128 = RBz	129 = RA/I/
		130 = RA^I/	131 = RAzI/
		132 = RA/I^	133 = RA^I^
		134 = RAzI^	135 = RA/Iz
		136 = RA^Iz	137 = RAzIz
		138 = RB/I/	139 = RB^I/
		140 = RBzI/	192 = RawA
		193 = RawB	194 = IFDT

Code	Parameter	Range	Resolution
MEASUREMENT INDEX READING 2	R2	see MEASUREMENT INDEX READING 1	
MEASUREMENT INDEX READING 3	R3	see MEASUREMENT INDEX READING 1	
MEASUREMENT INDEX READING 4	R4	see MEASUREMENT INDEX READING 1	
MEMO PRINT?	M?	0 = off 1 = on	
MEMO	MO	read only	
MODE	BO	0 = off 1 = on	
NOTE #	N#	1 ... 7	
NOTE PRINT?	N?	0 = off 1 = on	
NOTE	NO	read only	
NUM OF FILES	DL	read only	
PARAMETER PRINT?	P?	0 = off 1 = on	
PRF MODE	PF	0 = autolow 1 = autohigh 2 = manual 3 = external	
PRF VALUE	PV	15 ... 3715	
PRINTER	PR	0 = Epson 1 = HP Laserjet 2 = HP Deskjet	
PROBE #	P#	1 ... 25	
PROBE ANGLE	PA	0 ... 90	
PROBE DELAY	PD	0 ... 999.9997 µs	
PROBE NAME	PN	user defined	
PULSER TYPE	PY	0 = SQUARE 1 = SPIKE	
RANGE	DW	1 ... 28000 mm	
READING 1	S1	read only	
READING 2	S2	read only	
READING 3	S3	read only	

Code	Parameter	Range	Resolution
READING 4	S4	read only	
RECALL CURRENT FILE	RD	0 = off 1 = on	
RECORD	TS	0 = off 1 = on	
RECTIFY	RF	0 = positive HW 1 = negative HW 2 = fullwave 3 = RF	
REF ATTEN.	AR	0 ... 100 dB/m	
REFERENCE TYPE	RE	0 = SDH 1 = FBH 2 = BW	
REF SIZE	RS	0.5 ... 10 mm	
REJECT	RJ	0 ... 80	
SERIAL NUMBER	SN	read only	
S-REF2	KR	0 ... 12190 mm	
S-REF1	NR	0 ... 12190 mm	

Code	Parameter	Range	Resolution
TCG AMPLITUDE	TV	0 ... 210 dB	
TCG ATTENUATION	TN	–40 ... +40 dB per µs	
TCG CURVE RECORD FINISH	FH	0 = off 1 = on	
TCG DISPLAY	TY	0 = off 1 = on	
TCG MODE	TM	0 = off 1 = TCG 2 = DAC	
TCG OFFSET	TO	0 ... 110 dB	
TCG POINT	PT	1 ... 16	
TCG START MODE	SM	0 = IP 1 = IF	
TCG TIME	TT	0 ... 28 m	
TEST ATTEN	DN	0 ... 100 dB/m	
THICKNESS	TH	1 ... 28000 mm	

Code	Parameter	Range	Resolution
TIME	TI	read only	
TOF GATE A	D1	0 = flank 1 = peak	
TOF GATE B	D2	0 = flank 1 = peak	
TOF GATE IF	D3	0 = flank 1 = peak	
TRANSFER CORRECTION	TC	–110 ... +110 dB (for DAC/TCG, dependant on gain setting)	
TTL #1	T1	0 = OFF (All TTL use 0 to 5) 1 = GATE A	
TTL #2	T2	2 = GATE B 3 = IF GATE	
TTL #3	T3	4 = HIGH LIMIT 5 = LOW LIMIT	
TTL MODE	AL	0 = timed 0.25 s 1 = timed 0.5 s 2 = timed 1 s 3 = timed 2 s 4 = instantaneous 5 = latched	

Code	Parameter	Range	Resolution
TRANSFER CORR LS		–30 ... 30 dB (for DGS)	
UNIT	UN	0 = mm 1 = inch 2 = µs	
USER GAIN STEP	DS	0.0 ... 24.0	
VELOCITY	SV	1000 ... 16000 µs	
VERSION	VR	read only	
VOLTAGE	PO	50 ... 450 Volt	
WATER PATH VEL.	WV	1000 ... 16000 m/sec (for probes with fixed delay line or immersion testing with IF gate on)	
WIDTH	PW	50 ... 1000 ns	
WINDOW	NW	1 ... 16	
XTAL DIAMETER	XD	3 ... 35 mm	
XTAL FREQU.	XF	0.5 ... 10 MHz	
X VALUE	XV	0 ... 5080 mm	

Remote control codes for the keys

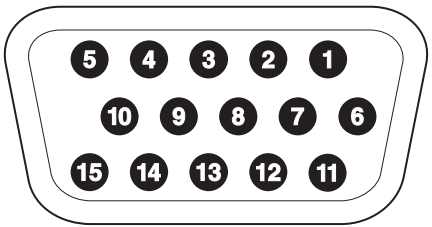
Key	Code	Range
	TE	0 = No Press 1 = Press
?	HE	0 = No Press 1 = Press
	HM	0 = No Press 1 = Press
	FZ	0 = No Press 1 = Press
COPY	CO	0 = No Press 1 = Press

Menu keys	Code	Range
first	M1	0 = No Press 1 = Press
second	M2	0 = No Press 1 = Press
third	M3	0 = No Press 1 = Press
fourth	M4	0 = No Press 1 = Press
fifth	M5	0 = No Press 1 = Press
sixth	M6	0 = No Press 1 = Press
seventh	M7	0 = No Press 1 = Press

Function keys ◧	Code	Range
first	P1	0 = No Press 1 = Press
second	P2	0 = No Press 1 = Press
third	P3	0 = No Press 1 = Press
fourth	P4	0 = No Press 1 = Press

15.5 Analog outputs

On the rear panel of USN 60 you will find a 15-way Sub-D socket that makes analog switching and control voltages available with a corresponding instrument setting. The cable UN 65, provided with a Sub-D plug on the instrument side, is used as an accessory part for analog voltage operations. There is no plug on the user side. Please use the connections as required according to the opposite table:



Contact pin	Designation	Signal direction	Level	Color of the wire UN65 cable
1	EXT_TRIG	Input	TTL	blue
2	DATA_OUT_INH	Input	TTL	green
3	RES_ALARM	Input	TTL	red
4	ANALOG OUT #3	Output	0 ... 2.5 V	orange
5	ANALOG OUT #4	Output	0 ... 2.5 V	white
6	ANALOG OUT #1	Output	0 ... 2.5 V	blue/white
7	ANALOG OUT #5	Output	0 ... 2.5 V	green/white
8	DATA_VALID	Output	TTL	red/white
9	TTL #2	Output	TTL	orange/white
10	TTL #3	Output	TTL	white/black
11	TTL #1	Output	TTL	blue/black
12	GROUND	–	–	black
13	SAP_OUT	Output	TTL	green/black
14	MUXD_ASN_ENA	Input	TTL	red/black
15	NC	–	–	black/white

Signal description

External trigger input (EXT_TRIG)

An external triggering of the USN 60 is only available in spike mode, i.e. **PULSER TYPE** = **SPIKE**.

The rising flank of the signal triggers the start of the next cycle. After 35 µs, the pulser sends the first pulse.

The USN 60 takes only signals into consideration that show a low level before the rise for at least 4 ns and afterwards have “high level” for at least 40 ns.

☞ **Note:**

The external trigger signal only starts a new cycle if the option **EXTERNAL** is selected for the function **PRF MODE** (only possible for **PULSER TYPE** = **SPIKE**).

Test data release (DATA_OUT_INH)

All outputs are activated with the rising flank.

Alarm acknowledgement (RES_ALARM)

The alarms at the TTL outputs are reset with the rising flank.

☞ **Note:**

Alarms are only reset if the option **LATCHED** is selected for the function **MODE**.

Analog outputs 1 ... 4 (ANALOG OUT #1 ... 4)

The output voltage is proportional to the reading displayed in the corresponding display box. It corresponds either to the amplitude of the highest echo within the corresponding gate or to the measured wall thickness (time of flight).

If an amplitude is displayed in the display box, the maximum signal voltage of 2.5 V corresponds to an amplitude of 100 % screen height. A voltage of 0 V corresponds to 0 % screen height.

If a wall thickness is displayed in the display box, then the maximum signal voltage of 2.5 V corresponds to the largest wall thickness that can be displayed on the screen. A voltage of 0 V corresponds to the smallest wall thickness that can be displayed on the screen, i.e. to the value in **DISPLAY DELAY**.

☞ Note:

In wall thickness operations, the signal voltage varies according to the settings of the functions **RANGE** and **DISPLAY DELAY**.

Data valid (DATA_VALID)

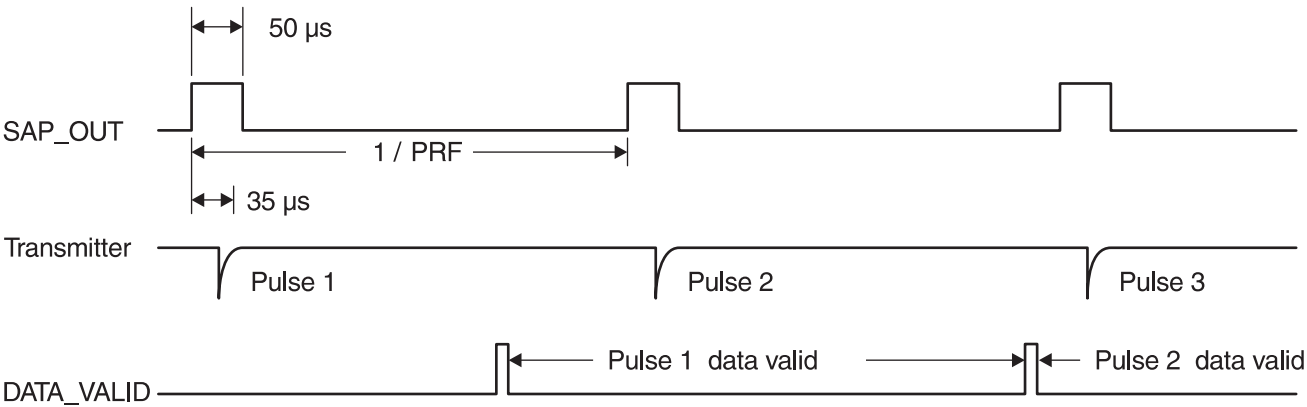
The signal is output once per cycle and signals the validity of the data. High level means that the data are still being processed. When changing from high level to low level, the data are valid and stable (please see figure).

Switching outputs 1 ... 3 (TTL # 1 ... 3)

The output signal corresponds to the alarm status. High level means alarm status, low level means no alarm.

☞ Note:

The alarm statuses are given according to the settings of the function group **TTL OUT**.



Transmitter trigger pulse (SAP_OUT)

A transmitter trigger pulse is output here for 50 psec at the start of every cycle. The pulser sends the first initial pulse 35 psec after changing to the high level (please see figure on the preceding page).

MUXD synchronization (MUXD_ASN_ENA)

A signal from the MUXD multiplexer from GE Inspection Technologies can be recorded at this input.The signal serves for transmitting the channel from the MUXD provided for the display in the USN 60.

Appendix 16

16.1 Function directory

☞ Notes:

The functions marked with * are located in the test menu.

The functions marked with ** are only available if the option DGS is installed.

The functions marked with *** are only available if the option Interface Echo Gate is installed.

The functions marked with ‡ are only available if the option Backwall Echo Attenuation is installed.

Function	Function group	Submenu	Description
ACTION	FILENAME	FILES	Selection of an action for file management
A INDICATION	AWS D1.1	TRIG	Absolute instrument gain for maximum flaw echo
ALARM RST *			Acknowledgement of an alarm
ALARM SELECT	NSE IMMN	GATES	Selection of the TTL output for setting the noise suppression.
AMPL CORRECT **	REF CORR	DGS	Amplitude correction
AMPLITUDE	GAIN	PLSRCVR	Display of amplitude value
ASCAN COLOR	DISPLAY	BASIC	Selection of color for the A-scan

Function	Function group	Submenu	Description
ASCAN ENHANCE	CONFIG	BASIC	Echo display with analog display effects
ASCAN MODE	CONFIG	BASIC	Selection of echo display mode
ASCAN PRINT ?	PRINTER	FILES	Recording A-scan in the test report
AWS MODE	A POS.	TRIG	Switches the AWS evaluation off or on
A THRESHOLD	A POS.	TRIG	Response threshold of the A gate
A THRESHOLD	RECORD	TCG	Response threshold of the A gate
BATTERY TYPE	OPTIONS	BASIC	Selection of the battery type
BAUD RATE	SER COMM	FILES	Selection of the data transfer rate
B REFERENCE	AWS D1.1	TRIG	Absolute instrument gain for maximum reference echo
BRIGHTNESS	DISPLAY	BASIC	Display brightness
B START ‡	BCK ATTN.	PLSRCVR	Start point of the B gate
BW GAIN ‡	BCK ATTN.	PLSRCVR	Separate gain for the echoes in gate B.
C ATTENUATION	AWS D1.1	TRIG	Automatically calculated sound attenuation.
CLEAR READING	DL DATA	FILES	Deletion of current reading in the Data Logger
COLOR	DISPLAY	BASIC	Selection of a color scheme for the display

Function	Function group	Submenu	Description
COLOR LEG	COLORING	TRIG	Coloring of legs in the ascan or grid
COPY MODE	PRINTER	FILES	Setting the function of the c key
COUNT	NSE IMMN	GATES	Number of echoes needed to trigger an alarm.
CREATE NEW	FILENAME	FILES	Creating a new file
DAC MODE	MODE	DAC/TCG	Setting of the DAC/TCG
DAC OFFSET	SETUP 2	DAC/TCG	dB offset of multiple DAC curves
DAMPING	PULSER	PLSRCVR	Setting of the damping resistance
DATE	REGIONAL	BASIC	Setting of the current date
dB REF	GAIN	PLSRCVR	Recording of reference echoes
dB REF *			Recording of reference echoes
dB STEP	GAIN	PLSRCVR	Setting the step size for gain variation
dB STEP *			Setting the step size for gain variation
D D1.1 RATING	AWS D1.1	TRIG	Result of the evaluation according to AWS
DELAY VELOCITY **	DGS PROBE	DGS	Sound velocity in the delay line
DELAY VELOCITY ***	IF ADV	TRIG	Sound velocity in the medium with immersion testing

Function	Function group	Submenu	Description
DELETE	FILENAME	FILES	Action: Delete file
DELETE CURVE !	SETUP 1	TCG	Deletion of DAC
DELETE REF **	REF CORR	DGS	Reference echo is deleted
DETECTION	GATEMODE	GATES	Detection or measurement point (peak, flank)
DGS CURVE **	DGS PROBE	DGS	Size of the DGS curve (diameter of circular disk)
DGS CURVE **	SETUP	DGS	Size of the DGS curve (diameter of circular disk)
DGS MODE **	SETUP	DGS	Switches the DGS evaluation off or on (only with reference echo)
DISPLAY DELAY	RANGE	BASIC	Setting of the measurement range
DISPLAY START	CONFIG	BASIC	Display start with initial pulse or interface echo
DL PRINT	NOTES	FILES	Recording readings from the Data Logger in the test report
DUAL	RECEIVER	PLSRCVR	Pulser-transmitter separation
EDIT	MEMO	FILES	Editing of memo texts
EDIT	NOTES	FILES	Editing of notes
EDIT	REP HEAD	FILES	Editing of file headers
ENERGY	PULSER	PLSRCVR	Setting of initial pulse energy

Function	Function group	Submenu	Description
ENTER	EDIT	TCG	Recording of a change in DAC
EVAL. RESULT **	EVALUATE	DGS	Choice of the evaluation result for the DGS method
FILENAME	DL DATA	FILES	Name of a file
FILENAME	FILENAME	FILES	Name of a file
FINISH	RECORD	TCG	Ending the recording of D AC or TCG
FREEZE MODE	OPTIONS	BASIC	Selection of action with A-scan freeze
FREQUENCY	RECEIVER	PLSRCVR	Selection of the frequency range for the connected probe
GATE A START	RECORD	TCG	Start point of the A gate
GATE A START **	REF-ECHO	DGS	Start point of the A gate
GATE A START	A POS.	TRIG	Start point of the A gate
GATE A START	SETUP	AUTOCAL	Start point of the A gate
GATE B WIDTH ‡	BCK ATTN.	PLSRCVR	Width of the B gate
GATE SELECT	ALARMS	GATES	Selection of a gate to be edited
GATE SELECT	GATEMODE	GATES	Selection of a gate to be edited
GATE SELECT	POSITION	GATES	Selection of a gate to be edited

Function	Function group	Submenu	Description
GATE START	POSITION	GATES	Start point of selected gate
GATE THRESHOLD	POSITION	GATES	Response threshold of a gate
GATE WIDTH	POSITION	GATES	Width of selected gate
GATE WIDTH	A POS.	TRIG	Width of a gate
GRID	DISPLAY	BASIC	Selection of display screen grid
HEADER NUMBER	REP HEAD	FILES	Selection of a line in the file header
HIGH LIMIT	LIMITS	GATES	Maximum wall thickness
HORN	ALARMS	GATES	Alarm horn enable/disable
IF DELAY MODE ***	IF ADV	TRIG	Choice of test method
IF OFFSET ***	IF ADV	TRIG	Correction referring to the exact time-of-flight measurement with IF triggering
INSTALLED OPT.	OPTIONS	BASIC	Overview of installed options
LANGUAGE	REGIONAL	BASIC	Selection of language
LOGIC	ALARMS	GATES	Selection of gate logic for selected gate
LOS	SER COMM	FILES	TTL level at output if no echo available in gate
LOW LIMIT	LIMITS	GATES	Minimum wall thickness

Function	Function group	Submenu	Description
LRG DISP *			Changing the display in the large display box
MAGNIFY *			Expanding of selected gate to screen width
MAGNIFY GATE	GATEMODE	GATES	Selecting the gate for zooming
MASTER LOCK	OPTIONS	BASIC	Locking of all functi ons except for the gain
MATERIAL	CONFIG	BASIC	Selecting the material of the test object
MODE ‡	BCK ATTN.	PLSRCVR	Activating the Backwall Echo Attenuation
MODE	TTL-OUT	GATES	Setting the signal output of TTL outputs
NOTE ACTION	DL-DATA	FILES	Using notes
NOTE NUMBER	NOTES	FILES	For the selection of a note
NOTE PRINT ?	NOTES	FILES	Recording of texts of all notes in the test report
NOTES	NOTES	FILES	Seven editable comments for thickness readings
O-DIAMETER	SETUP	TRIG	Setting of the outside diameter with curved surfaces
OUTPUT DELAY	ALARMS	GATES	Delay of gate alarm
PARAM PRINT ?	PRINTER	FILES	Recording of instrument settings in the test report
POINT	EDIT	TCG	Selecting a curve point for editing

Function	Function group	Submenu	Description
PREVIEW	FILENAME	FILES	File preview with file header and memo text
PRF MODE	PULSER	PLSRCVR	Selecting the mode of pulse repetition frequency
PRF VALUE	PULSER	PLSRCVR	Setting the value for pulse repetition frequency
PRINT ?	MEMO	FILES	Recording of a memo text in the test report
PRINT ?	REP HEAD	FILES	Recording of a header file in the test report
PRINTER	PRINTER	FILES	Selecting a printer for the test report
PROBE # **	SETUP	DGS	Number of the probe
PROBE ANGLE	SETUP	TRIG	Input of the angle for calculating the (reduced) projection distance with angle-beam probes
PROBE DELAY	RANGE	BASIC	Compensating for the probe delay line
PROBE DELAY	READING	AUTOCAL	Display of probe delay line
PROBE NAME	DGS PROBE	DGS	Name of the probe
PROBE NAME	SETUP	DGS	Name of the probe
PULSER TYPE	PULSER	PLSRCVR	Selecting square or spike pulser
RANGE	RANGE	BASIC	Setting of the measurement range

Function	Function group	Submenu	Description
READING 1	RESULTS	BASIC	Reading in the display box at the top left
READING 2	RESULTS	BASIC	Reading in the display box at the bottom left
READING 3	RESULTS	BASIC	Reading in the display box at the top right
READING 4	RESULTS	BASIC	Reading in the display box at the bottom right
RECALL	FILENAME	FILES	Loading a stored data set
RECORD	RECORD	TCG	Recording of a reference echo
RECORD	SETUP	AUTOCAL	Recording of a calibration step
RECORD REF **	REF-ECHO	DGS	Reference echo is recorded (and saved)
RECTIFY	RECEIVER	PLSRCVR	Selection of rectification mode
REF ATTEN. **	REF CORR	DGS	Sound attenuation in the reference block
REF SIZE **	REF-ECHO	DGS	Diameter of the reference echo used
REFERENCE TYPE **	REF-ECHO	DGS	Type of the ref erence echo used
REJECT	RECEIVER	PLSRCVR	Suppression of unwanted echo indications
SCROLL FILE	DL DATA	FILES	Navigation within a Data Logger file
S-REF1	SETUP	AUTOCAL	Length of the first calibration step with automatic calibration

Function	Function group	Submenu	Description
S-REF2	SETUP	AUTOCAL	Length of the second calibration step with automatic calibration
START MODE (Gate A)	GATEMODE	GATES	Gate position setting for gate A via IP or IF
START MODE (Gate B)	GATEMODE	GATES	Gate position setting for gate B via IP, IF or gate A
TCG ATTEN	SETUP 2	TCG	Adaptation of TCG to the test object's material
TCG DISPLAY	SETUP 1	TCG	Display of DAC
TCG GAIN	EDIT	TCG	Gain variation on a curve point of DAC or TCG
TCG MODE	SETUP 1	TCG	TCG mode
TCG START MODE	SETUP 1	TCG	Display start of TCG
TCG TIME	EDIT	TCG	Position of a curve point
TEST ATTEN **	MAT ATTN	DGS	Sound attenuation of the test object
THICKNESS	SETUP	TRIG	Input of workpiece thickness for calculating the true flaw depth
TIME	REGIONAL	BASIC	Current time
TRANSFER CORR. **	MAT ATTN	DGS	Correction of transfer loss
TRANSFER CORR	SETUP 2	TCG	Correction of instrument sensitivity

Function	Function group	Submenu	Description
TTL #1	TTL-OUT	GATES	Selection of the alarm event for activating the output 1
TTL #2	TTL-OUT	GATES	Selection of the alarm event for activating the output 2
TTL #3	TTL-OUT	GATES	Selection of the alarm event for activating the output 3
UNITS	REGIONAL	BASIC	Selecting units of measurement
USER GAIN STEP	GAIN	PLSRCVR	User-definable step size for gain variation
VELOCITY	RANGE	BASIC	Current sound velocity
VIEW *			Change of A-scan view
VOLTAGE	PULSER	PLSRCVR	Voltage of initial pulse
WIDTH	PULSER	PLSRCVR	Width of initial pulse
WINDOW	NSE IMMN	GATES	Setting the number of transmitter cycles in which the flaw echoes must occur before an alarm is output
XTAL DIAMETER **	DGS PROBE	DGS	Effective probe element diameter
XTAL FREQUENCY **	DGS PROBE	DGS	Frequency of the probe
X VALUE	SETUP	TRIG	Input of the distance between probe index and the front face of the angle-beam probe

16.2 Manufacturer/ Service addresses

The Krautkramer USN 60 is manufactured by:

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

Phone +1 717 - 242 03 27
Fax +1 717 - 242 26 06

The Krautkramer USN 60 is manufactured using high-quality components according to state-of-the-art methods. Thorough in process inspections and a quality management system certified according to DIN EN ISO 9001 ensure an optimum quality of conformance of the instrument.

Should you nevertheless detect an error or malfunction on your product, please inform the Service of GE Inspection Technologies responsible for your products by giving the details (if possible, error number) and a description of the error or malfunction.

Keep the shipping container for any possibly required repair work that cannot be carried out on site.

If there's anything specific you would like to know about the use, handling, operation and specifications of your instrument, or about our Service Agreement, please contact your local representative of GE Inspection Technologies, or one of the following direct addresses:

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Changes 17

Changes

This chapter contains information about changes and additions made at short notice and not yet included in the operating manual.

If none exist, the chapter remains blank.

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