

Subject to change without notice.

USM 32X F V.02.01.1x

USM 32X L V.02.02.1x

USM 32X B V.02.00.1x

This issue 01, 04/2005 applies to the following software versions:

Unfold this page. You will find an overview of the function groups and operator's controls. This information will help you to quickly find your way through the operating manual.

USM 32X

Technical Reference and Operating Manual

Ident-Nr. 48 008

USM 32X B

RANGE
250 _{nm}
MTLVEL
± 5920%
D-DELAY
± 0.00 _{nm}
P-DELAY
0.000 _{µs}

BASE

DAMPING
low
POWER
low
REJECT
0%
DUAL
off

P/R

aLOGIC>
pos
aSTART>
± 35.00
aWIDTH>
± 40.00
aTHRSH>
40%

GATE

SET-#
1
RECALL
off
STORE
off
DELETE
off

MEM

S-DISP>
off
FILLED>
off
COPYM0>
report
DIALOG>
English

CFG

USM 32X L

RANGE
250 _{nm}
MTLVEL
± 5920%
D-DELAY
± 0.00 _{nm}
P-DELAY
0.000 _{µs}

BASE

PRF-MOD
10
POWER >
low
FREQU >
2 - 18
DUAL
off

P/R

aLOGIC>
pos
aSTART>
± 35.00
aWIDTH>
± 40.00
aTHRSH>
40%

GATE

SET-#
1
RECALL
off
STORE
off
DELETE
off

MEM

S-DISP>
off
FILLED>
off
COPYM0>
report
DIALOG>
English

CFG

Note:

The character > after a function indicates a double assignment.

USM 32X F

RANGE
250 _{nm}
MTLVEL
± 1450%
D-DELAY
± 0.00 _{nm}
P-DELAY
0.000 _{µs}

BASE

DAMPING
low
POWER
low
REJECT
0%
DUAL
off

P/R

aLOGIC>
pos
aSTART>
± 35.00
aWIDTH>
± 40.00
aTHRSH>
40%

GATE

SET-# >
± 1
RECALL
off
STORE
off
DELETE>
off

MEM

S-DISP>
off
FILLED>
off
COPYM0>
report
DIALOG>
English

CFG








Status symbols

Symbol	Description
*	Display memory is enabled (freeze), display is stored.
!	Data transfer active, printing or remote control
B	Battery indicator; appears with low battery charge, batteries must be charged.
F	TOF is set to flank.

LED

Symbol	Description
A	Gate alarm
R	Function REJECT is active.
D	Function DUAL (pulser-receiver separation) is active.

Key functions

Key	Function
	Switching the unit on and off
	Step size for gain setting
	Storage (freezing) of screen display
	Enlarged echo display over the entire screen
	Printing or transferring data
	Selecting the function group
	Selecting the function


1 Introduction	1-1	1.3 The USM 32X	1-8
1.1 Safety information	1-2	The different instrument versions	1-8
Batteries	1-2	Special features	1-9
Software	1-2	1.4 How to use this manual	1-11
Defects/errors and exceptional stresses	1-3	1.5 Layout and presentation in	
1.2 Important information on		this manual	1-11
ultrasonic testing	1-3	Attention and Note symbols	1-11
Preconditions for testing with		Listings	1-12
ultrasonic test equipment	1-3	Operating steps	1-12
Operator training	1-4		
Technical test requirements	1-4	2 Standard package and	
Limits of testing	1-5	accessories	2-1
Ultrasonic wall thickness measurement	1-5	2.1 Standard package	2-3
Effect of the test object's material	1-5	2.2 Recommended accessories	2-6
Effect of temperature variations	1-6	2.3 Recommended externally supplied	
Measurement of remaining wall		accessories	2-8
thickness	1-6		
Ultrasonic evaluation of flaws	1-6		
Flaw boundary method	1-6		
Echo display comparison method	1-7		

Contents

3	Initial start-up	3-1	4.3 Keys and rotary knobs	4-6
3.1	Power supply	3-2	Function keys	4-6
	Operation using the power supply unit	3-2	On/Off key	4-6
	Operation using batteries	3-3	Special keys	4-6
	Charging the batteries	3-5	Rotary knobs	4-7
3.2	Connecting a probe	3-7	4.4 Operational concept	4-8
			Setting the functions	4-8
3.3	Starting the USM 32X	3-8	4.5 Important basic settings	4-9
	Switching on	3-8	Selecting the language	4-9
	Reset	3-8	Selecting units	4-9
	Information lines in the startup screen	3-8	4.6 Basic settings of the display	4-11
			Selecting the color scheme	4-11
4	Principles of operation	4-1	Setting the lighting	4-11
4.1	Operator's controls	4-2		
4.2	Screen display	4-3		
	Functions on the display	4-4		
	Other displays	4-5		

5	Operation	5-1		
5.1	Overview of the functions	5-2		
	Function groups	5-2		
5.2	Setting the gain	5-3		
	Defining the dB incrementation for gain	5-3		
5.3	Adjusting the display range (function group BASE)	5-4		
	RANGE (Display range)	5-4		
	MTLVEL (Sound velocity)	5-5		
	D-DELAY (Display starting point)	5-6		
	P-DELAY (Probe delay)	5-6		
5.4	Adjusting the pulser and receiver (function group P/R)	5-7		
	DAMPING (Probe matching)	5-7		
	POWER (Intensity)	5-8		
	REJECT	5-8		
	DUAL (Pulser-receiver separation)	5-9		
	PRF-MOD (Pulse repetition frequency)	5-9		
	FREQU (Frequency range)	5-10		
5.5	Setting the gates (function group GATE)	5-11		
	Tasks of the gates	5-11		
	aLOGIC/bLOGIC (Evaluation logic of the gates)	5-12		
	aSTART/bSTART (Starting points of the gates)	5-13		
	aWIDTH/bWIDTH (Width of the gates) ...	5-13		
	aTHRSH/bTHRSH (Response and measurement threshold of the gates)	5-13		
5.6	Calibrating the USM 32X	5-14		
	Calibrating the display range	5-14		
	Calibration with straight-beam probes	5-14		
	Calibration with dual-element (TR) probes	5-18		
5.7	Measuring	5-22		
	General notes	5-22		

Contents

5.8 Data saving (function group MEM)	5-24	5.11 Status symbols and LEDs	5-33
Storing a data set	5-25	Status symbols	5-33
Deleting a data set	5-25	LEDs	5-33
Recalling a stored data set	5-26	6 Documentation	6-1
5.9 Configuring the USM 32X	5-27	6.1 Printing data	6-2
S-DISP (Zoomed display of reading)	5-27	Preparing the USM 32X	6-2
FILLED (Echo display mode)	5-28	Preparing the printer	6-3
COPYMOD (Assignment of the  key)	5-28	Printing	6-3
DIALOG (Selecting the language)	5-29	6.2 Documentation with UltraDOC	6-4
SCHEME	5-30	7 Maintenance and care	7-1
LIGHT	5-30	7.1 Care of the instrument	7-2
PRINTER (Printer for test report)	5-31	7.2 Care of the batteries	7-3
UNIT (Selecting units of measurement)	5-31	Care of the batteries	7-3
5.10 Other functions with special keys	5-32	Charging the batteries	7-3
Freeze	5-32	How to handle alkaline batteries	7-4
Zooming the echo display	5-32	7.3 Maintenance	7-5

7.4 Recycling	7-6	9 Appendix	9-1
General view of the device	7-6	9.1 Function directory	9-2
Materials for separate disposal	7-8	9.2 EC declaration of conformity	9-4
Further materials and components	7-10	9.3 Manufacturer/Service addresses	9-4
Recycling data of master device	7-12	9.4 Spare parts list	9-6
8 Interfaces and peripherals	8-1	10 Special measurements	
8.1 Interfaces	8-2	using the USM 32X F	10-1
8.2 RS 232 interface	8-3	10.1 Calibration	10-2
Contact assignment of the Sub-D socket	8-3	Calibrating the display range	10-2
Data exchange	8-4	10.2 Measurement	10-3
Connecting a printer or a PC	8-4	Measurement on a live pig	10-3
Activation of serial communication	8-4	Preparing a measurement series	10-5
Printing data	8-5	Saving readings	10-5
8.3 Remote control	8-6	Clearing the data logger	10-6
Syntax and timing	8-8	10.3 Documentation	10-6
Functions and remote control codes	8-14		
Other remote control codes	8-17		
Control codes for the rotary knobs/ function keys	8-18		

Contents

11 Changes 10-1

12 Index 11-1

**Technical Specifications according
to EN 12668-1**

Introduction 1

1.1 Safety information

The USM 32X has been designed and tested according to DIN EN 61 010 Part 1, 2002, Safety requirements for electrical measuring, control and lab equipment, 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, you should urgently read the following safety information before putting the instrument into operation.



Attention:

The USM 32X is an instrument for materials testing. Any use for medical applications or other purposes is not allowed!

The USM 32X may only be used in industrial environments!

The USM 32X can be operated with batteries or a power supply unit.

The power supply unit has the electrical safety class II.

Batteries

For the battery operation of the USM 32X, we recommend the use of a lithium-ion battery. The operation using alkaline batteries, NiMH or NiCad cells is likewise possible. You should only use the products recommended by us for the battery operation.

You can charge the lithium-ion battery within the instrument itself or in an external battery charger. If you want to use NiMH or NiCad cells, you have to charge them in an external battery charger.

As soon as you connect the power supply unit to the USM 32X, the battery power supply is interrupted. If a lithium-ion battery is inserted, the charging process starts automatically when you connect the instrument to the mains supply. Please refer to chapter 3.1 on power supply, and to chapter 7 on how to handle 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 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 USM 32X 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 USM 32X. 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.

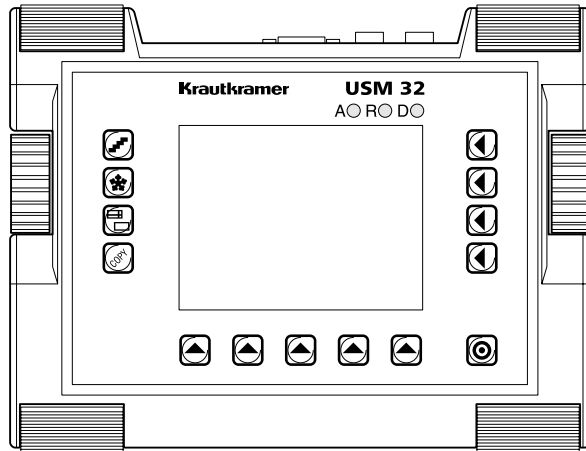
If the test object has a rough surface, part of the incident sound energy will be scattered at its surface and is not available for the test. The larger this initial scattering, the smaller the flaw echoes appear, and the more errors occur in the evaluation result.

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 USM 32X

The USM 32X is a lightweight and compact ultrasonic flaw detector especially suitable for

- locating and evaluating material defects,
- measuring wall thicknesses.



The different instrument versions

The USM 32X is available in several versions which are designed for different applications:

- **Basic version USM 32X B**
standard version, for universal ultrasonic test tasks.
- **Version USM 32X L**
special version, designed for ultrasonic testing of large components (up to 10 m / 390") and for the frequency range from 0.1 to 18 MHz. Typical applications using this version are thickness measurement and flaw detection on:
 - large forgings
 - cast blocks (steel, aluminium)
 - workpieces made of non-ferrous metals
 - plastics
 - composites (bonding test)
- **USM 32X F**
special version, designed for the measurement of fat and muscle thicknesses in stockbreeding.

Special features

All versions

- low weight (2.2 kg including lithium-ion battery) and compact size
- long operating time (> 10 hours) by means of lithium-ion battery with internal and external charging possibility
- handy – equipped with handle/non-slip, ratcheting prop-up stand
- rotary knobs for direct adjustment of gain as well as for changing the currently selected function
- two independent gates for accurate wall thickness measurements from the workpiece surface up to the first echo, or between two backwall echoes, including measurement on coated workpieces with a resolution of 0.01 mm (up to 100 mm), referred to steel (0.1 mm in USM 32X F)
- 5.7", 1/4 VGA-TFT color display to display the digitized signals (320 × 240 pixels, 115 × 86 mm)

- display of sound path and amplitude for gate A plus 1 reading zoomed in the A-scan, user-configurable
- data memory: 100 data sets, documentation possibility via a printer or in file

USM 32X L

- increased calibration range: up to 9999 mm/390" (steel), depending on the frequency range
- pulse repetition frequency variable in ten steps to avoid phantom echoes when testing large workpieces
- selection of frequency range for the connected probe

All other functions correspond to those of the basic version.

USM 32X F

- special gate evaluation:
Several echoes from the different tissue layers appear with fat thickness measurement. The gate is set in such a way that all echoes are covered. The measurement function of the gate displays the sound path of the last echo in gate A and the sound path difference between gate B and gate A. These are the relevant measured values for the evaluation.
- display of amplitude for gate A and test location number plus 2 readings (fat and muscle thickness) zoomed in the A-scan

All other functions correspond to those of the basic version.

1.4 How to use this manual

The present operating manual applies to all instrument versions of the USM 32X. Differences in the functions or setting values are always marked.

Before operating the USM 32X 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 11 *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.

The specifications/Technical Specifications according to EN 12668-1 can be found in the attachment at the end of this operating manual.

1.5 Layout and presentation in this manual

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.

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:

- Loosen the two screws at the bottom.
- Remove the cover.
- ...

Standard package and accessories **2**

Scope of supply and accessories

This chapter informs you about the standard package and the accessories available for the USM 32X.

It describes

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

2.1 Standard package

Product code	Description	Order number
USM 32X B	Ultrasonic testing kit with Lemo connectors	36 066
	or with BNC connectors	36 067
	consisting of:	
USM 32X	Compact Ultrasonic Flaw Detector, basic version Lemo or BNC	
	Power supply unit/charger	102 163
UM 30	Transport case	35 654
	Manufacturer's certificate	
	Operating manual in English	48 007

Scope of supply and accessories

Standard package

Product code	Description	Order number
USM 32X L	Ultrasonic testing kit with Lemo connectors	36 074
	or	
	with BNC connectors	36 075
	consisting of:	
USM 32X	Compact Ultrasonic Flaw Detector, especially for use on large forgings or workpieces showing high sound attenuation or sound scattering, e.g. castings, plastics, fiber composites Lemo or BNC	
	Power supply unit/charger	102 163
UM 30	Transport case	35 654
	Manufacturer's certificate	
	Operating manual in English	48 007

Product code	Description	Order number
USM 32X F	Ultrasonic testing kit with Lemo connectors	36 068
	or	
	with BNC connectors	36 069
	consisting of:	
USM 32X	Compact Ultrasonic Flaw Detector, especially for fat and tissue thickness measurement, Lemo or BNC	
	Power supply unit/charger	102 163
UM 30	Transport case	35 654
	Manufacturer's certificate	
	Operating manual in English	48 007

2.2 Recommended accessories

Product code	Description	Order number
	Operating manual in German	48 008
	Operating manual in French	48 009
	Operating manual in Spanish	48 010
	Operating manual in Japanese	48 011
	Operating manual in Chinese	48 012
LI-ION	Li-Ion battery NI2020, 10.8 V, 6.6 Ah	102 208
DR36	Battery charger for external charging of the Li-Ion battery	35 297
NCA 1-6	6 NiCd cells (alternatively to Li-Ion battery)	25 810
Energy 16	Desk rapid charger for external charging of NiMH or NiCd cells	101 729
UM 32	Protection bag including neck strap	35 655
UD 20	PC cable, 25-pin (PC), 9-pin (instrument)	32 291

Product code	Description	Order number
UD 31	PC cable, 9-pin (PC), 9-pin (instrument)	34 943
UD 30	Seiko Printer cable, 9-pin (instrument)/9-pin (printer)	18 495
UD 32	Epson Printer cable, 9-pin (instrument)/25-pin (printer)	34 944
	Adapter 25/9-pin for printer cable UD 19-1 on USM 35	16 121
	Serial-to-parallel printer cable (Patton, Model 2029)	101 761
USB-RS	Adaptor USB/RS for PC without COM port	35 838
UM 200 W	UltraDOC data communication software for USM	35 024
U 100 W	UltraDOC	33 829
PZ-USM32	Calibration certificate according to EN 12668-1	35 779

2.3 Recommended externally supplied accessories

Product code	Description	Order number
Epson LX	Matrix printer for mains operation, single sheet and continuous stationary	17 995
Seiko DPU	Thermal printer for mains and battery operation	17 993

Initial start-up **3**

3.1 Power supply

The USM 32X can be operated with an external power pack adaptor or with batteries.

You can connect the USM 32X to the mains supply system even if it carries batteries. The battery power is then automatically interrupted.

Operation using the power supply unit

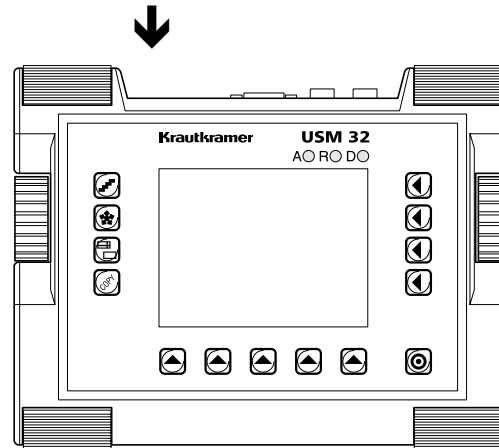
Mains connection

The power supply unit is delivered with two different power cables – for Euro and USA standard.

Connecting the instrument

Connect the USM 32X to the mains socket-outlet using the corresponding power supply unit. The plug receptacle is at the top left of the USM 32X.

- Push the Lemo plug of the power supply unit into the plug receptacle until it snaps into place with a clearly audible click.



- When pulling off the Lemo plug, withdraw the metal bushing on the plug first in order to release the lock.

The power supply unit is automatically set to any nominal voltage between 90 VAC and 240 VAC.

Operation using batteries

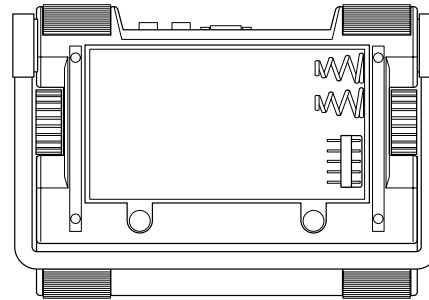
Use either a lithium-ion battery or 6 standard C-cells (NiCad, NiMH, or alkaline cells) for the battery operation. We recommend the use of a lithium-ion battery. It has a higher capacity and consequently ensures a longer operating time of the instrument.

Inserting batteries

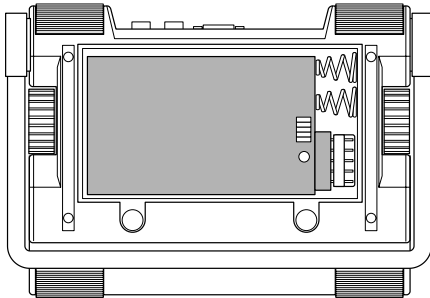
The battery compartment is situated at the instrument back; the lid is fastened with 2 attachment screws.

- Press the two attachment screws of the battery compartment downward in order to loosen them.

- Lift the lid off upward. To the right in the open battery compartment, you will see two springs and several connection pins.

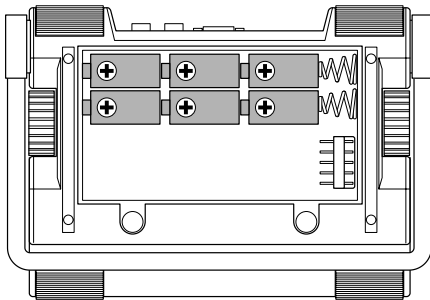


- Insert the battery into the battery compartment. To do this, first press the right side of the battery against the springs of the battery compartment. Make sure that the socket on the right side of the battery is connected with the connection pins in the battery compartment.



or

- Insert the batteries into the battery compartment and check the right polarity.



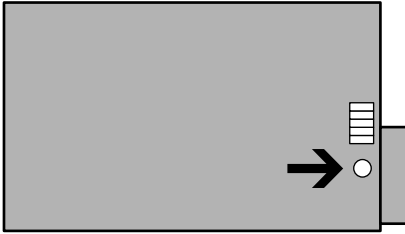
- Close the battery compartment and fasten the attachment screws.

Checking the battery charge of lithium-ion batteries

The lithium-ion battery is equipped with a battery charge indicator. The battery charge indicator is situated at the front right of the battery. Four LED's indicate the charge level of battery. Check the battery charge before inserting the battery into the instrument.

The number of LED's that are on has the following meaning:

- 4 LED's – battery charge 100 ... 76%
- 3 LED's – battery charge 75 ... 51%
- 2 LED's – battery charge 50 ... 26%
- 1 LED – battery charge 25 ... 10%
- 1 LED flashing – battery charge <10%



- Press the button PUSH at the front side of the battery. Four LED's indicate the charge level of battery.

 **Note:**

You can also check the battery charge even if the battery is located in the battery compartment of the instrument.

Battery charge indicator

In the measurement line of the USM 32X, an inverted **B** appears if the battery charge is low.

 **Note:**

If the icon for low battery charge appears, you should urgently close your test job and exchange the batteries. You should take replacement batteries with you if you aim to carry out measurements on site.

Charging the batteries

You can charge the lithium-ion battery either directly in the instrument or by means of an external battery charger. You always need an external battery charger to charge standard C-cells.

Internal charging

Requirement:

- Lithium-ion battery, order number 102 208
- Power supply/charger unit, order number 102 163

If a battery is located in the instrument, the charging process is started automatically when you connect the plug-in power supply unit. You can carry out ultrasonic inspections and charge a battery at the same time.

The charging time is 10 hours with a simultaneous ultrasonic inspection. If the instrument is not being used for ultrasonic inspections, the charging time is 8 hours. This charging time applies to ambient temperatures from 25 to 30 °C. Please take into consideration that the batteries are not charged to their full capacity at higher temperatures.

The LED display on the plug-in power supply unit indicates the status of the charging process.

External charging

Lithium-ion batteries can be charged by means of an external battery charger. We recommend the battery charger with the order number 35 297. To charge single NiCad or NiMH cells, you need the external desktop battery charger with the order number 101 729.

green LED	yellow LED	red LED	status
off	flashing	off	no battery detected
off	flashing dark/bright	flashing bright/dark	charging at low power
off	on	off	quick charging phase 1
flashing dark/bright	flashing bright/dark	off	quick charging phase 2
on	off	off	battery charged
off	off	flashing bright/dark	temperature error, auto-reversible
off	off	on	charging error, permanent

3.2 Connecting a probe

To prepare the USM 32X for operation, you have to connect a probe to it. Any Krautkramer probe can be used for the USM 32X, provided the appropriate cable is available and the operating frequency is within an adequate range.

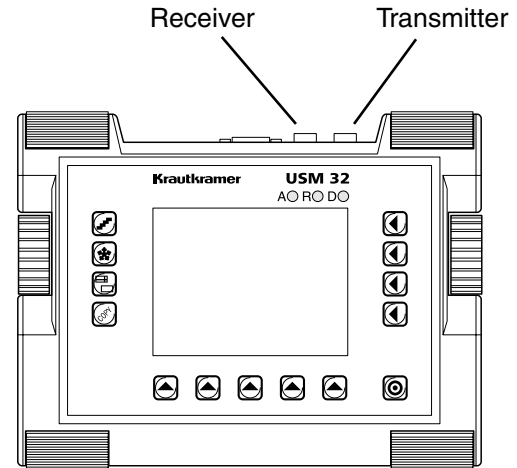
The USM 32X is available with the probe connectors LEMO-1-TRIAX or BNC.

The probe is connected to the sockets at the top right on the instrument casing. Both connector sockets are equally suitable (connected in parallel) for connecting probes equipped with 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 (TR) probe (having one transmitter element and one receiver element), or two probes (of which one is transmitting and the other one receiving), attention should be paid to connecting the transmitter element to the right-hand socket (transmitter, marked with black circle at the rear of the instrument case) and the receiver element to the left-hand socket (receiver, marked with red circle).

Attention:

If this is not taken into account, the consequence would be a mismatching which may lead to considerable power losses or even to echo waveform distortions.



3.3 Starting the USM 32X



Switching on

To start the USM 32X, press the switch-on key .

The start display of the USM 32X appears; here you will also see the current software version of the instrument. The instrument carries out a self-check and then switches over to stand-by mode.

The settings of all function values and the basic settings (language and units) are the same as before switching-on of the instrument.

Reset

If any functions can no longer be operated after a warm start, or if you want to reset the instrument to the basic setup, then you should carry out a cold start by simultaneously pressing the  and the  key.

The cold start message “Basic Initialization” is displayed. The instrument is initialized and reset to its basic setup (dialog language: English, for more details on how to select the language, please refer to chapter 4).



Attention:

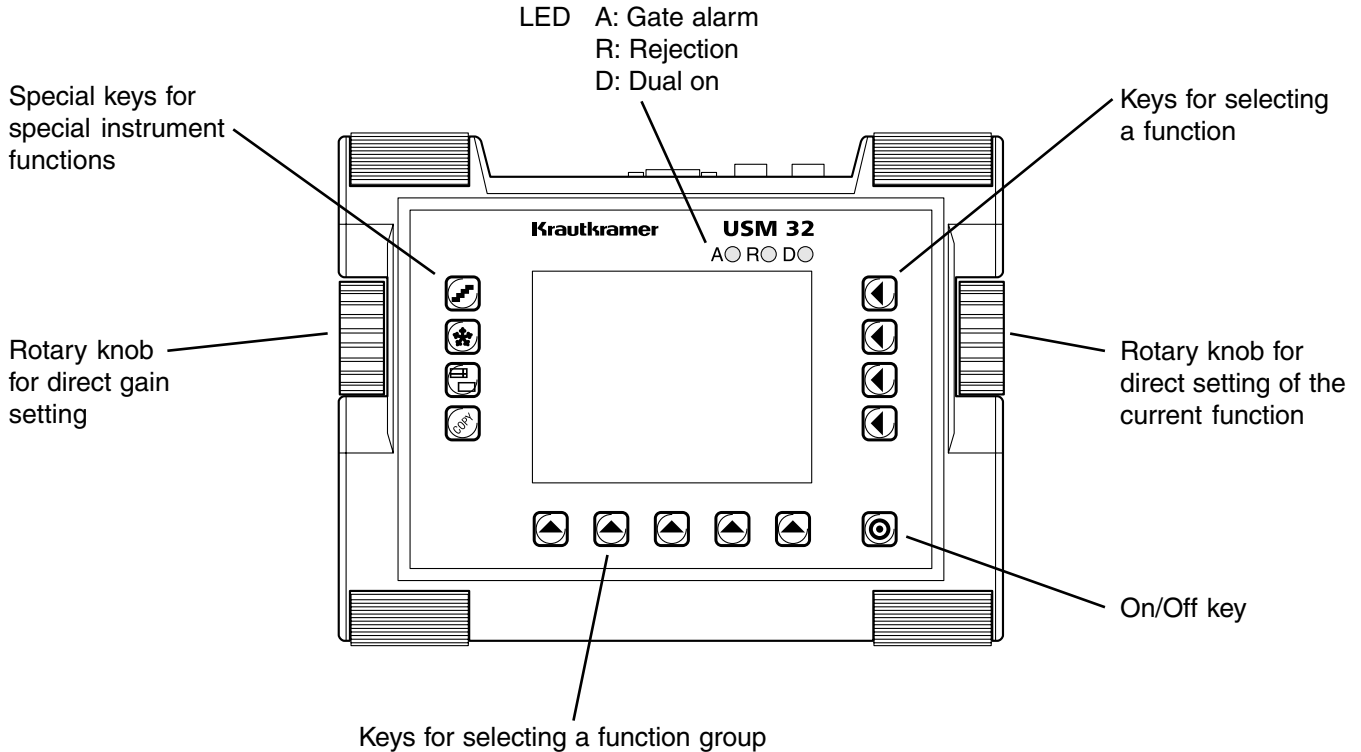
All saved data are deleted.

Information lines in the startup screen

You can enter two lines (each with up to 39 characters) for information purposes in the startup screen. For this use the remote function (codes I1 and I2, refer to chapter 8).

Principles of operation 4

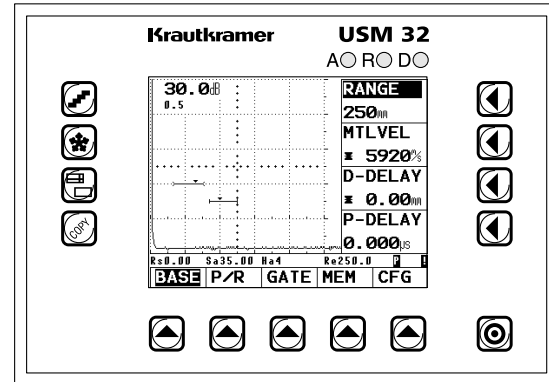
4.1 Operator's controls




4.2 Screen display

The USM 32X has a digital screen for the display of

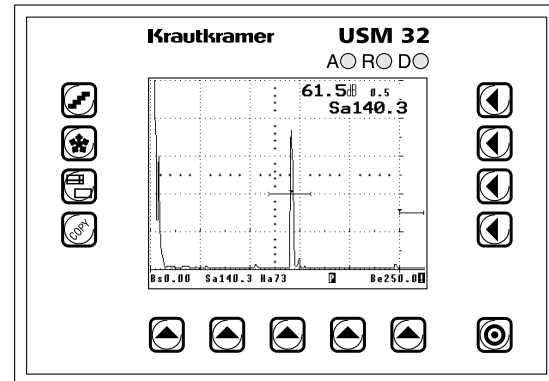
- A-scan in the normal mode



- A-scan in the zoom mode
The zoom mode is activated using the key .

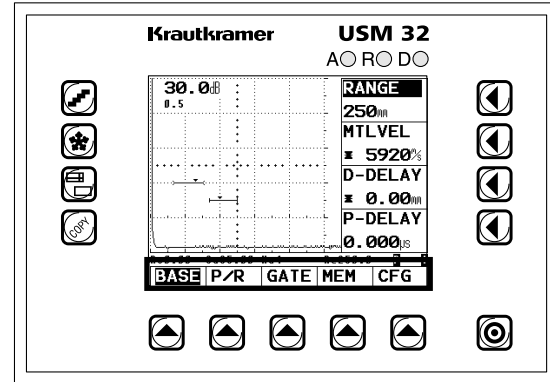
Note:

The screen display always shows the gain and the adjusted dB step value. All other functions are locked in zoom mode.

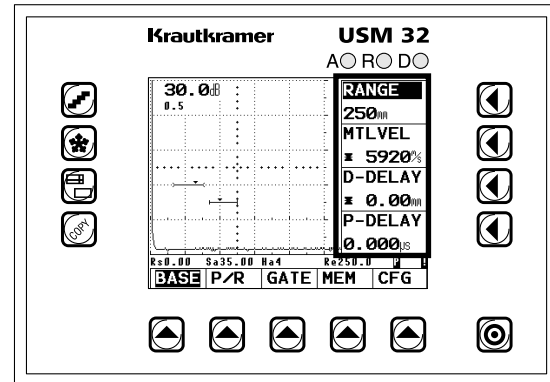


Functions on the display

The names of the five function groups are displayed at the bottom of the screen. The currently selected function group is highlighted.



Indicated at the right of the display, next to the A-scan, are the functions of the corresponding function group. The display of the functions disappears in the zoom mode.

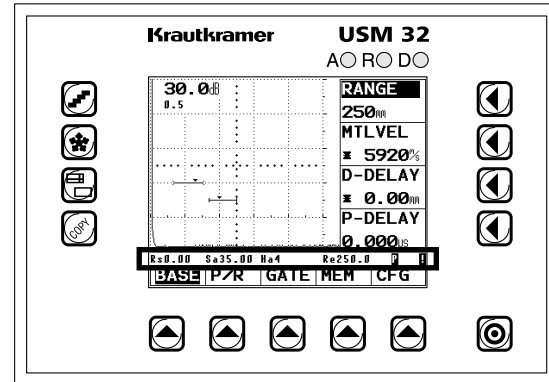


Other displays

The measurement line below the screen display shows values of settings, measured values, and status indications.



Note:

Every measurement value can also be shown in an enlarged display at the top right corner of the A-scan (setting in the function group **CFG**, function **S-DISP**).




4.3 Keys and rotary knobs

Function keys





-  For selection of the function groups
-  For selection and setting of the functions and for choice between coarse and fine adjustment

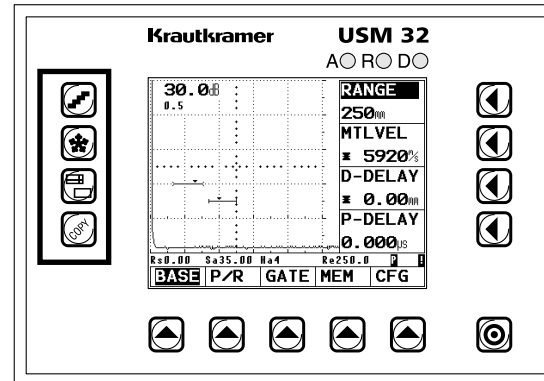
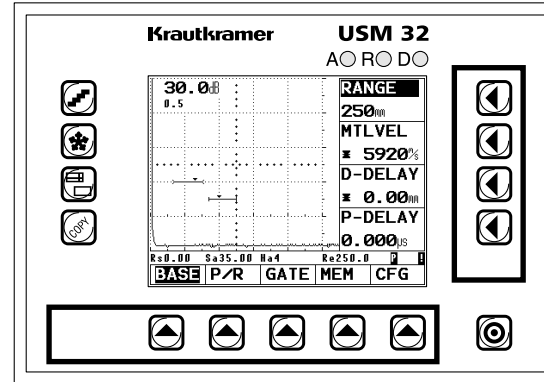
On/Off key

-  For turning the device on or off.

Special keys

To directly activate individual instrument functions:

-  To choose the increment for the gain setting
-  To freeze the A-scan
-  To display a zoomed A-scan
-  To transfer the data



Rotary knobs

The USM 32X 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.


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 Operational concept

The USM 32X is an easy-to-use instrument. It only has one operating level, all functions are directly accessible.


Setting the functions

Shown below the A-scan are the five function groups that you can directly select using the corresponding  key. The selected function group is highlighted and the corresponding four functions are displayed next to the A-scan on the right.


You can likewise directly select the individual functions using the corresponding  keys.

Functions with double assignments

Some functions have double assignments. You will recognize the functions with double assignments by an arrow (icon >) after the function name.

Toggle between the two functions by repeatedly pressing the corresponding key .

Coarse and fine adjustment of functions

You can choose between coarse and fine adjustment for some functions. You can toggle between these two adjustment modes by pressing the corresponding  key several times. The fine adjustment is identified by an asterisk preceding the function value.

The following functions offer a choice between coarse and fine adjustment:

Function	Function group
RANGE	BASE
MTLVEL	BASE
D-DELAY	BASE
P-DELAY	BASE

For more details on the adjustment possibilities, please read from page 5-5 onward.

4.5 Important basic settings

Selecting the language

Select the language in which the function names should be displayed on the screen in the function **DIALOG** (Function group **CFG**). The following languages are available:

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

Note:

More dialog languages can be added on request.

- In the function group **CFG** select the function **DIALOG**.
- Select the required language by means of the right-hand rotary knob.

Selecting units


In the function **UNIT** (function group **CFG**) you can choose your favorite units between mm or inch.

- In the function group **CFG** select the function **UNIT**.
- Set the required unit by means of the right-hand rotary knob.

Attention:

Select your units immediately when you start working with the USM 32X because if you change the unit, all the current settings are deleted, and the basic setup is loaded again.

In order not to delete anything by accident, a safety prompt is displayed in the measurement line.

- If you are sure that you want to change the unit, press the  key to confirm the safety prompt.

The unit is now changed, the current data are deleted.

- If you want to abort the process, press any other key. The previous setting is kept in that case.

4.6 Basic settings of the display

The equipment of the USM 32X includes a high-resolution color display. You can optimize the display settings to your individual viewing habits and to the operational environment.

Selecting the color scheme

You can use the function **SCHEME** (function group **CFG**) to choose one of four color schemes. The color scheme determines the color of all displays and that of the background. You cannot vary the colors of gates because they are fixed as follows:

- Gate A – red
- Gate B – green

Note:

All color schemes are suitable for indoor use. For outdoor use, we recommend the color schemes 3 and 4.

- Select the function **SCHEME** in the function group **CFG**.
- Use the right-hand rotary knob to choose the required color scheme.

Setting the lighting

Use the function **LIGHT** (function group **CFG**) to set the display lighting. You can choose between the default lighting **max.** and a lighting in the economy mode **min.**

Note:



The economy mode reduces the current consumption and consequently increases the operating time in battery operation.

- Select the function **LIGHT** in the function group **CFG**.
- Use the right-hand rotary knob to set the required lighting.

Operation **5**

5.1 Overview of the functions

All functions of the USM 32X are located – combined to form function groups – on one operation level.

- Press the  key to select the function group shown above it.
- Press the  key to select the function shown next to it. The setting of the selected function is carried out via the right-hand rotary knob.

The character > after a function indicates a double assignment.

The gain function is always directly available via the left-hand rotary knob.

You can carry out important functions (switch on/off, dB-step, freeze, zoom and report printout) by pressing the special keys (ref. chapter 4).

You will also find an overview of the function groups and their functions on the fold-out page.

Function groups

BASE	The functions that you find here are required for the basic adjustment of the screen displays.
P/R	Combined in this group are the functions that serve for the adjustment of pulser and receiver.
GATE	All functions for setting gate A and B can be found in this group.
MEM	These functions serve for storing, recalling and deleting of data sets.
CFG	This function group makes configuration functions available to you (enlarged display of reading, echo display, data transfer, dialog language, backlight).


5.2 Setting the gain

This function, operated via the left-hand rotary knob, enables you to quickly and directly set the gain.

You can use the gain to adjust the required sensitivity in order to control the echo amplitudes.

- Turn the left-hand rotary knob to set the gain. The current gain is indicated in the top left corner of the screen.


Defining the dB incrementation for gain

You can use the  key to select a certain incrementation for setting the gain. You have a choice between 6 steps:

- 0.0 dB (locked)
- 0.5 dB
- 1.0 dB
- 2.0 dB
- 6.0 dB
- 12.0 dB

Note:

The setting 0.0 dB locks the gain in this way preventing any accidental change of setting.

- Press  to change between the six steps. The corresponding step size setting is indicated below the current gain on the screen.

5.3 Adjusting the display range (function group BASE)

The function group **BASE** enables you to make the basic adjustment of the display range. The display on the screen must be adjusted for the material to be tested (function **MTLVEL**) and for the probe used (function **P-DELAY**).

- Select the function group **BASE**.

RANGE
250 _{mm}
MTLVEL
± 5920 _%
D-DELAY
± 0.00 _{mm}
P-DELAY
0.000 _{µs}

 **Note:**

In order to accurately adjust the material velocity and the probe delay, please read the section *Calibrating the USM 32X*, chapter 5.6, beforehand.

RANGE (Display range)

You can adjust the range for measurement in **RANGE**.

Adjustment range: 0.5 ... 1420 mm (USM 32X B)
 0.5 ... 9999 mm (USM 32X L)
 with c = 5920 m/s

0.7 ... 355 mm (USM 32X F)
 with c = 1480 m/s

 **Note:**

With the USM 32X L, the adjustment range for **RANGE** depends on the frequency range setting.

You can select between coarse and fine adjustment of the values.

- Coarse adjustment:
 from 2.5 mm ... 1400 mm in even steps
only USM 32X L: 1500 ... 9999 mm additionally
- Fine adjustment:
 up to 99.9 mm in steps of 0.1 mm
 up to 999 mm in steps of 1 mm
 up to 9999 mm in steps of 10 mm
 (above 1420 mm **only in USM 32X L**)

- Select the function **RANGE**.
- If required, toggle between coarse and fine adjustment.
- Adjust the required value by means of the right-hand rotary knob.

MTLVEL (Sound velocity)

Use **MTLVEL** to set the sound velocity within the test object. You can use sound velocities between 1000 and 15000 m/s.



Attention:

Always ensure that the function **MTLVEL** is correctly set. The USM 32X calculates all range and distance indications on the basis of the value adjusted here.



Note:

Only the values 1450 m/s and 1600 m/s are available for the USM 32X F as coarse adjustment.

- Coarse adjustment, in steps of thousand; additionally:

1450 m/s	57 "/ms	for fat
1600 m/s	63 "/ms	for muscle tissue
2730 m/s	107 "/ms	for plexiglass
3130 m/s	123 "/ms	for aluminium (trans)
3250 m/s	132 "/ms	for steel (trans)
5920 m/s	233 "/ms	for steel (long)
6320 m/s	249 "/ms	for aluminium (long)

- Fine adjustment
1000 ... 15000 in steps of 1 m/s

- Select the function **MTLVEL**.
- If required, toggle between coarse and fine adjustment.
- Adjust the required value by means of the right-hand rotary knob.

D-DELAY (Display starting point)

Here you can choose whether to display the adjusted range (for example 250 mm) starting from the surface of the test object, or in a section of the test object starting at a later point. This allows you to shift the complete screen display and consequently also the display zero.

If the display should for example start from the surface of the test object, the value in **D-DELAY** must be set to 0.

- Coarse adjustment
–10 mm ... 1024 mm/–0.3" ... 40" in even steps
- Fine adjustment
up to 99.9 mm/9.999" in steps of 0.01 mm/0.001"
up to 1024 mm/10" in steps of 0.1 mm/0.001"
- Select the function **D-DELAY**.
- If required, toggle between coarse and fine adjustment.
- Adjust the value for the display starting point by means of the right-hand rotary knob.

P-DELAY (Probe delay)

Every probe has a delay line between the transducer element and the coupling face. This means that the initial pulse must first pass through this delay line before the sound wave can enter the test object. You can compensate for this influence of the delay line in the function **P-DELAY**.

Note:

If the value for **P-DELAY** is not known, read the section *Calibrating the USM 32X*, chapter 5.6, in order to determine this value.

- Select the function **P-DELAY**.
- Adjust the value for the probe delay by means of the right-hand rotary knob.

5.4 Adjusting the pulser and receiver (function group P/R)

You will find all functions for the adjustment of pulser and receiver in the function group **P/R**.

Note:

With the USM 32X L, the functions and their order are different from those in the other USM 32X versions.

- Select the function group **P/R**.

DAMPING
low
POWER
low
REJECT
0%
DUAL
off

USM 32X B
USM 32X F

PRF-MOD
10
POWER >
low
FREQU >
2 - 18
DUAL
off

USM 32X L

DAMPIN>
low
REJECT>
0%

DAMPING (Probe matching)

This function serves for matching the probe. You can use it to adjust the damping of the probe's oscillating circuit and to consequently change the height, width and resolution of the echo display.

- **low**
This setting has a lower damping effect and produces higher and broader echoes.
 - **high**
This setting reduces the echo height but mostly also produces narrow echoes with higher resolution.
- Select the function **DAMPING**.
 - Set the required value by means of the right-hand rotary knob.

POWER (Intensity)

Use the function **POWER** to set the pulser voltage. You can choose between two settings:

- **high** – high voltage
- **low** – low voltage

The setting **high** is recommended for all inspections in which maximum sensitivity is important, e.g. for the detection of small flaws. Choose the setting **low** for broadband probes or if narrow echoes are required (better lateral resolution).

- Select the function **POWER**.
- Use the right-hand rotary knob to choose the required setting.

REJECT

The function **REJECT** allows you to suppress unwanted echo indications, for example structural noise from your test object.

The % screen height setting indicates the minimum height that the echoes should attain in order for them to be displayed on the screen at all. The Reject setting cannot be higher than the lowest threshold setting (–1 %) of any gate.



Attention:

You should handle this function with great caution, as it may of course happen that you suppress echoes from flaws as well. Many test specifications expressly forbid using the Reject function.

- Select the function **REJECT**.
- Set the required percentage value by means of the right-hand rotary knob.

The LED **R** is therefore lit with active **REJECT** function.

DUAL (Pulser-receiver separation)

You can use the function **DUAL** to activate the pulser-receiver separation.

- **on**
Dual mode or through-transmission mode; the initial pulse is available at the left-hand socket whereas the right-hand socket is connected with the amplifier input.
 - **off**
Single-element operation; the probe connection sockets are connected in parallel.
- Select the function **DUAL**.
 - Use the right-hand rotary knob to choose the required setting.

If the **DUAL** function is active, the LED **D** (dual) is on.

PRF-MOD (Pulse repetition frequency)

Note:

This function is only available on the USM 32X L.

The pulse repetition frequency indicates the number of times an initial pulse is triggered per second. You can determine whether you need the highest possible PRF value, or whether you are satisfied with a low value. You have 10 steps available for the setting; step 1 means the lowest PRF value.

The larger your workpiece, the smaller PRF values are needed in order to avoid phantom echoes. In the case of smaller PRF values, however, the A-scan update rate becomes lower; for this reason, high values are required if a workpiece should be scanned fast.

The best way to determine the suitable PRF value is by experimenting: start from the highest step and reduce the value until there are no more phantom echoes.

- Select the function **PRF-MOD**.
- Adjust the required value by means of the right-hand rotary knob.

FREQU (Frequency range)

 **Note:**

This function is only available on the USM 32X L.

In this function, you can adjust the operating frequency according to the frequency of your probe.

You have a choice between three frequency ranges:

- 0.1 ... 1 MHz
 - 0.5 ... 4 MHz
 - 2 ... 18 MHz
- Select the function **FREQU**.
 - Adjust the required value by means of the right-hand rotary knob.

5.5 Setting the gates (function group GATE)

All functions for setting the gates A and B are arranged in the function group **GATE**.

- Select the function group **GATE**.

a LOGIC>	b LOGIC>
pos	pos
aSTART>	bSTART>
≙ 35.00	≙ 85.00
aWIDTH>	bWIDTH>
≙ 40.00	≙ 40.00
aTHRSH>	bTHRSH>
40%	30%

Tasks of the gates

- It monitors the range of the test object where you expect to detect a flaw. If an echo exceeds or falls below the gate, an alarm signal is output via the LED **A**.
- The gate chooses the echo for the digital time-of-flight or amplitude measurement. The measured value is indicated in the measurement line.

Note:

Error alarms can be triggered under certain circumstances. These are caused by intermediate conditions in instrument operation occurring when the instrument is used, i.e. when function parameters are changed.

Possible alarms occurring during instrument operation (setting of functions) are to be ignored.

Display of gates

To make the assignment easier, the gates are displayed in different colors. You cannot vary the colors of gates because they are fixed as follows:

- Gate A – red
- Gate B – blue

aLOGIC/bLOGIC (Evaluation logic of the gates)

This function allows you to choose the method for triggering the gate alarm. The alarm is output to the LED **A** on the front panel of the USM 32X.

There are three setting options available:

- **off** – Evaluation logic off
The alarm and measurement capability are switched off. The gate is not visible.
- **pos** – Coincidence
The alarm (LED A) is on if the preset response threshold of the gate is exceeded within the displayed range.

- **neg** – Anticoincidence

The alarm (LED A) is on if the preset response threshold of the gate is not reached within the displayed range.

- Select the function **aLOGIC** or **bLOGIC**.
- Set the required alarm logic by means of the right-hand rotary knob.



Note:

The alarm and measurement function of the gates is only active within the display range.

aSTART/bSTART (Starting points of the gates)

You can fix the starting point of the gates A or B within the adjustment range of 0 ... 9999 mm/250".

- Select the function **aSTART** or **bSTART**.
- Use the right-hand rotary knob to adjust the required setting.

aWIDTH/bWIDTH (Width of the gates)

You can determine the gate width within the range of 0.2 ... 9999 mm/0.008 ... 250".

- Select the function **aWIDTH** or **bWIDTH**.
- Use the right-hand rotary knob to adjust the required value.

aTHRSH/bTHRSH (Response and measurement threshold of the gates)

You can determine the threshold value of the gates within the range of 10 to 90 % screen height for triggering the LED alarm if this value is exceeded or not reached, depending on the setting of the **aLOGIC/ bLOGIC** function.

- Select the function **aTHRSH** or **bTHRSH**.
- Set the required value using the right-hand rotary knob.

5.6 Calibrating the USM 32X

Calibrating the display range

Before working with the USM 32X, you have to calibrate the instrument: you have to adjust the material velocity and display range and allow for the probe delay depending on the material and dimensions of the test object.

To ensure a safe and proper operation of the USM 32X, it is necessary that the operator be adequately trained in the field of ultrasonic testing technology.

Below you will find some examples of common calibration methods for certain test tasks.

Note:

The special calibration of the USM 32X F is described in chapter 10 *Special measurements using the USM 32X F*.

Calibration with straight-beam probes

Case A: With known material velocity

Calibration process

- Set the known material velocity in **MTLVEL** (function group **BASE**).
- Couple the probe to the calibration block.
- Set the required display range in **RANGE** (function group **BASE**). The calibration echo must be displayed on the screen.
- Position the gate on one of the calibration echoes until the sound path of the echo is indicated in the measurement line.
- After this, change the adjustment of the function **P-DELAY** (function group **BASE**) until the correct sound path for the selected calibration echo is indicated in the measurement line.

Example:

You are carrying out the calibration for the calibration range of 100 mm/5" via the function group **BASE** using the calibration block V1 (thickness 25 mm/1") which is laid flatwise.

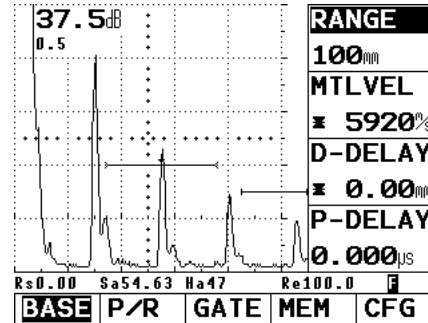
- Set **RANGE** to 100 mm/5".
- Set the known material velocity of 5920 m/s (233 "/ms) in **MTLVEL**.
- Set the gate so that it is positioned on the first calibration echo (from 25 mm/1").
- Read the sound path in the measurement line. If this value is not equal to 25 mm/1", change the adjustment for the function **P-DELAY** until it is at 25 mm/1".

This completes the calibration of the USM 32X to the material velocity of 5920 m/s (233 "/ms) with a calibration range of 100 mm/5" for the probe used.

Case B: With unknown material velocity**Calibration process**

- Set the approximate material velocity in **MTLVEL** (function group **BASE**).
- Couple the probe to the known calibration line of the calibration block.
- Move gate A onto the first calibration echo.
- Move gate B onto the second calibration echo.
- Make sure to set the gate heights so that the measurement is carried out at the same point of the flanks (e.g. middle of the flank).
- Use the function **S-DISP** (function group **CFG**) to select the setting **Sb-a** (sound path difference gate B – gate A). The value is displayed in large digits in the A-scan.
- Continue by increasing and reducing the value of the function **MTLVEL** until the value **ba** displayed in the A-scan corresponds to the known thickness of the calibration block. You have now determined the sound velocity in the material.

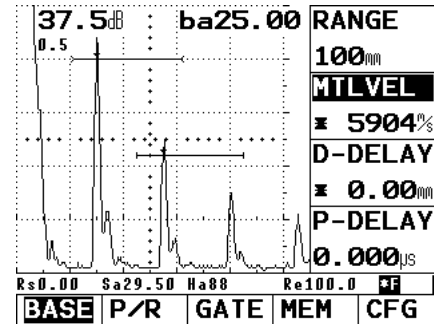
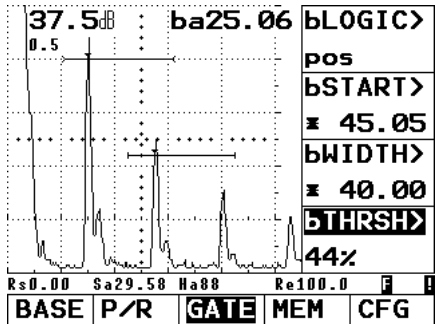
- Then increase the value of the function **P-DELAY** (function group **BASE**) until the value **Sa** displayed in the measurement line corresponds to the thickness of the calibration block. You have now determined the probe delay.
- Finally, check your calibration using another echo from a known distance; however, do not use the first or the second backwall echo for this.



Example

You are carrying out the calibration for the calibration range of 100 mm/5" via the function group **BASE** using the calibration block V1 (thickness 25 mm/1") which is laid flatwise.

- Set **RANGE** to 100 mm/5".
- Set the approximate sound velocity in the material in **MTLVEL** (function group **BASE**).
- Couple the probe to the calibration block.
- Set the gain so that the first echo reaches approx. 80 % screen height.
- Use the function **S-DISP** (function group **CFG**) to select the setting **Sb-a** (sound path difference between gate B and gate A). The value is displayed in large digits in the A-scan.
- Position the gate A on the first calibration echo.
- Position the gate B on the second calibration echo.
- Make sure to set the gate heights so that the measurement is carried out at the same point of the flanks (e.g. middle of the flank).



- Continue by increasing and reducing the value of the function **MTLVEL** until the value **ba** displayed in the A-scan corresponds to the known thickness of the calibration block (= 25 mm). You have now determined the sound velocity in the material.
- Then increase the value of the function **P-DELAY** (function group **BASE**) until the value **Sa** displayed in the measurement line corresponds to the thickness of the calibration block (= 25 mm). You have now determined the probe delay.

Calibration with dual-element (TR) probes

Dual-element (TR) probes are especially used for wall thickness measurement. The following peculiarities must be taken into account when using these probes:

Echo flank

Most dual-element (TR) probes have a roof angle (transducer elements with inclined orientation toward the test surface). This causes mode conversions both at beam index (sound entry into the material) and at the reflection from the backwall, which can result in very jagged echoes.

V-path error

Dual-element (TR) probes produce a v-shaped sound path from the pulser via the reflection from the backwall to the receiver element. This so-called "V-path error" affects the measuring accuracy. You should therefore choose two wall thicknesses that cover the expected thickness measurement range for the calibration. In this way, the V-path error can be corrected to the greatest possible extent.

Higher material velocity

Due to the V-path error, a higher material velocity than that of the test material is given during calibration, especially with small thicknesses. This is typical of dual-element (TR) probes and serves for compensation of the V-path error.

With small wall thicknesses, the above-described effect leads to an echo amplitude drop which has to be especially taken into account with thicknesses less than 2 mm/0.08".

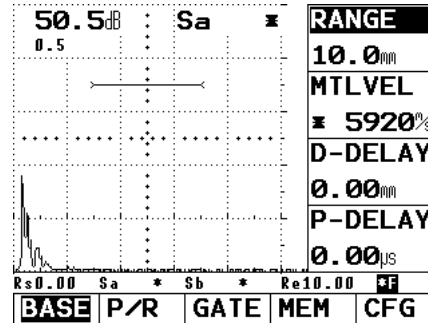
A stepped reference block having different wall thicknesses is required for calibration. The wall thicknesses must be selected so that they cover the expected readings.

Calibration process:

- Set the function **DUAL** (function group **P/R**) to **on**.
- Set the required test range.
- Set the functions of transmitter and receiver according to the probe used and according to the present test task.
- Couple the probe to the calibration block.
- Use the function **P-DELAY** (function group **BASE**) to increase the probe delay until both calibration lines are displayed within the range.
- Set the gain so that the highest echo reaches more or less the full screen height.
- Set the gate A (function group **GATE**) so that it cuts the calibration echo from the small step of the calibration block.
- Set the gate B so that it covers the calibration echo from the large step.
- Make sure to set the gate heights in such a way that the measurement is carried out at the same point of the flanks (e.g. middle of the flank).
- Use the function **S-DISP** (function group **CFG**) to select the setting **Sb** (sound path in gate B). The value is displayed in large digits in the A-scan.
- Couple the probe to the small step of the calibration block and use the function **P-DELAY** (function group **BASE**) to set the probe delay so that the sound path in gate A (value **Sa** in the measurement line) corresponds to the thickness of the small step.
- Couple the probe to the large step of the calibration block and use the function **MTLVEL** (function group **BASE**) to set the sound velocity in the material so that the sound path in gate B (value **Sb** in the A-scan) corresponds to the thickness of the large step.
- Repeat these processes often enough until the thickness values of the two steps are displayed correctly.
- If necessary, check the calibration on one or several known calibration lines, e.g. using the stepped reference block VW.

Note:

Always keep in mind that the measured value is determined at the intersection point of the gate and the echo flank. A correct adjustment of the echo height and gate threshold is therefore decisive for accurate calibration and measurement!



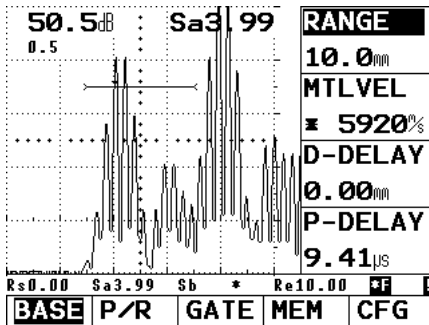
Example

You are carrying out the calibration for the calibration range of 100 mm/5" via the function group **BASE**.

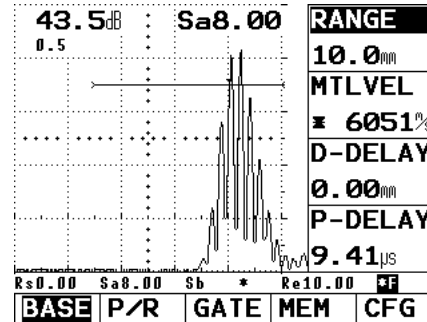
- Set **RANGE** to 100 mm/5".
- Set the known material velocity of 5920 m/s (233 "/ms) in **MTLVEL** (ref. EN 12668-1).
- Use the function **P-DELAY** (function group **BASE**) to set the probe delay to 0.
- Position the gate A so that it covers the range from 3 to 7 mm.

- Couple the probe to the 4-mm step of the calibration block (small step).
- Set the gain so that the first echo reaches approx. 80 % screen height.
- Use the function **S-DISP** (function group **CFG**) to select the setting **Sa** (sound path in gate A). The value is displayed in large digits in the A-scan.

- Then use the function **P-DELAY** (function group **BASE**) to vary the probe delay until the value **Sa** displayed in the A-scan corresponds to the thickness of the calibration block (= 4 mm).



- Couple the probe to the 8-mm step of the calibration block (large step).
- Set the gain so that the first echo reaches approx. 80 % screen height.
- Continue by increasing or reducing the value of the function **MTLVEL** until the value **Sa** displayed in the A-scan corresponds to the known thickness of the calibration block (= 8 mm).



- Couple the probe again to the 4-mm step of the calibration block.
- Set the gain so that the first echo reaches approx. 80 % screen height.
- Then use the function **P-DELAY** (function group **BASE**) to vary the probe delay until the value **Sa** displayed in the A-scan corresponds to the thickness of the calibration block (= 4 mm).
- Repeat these processes often enough until the thickness values of the two steps of the calibration block are displayed correctly.

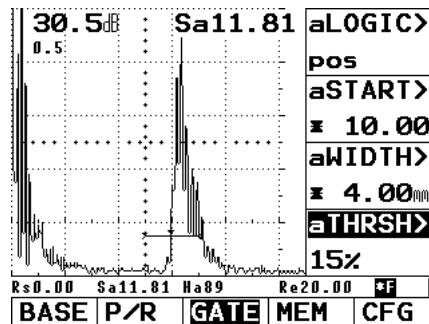
5.7 Measuring

General notes

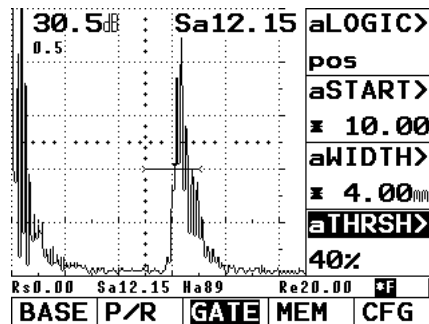
Please pay attention to the following notes when measuring with the USM 32X.

- Condition for measurements is the correct instrument calibration (sound velocity, probe delay).
- All amplitude measurements are carried out at the highest signal in the gate.
- All distance measurements are carried out at the intersection point of the gate with the first (USM 32F: last) echo flank (flank measurement).

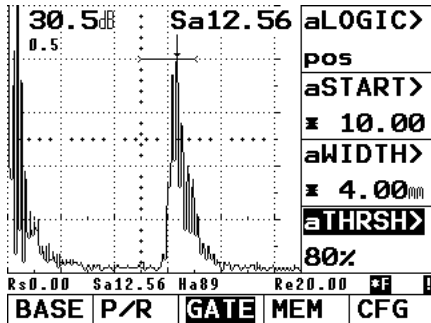
The following examples show the dependency of distance measurement on the echo waveform, i.e. on the height of the gate threshold and thus on the selection of the intersection point at the signal.



Gate threshold at 15 %
measured sound path: 11.81 mm/0.735"



Gate threshold at 40 %
measured sound path: 12.15 mm/0.756"



Gate threshold at 80 %
 measured sound path: 12.56 mm/0.781"

- Activate the function with the right-hand rotary knob.

 **Note:**

Special measurements using the USM 32X F are described in chapter 10.

5.8 Data saving (function group MEM)

You will find all functions for storing, recalling and deleting complete data sets in the function group **MEM**.

 **Note:**

The functions and the arrangement of functions in the USM 32X F differ from those in other versions of the USM 32. The special data logger functions of the USM 32F are described in chapter 10.

- Select the function group **MEM**.

SET-#
1
RECALL
off
STORE
off
DELETE
off

USM 32X B
USM 32X L

SET-# >
≠ 1
RECALL
off
STORE
off
DELETE >
off

USM 32X F

LOC-# >
≠ 1
CLEAR >
off

A data set contains all instrument settings as well as the A-scan. This means that whenever you recall a stored data set, your instrument is again set up exactly the same as it was at the moment when the data set was stored. This makes each one of your tests reproducible.

You will find the following functions:

SET-# selecting number of a data set

RECALL recalling a stored data set

STORE storing a data set

DELETE deleting a data set

The functions are described in the order in which you need them during your work.

Storing a data set

You can save your current setup to a data set.

- Select the function **SET-#**.
- Use the right-hand rotary knob to set the number where you would want to store the current data set (1 to 100).
- Select the function **STORE**.
- Use the right-hand rotary knob to set it to **on**.


The USM 32X stores the current data set. When the storage process is completed, the function **STORE** is automatically reset to **off**.

Note:

The asterisk (*) before a selected data set number indicates that this data set is already occupied. It is not possible to overwrite an occupied data set; select another data set which is still empty, or delete the occupied data set.

Deleting a data set

An occupied data set is marked with an asterisk (*) before the data set number. You can delete these data sets if you no longer need them.

- Select the function **SET-#**.
- Use the right-hand rotary knob to set the number of the data set that you want to delete.
- Select the function **DELETE**.
- Use the right-hand rotary knob to set it to **on**. The measurement line will then prompt: **Delete data set?**
- Confirm by pressing the corresponding key  one more time (all other keys would abort the process).

The data set is now deleted; the asterisk preceding the data set number is no longer there. The function **DELETE** is automatically reset to **off**.


Recalling a stored data set

You can recall a stored data set; your instrument will then be provided with all the test-relevant technical features that existed at the moment of the setup. A frozen display of the stored A-scan appears.



Attention:

If a saved data set is loaded, the current instrument setup is lost. If necessary, save the current instrument setup to a new data set before loading a saved data set.

- Select the function **SET-#**.
- Use the right-hand rotary knob to set the number of the data set that you want to recall.
- Select the function **RECALL**.
- Use the right-hand rotary knob to set it to **on**. The measurement line will then prompt: **Recall data set?**
- Confirm by pressing the corresponding key  one more time (all other keys would abort the process).

The data set is now loaded and the current setup is overwritten. When the loading process is completed, the function **RECALL** is automatically reset to **off**.



Note:

The gate for surveying the echo can be moved in the recalled A-scan. However, as the evaluation is made in the frozen A-scan, the measurement resolution is only 0.5 % of the adjusted calibration range.

5.9 Configuring the USM 32X

The function group **CFG** contains the functions that you need for configuring the USM 32X (enlarged reading display in A-scan, backlight and echo display, printer, language and unit).

In the function group **CFG**, all functions have double assignments

- Select the function group **CFG**.

S-DISP>	SCHEME>
off	1
FILLED>	LIGHT >
off	eco
COPYM0>	PRINTE>
report	Epson
DIALOG>	UNIT >
English	mm

S-DISP (Zoomed display of reading)

You can have a selected reading zoomed in the A-scan display. The following readings can be selected for the zoomed display (in the second column the indication of the readings in the measurement line):

Sa	Sa	Sound path for gate A
Sb	Sb	Sound path for gate B
Sb-a	S'	Difference of single measurements for sound path gate B – gate A
Ha %	Ha	Echo height gate A in % screen height
Hb %	Hb	Echo height gate B in % screen height
R-start	Rs	Range start
R-end	Re	Range end
Alarm	Al	Choice of gates for alarm triggering: gate A , B or A+B
Set-#	S#	Number of data set (only USM 32X F)

- Select the function **S-DISP**.
- Use the right-hand rotary knob to select the required value for the zoomed display.

FILLED (Echo display mode)

The function **FILLED** toggles between the filled and the normal echo display mode. The filled echo display mode improves the echo perceptibility due to the strong contrast, especially in cases where workpieces are scanned more quickly.



Notes:

With the setting **FILLED** = **on** the A-scan refresh rate is considerably reduced.

If the function **COLOR** is active, the filled area is also displayed in different colors.

- Select the function **FILLED**.
- Use the right-hand rotary knob to set the function to **on** or **off**.

COPYMOD (Assignment of the key)

When the  key is pressed, data are output to the RS232 interface and transferred to a printer or a PC. You can use the function **COPYMOD** to choose the data to be transferred when the  key is pressed. You have the following setting options:

- **off**
The key is deactivated.
- **hardcopy**
Hardcopy of the screen contents
- **report**
Test report with A-scan, all relevant settings for the inspection and space for hand-written remarks
- **meas P5**
The measured value given at position 5 in the measurement line
- **pardump**
All instrument functions with the current settings
- **PCX**
Screen contents as a PCX-format file. To transfer the data to the PC, you will need a terminal program.

- **sto SET**

The current instrument setting is stored to the selected (free) data set, and the data set number (**SET-#**) is automatically increased.

- **sto LOC** (only in USM 32X F)

Memory location and pair of values fat/muscle thickness

- **datalog** (only in USM 32X F)

The selected job is printed out as a report including all measured values.

- **special**

as setting “hardcopy”. After printout of the screen contents no form feed, every press on the key prints out the next hardcopy on the same page (three or four hardcopies depending on the printer).

 **Note:**

Please also refer to chapter 6 *Documentation*.

- Select the function **COPYMOD**.
- Use the right-hand rotary knob to set the required assignment for the key.

DIALOG (Selecting the language)

In the function **DIALOG** you can select the language for displaying the function names on the screen. The following languages are available:

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

 **Note:**

More dialog languages can be added on request.

- Select the function **DIALOG**.
- Use the right-hand rotary knob to select the required language.

SCHEME

You have a choice between four color schemes. The color scheme determines the color of all displays and that of the background. You cannot vary the colors of gates because they are fixed as follows:

- Gate A – red
- Gate B – blue

Note:

All color schemes are suitable for indoor use. For outdoor use, we recommend the color schemes 3 and 4.

- Select the function **SCHEME**.
- Use the right-hand rotary knob to choose the required color scheme.

LIGHT

You can choose between the economy backlight mode **eco** and a brighter backlight **full** for the display backlight. The economy mode is the default setting.

Note:

The economy mode reduces the current consumption and consequently increases the operating time in battery operation.

- Select the function **LIGHT**.
- Use the right-hand rotary knob to set the required lighting.

PRINTER (Printer for test report)

In this function you can select the connected printer for printing out your test report.

You have a choice between the following printer types:

- Epson
- HP LaserJet
- HP DeskJet
- Seiko DPU
- HP LaserJet 1200
- HP DeskJet 1200

Note:

For more details on the how to print out a test report, please refer to chapter 6 *Documentation*.

- Select the function **PRINTER**.
- Use the right-hand rotary knob to select the required printer.

UNIT (Selecting units of measurement)

You can choose the required units between mm or inch in the function **UNIT**.




Attention:

You should always make your decision on the units immediately when starting to work with the USM 32X. If you change the unit, all current settings are deleted, and the basic setup is loaded.

- Select the function **UNIT**.
- Use the right-hand rotary knob to select the required unit.


To avoid any accidental deleting of values, the measurement line will display a safety prompt: **Change unit?**

- If you are sure that you want to change the unit of measurement, press the corresponding  key to confirm the safety prompt. Any other key would abort the process.



The unit of measurement is now changed; the current data are deleted.

5.10 Other functions with special keys


Freeze

The  key enables you to store (freeze) the displayed image on the screen.

Gate parameters may still be changed in order to evaluate any signal being displayed in the frozen screen. The measurement resolution is only 0.5 % of the displayed range.

- Press  if you want to store (“freeze”) a current display.
- Press  again in order to return to normal mode.



Zooming the echo display

If you press the key , the echo display is zoomed (zoom function) and is superimposed on the function group.

The functions are not accessible in this mode, except for the gain. It can still be set by means of the left-hand rotary knob.

Note:

You cannot switch on the zoom function with gate widths smaller than 0.5 mm/0.02" (5920 m/s).

- Press the button  in order to change to the zoom mode.
- Press the button  one more time in order to return to the normal mode.

5.11 Status symbols and LEDs

Status symbols can be displayed in the line below the screen display to inform about certain settings and conditions of the USM 32X. The LEDs above the display give you further information.

Status symbols

Symbol	Description
*	Display memory is enabled (freeze), display is stored.
!	Data transfer active (printing or remote control)
B	Battery indicator; appears with low battery charge, batteries must be charged!

LEDs

Symbol	Description
A	Gate alarm
R	Function REJECT is active.
D	Function DUAL (pulser-receiver separation) is active.

Note:

Error alarms can be triggered under certain circumstances. These are caused by intermediate conditions in instrument operation occurring when the instrument is used, i.e. when function parameters are changed. **Possible alarms occurring during instrument operation (setting of functions) are to be ignored.**

Documentation **6**

6.1 Printing data


Direct printing of the following data via the RS 232 interface is possible using the USM 32X:

- test report containing the A-scan and the adjustment data
- A-scan
- single reading (enlarged reading in the A-scan)
- function list (including all current settings)
- Data Logger (only in USM 32X F)

To do this, you need

- a printer with serial interface RS 232
- a printer cable (please see chapter 2)

Preparing the USM 32X

You decide on the type of printout by assigning the  key. Therefore you have the following setting options:

- **hardcopy** (A-scan)
- **report**
- **meas P5** (reading in A-scan)
- **pardump** (function list)
- **PCX** (screen hardcopy)
- **sto SET** (data set)
- **special** (several A-scans on one page)
- **sto LOC** only in USM 32X F
(Memory location and pair of values fat/muscle thickness)
- **datalog** only in USM 32X F
(Data Logger job including measured values)

- Select the function group **CFG**.
- Select the function **PRINTER**, and then use the right-hand rotary knob to select the correct printer driver.
- Select the function **COPYMOD**, and then use the right-hand rotary knob to select the setting.

 **Note:**

The setting **PCX** generates a PCX-format file which you can transfer to a PC by means of a suitable program capable of receiving and storing data.


Preparing the printer

The transfer parameter settings are fixed in the USM 32 and cannot be changed.


- Baud rate 9600
- Word length 8 data bits
- Parity none

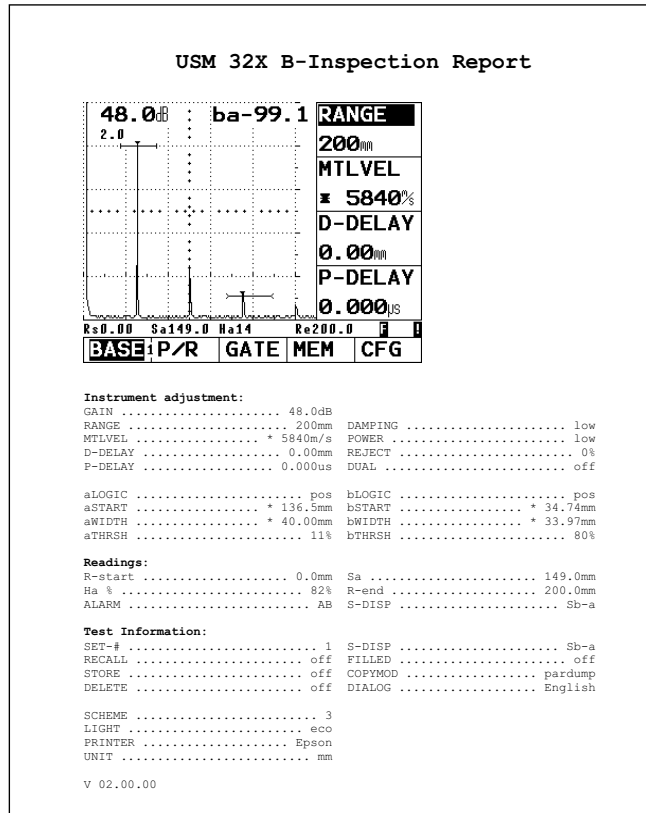
In order to ensure a perfect communication, set the printer to the parameters of the USM 32X.

Printing

If you have connected, prepared and activated the printer, just press the  key.

The report is printed out.

If you have selected the setting **special**, press the  key again for each A-scan that you want to print out.



6.2 Documentation with UltraDOC

The special application program UltraDOC from GE Inspection Technologies enables you to remote-control the USM 32X and to include instrument settings in ASCII format or screen contents in PCX or IMG format in your test report.

All data can be further processed using commercial word processing or DTP programs.

You will receive information about the reliable use of the program in a detailed operating manual.

Maintenance and care 7

7.1 Care of the instrument

Clean the instrument and its accessories using a moist cloth. Only use the following recommended instrument cleaners:

- water,
- a mild household cleaner or
- alcohol (no methyl alcohol).



Attention:

Do not use any methyl alcohol, solvents, or dye penetrant cleaners!

The plastic parts can be damaged or embrittled by this.

7.2 Care of the batteries

Care of the batteries

Capacity and life of batteries mainly depend on the correct handling. Please therefore observe the tips below.

You should charge the batteries in the following cases:

- before the initial startup
- after a storage time of 3 months or longer
- after frequent partial discharge

Charging the batteries

You can charge the lithium-ion battery either directly in the instrument or by means of the external battery charger DR36 (order number 35 297) recommended by us. You always need an external battery charger to charge standard C-cells. In this regard, please pay attention to the information on the operation of the battery charger.



Attention:

You should only use the batteries recommended by us and the corresponding battery charger. An improper handling of the batteries and of the battery charger may cause explosion hazard.

Charging of partially discharged NiCd 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 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 NiCd 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.

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.

7.3 Maintenance

The USM 32X requires basically no maintenance.



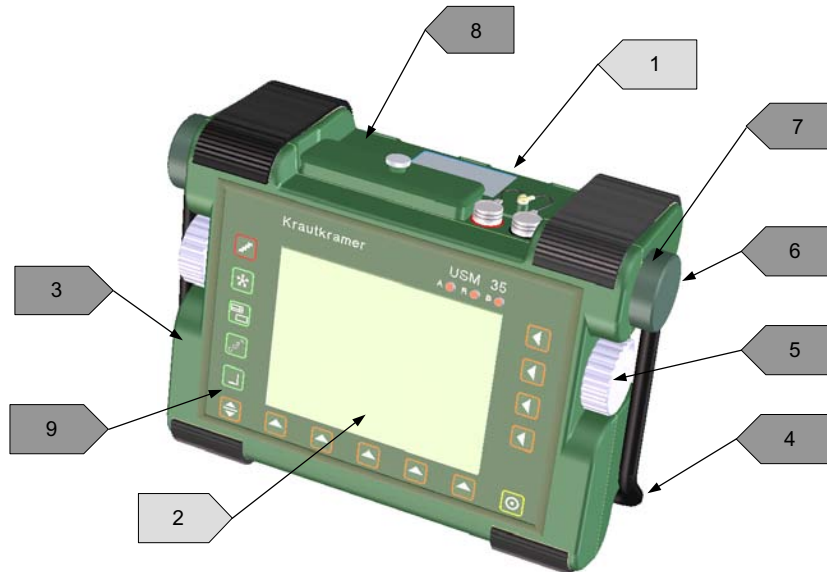
Attention:

Repair work may only be carried out by members of authorized Service staff of GE Inspection Technologies.

7.4 Recycling

General view of the device

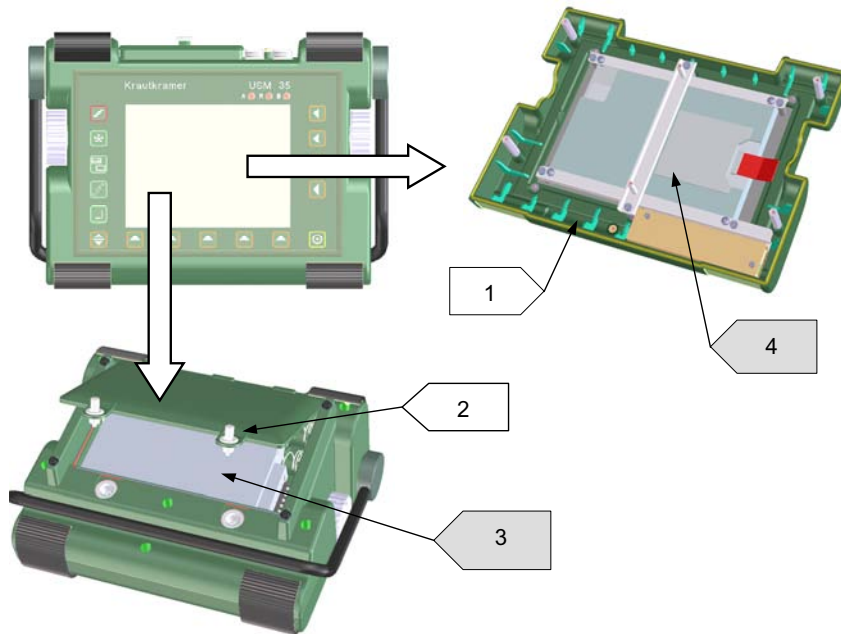
In the following you find an instrument overview as well as guidelines and notes for recycling and waste disposal of the components.



No.	Recycling/material code	Description
1	Lithium-ion battery	Battery inside the battery compartment at the bottom of the instrument. In order to open the compartment the quick acting closures have to be actuated.
2	LCD - display	Fluorescent lamps of the LCD display contain trace amounts (0 – 0.5 mg) of Mercury (Hg)
3	>PC< / Brass	Upper equipment cover Polycarbonat >PC< with pressed in brass thread insert.
4	Stainless steel	Handle complete
5	Aluminium	Rotary control button
6	>PC<	Holder for handle
7	Stainless steel	Ratchet disk
8	>PC<	Housing lower part
9	Aluminium	Div. mounting brackets

Materials for separate disposal

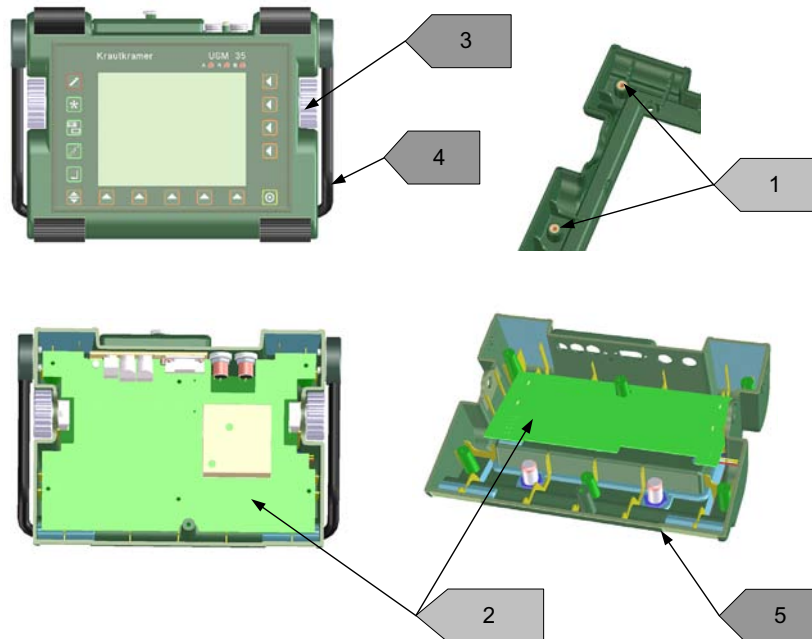
In the following you find guidelines and notes for removing materials/components, which must be removed and treated separately.



No.	Recycling/material code	Description
1		In order to remove the LCD-Display the upper housing has to be withdrawn first. After loosing 6 screws on the bottom side and one further in battery-compartment, the complete upper housing can be taken away.
2		In order to open the compartment at the bottom of the equipment, the quick acting closures have to be actuated.
3	Lithium-ion battery	Inside the battery compartment. Can easily be removed after opening the battery cover.
4	LCD - display	Fluorescent lamps of the LCD display contain trace amounts (0 – 0.5 mg) of Mercury (Hg).

Further materials and components

In the following you find notes for dismantling materials/components, which can disturb several recycling processes, and materials/components for which benefits can normally be achieved.



No.	Recycling/material code	Description
1	>PC< / Brass	Upper equipment cover Polycarbonat >PC< with pressed in brass thread insert.
2	Circuit boards	Circuit board in lower housing, under it battery-PCB
3	Aluminium	Two rotary control buttons
4	Stainless steel	Handle, rubber tube can be removed
5	>PC<	Lower housing and battery-cover

Recycling data of master device

Recycling/material code	Weight approx. (kg)	Description
Materials/components, which must be removed and treated separately:		
LCD - display	0.22	Fluorescent lamps of the LCD display contain trace amounts (0 – 0.5 mg) of Mercury (Hg)
Lithium-ion battery	0.49	Located inside the battery compartment
subtotal	0.71	
Materials/components, which can disturb certain recycling processes:		
>PC< / brass	0.16	Upper equipment cover Polycarbonat >PC< with pressed in brass thread insert.
Circuit boards	0.33	Under LC display unit
subtotal	0.49	
Materials/components, through which benefits can normally be achieved:		
Stainless steel	0.18	Handle, ratchet disk,
Aluminium	0.15	Rotary control button, mounting sheets, ...
>PC<	0.42	Lower housing, holder for handle, battery-cover
Rubber	0.05	O-Rings, rubberbase, rubber tube of handle, keypad sealing
subtotal	0.80	

Recycling/material code	Weight approx. (kg)	Description
Composite materials*:		
Membrane keypad	0.20	Foil/aluminium/glass/spring steel/stainless steel
subtotal	0.20	
Total	2.20	
Mounting material, cables, clamps, screws ...	0.16	
Total weight (incl. battery)	2.36	

Special notes: none

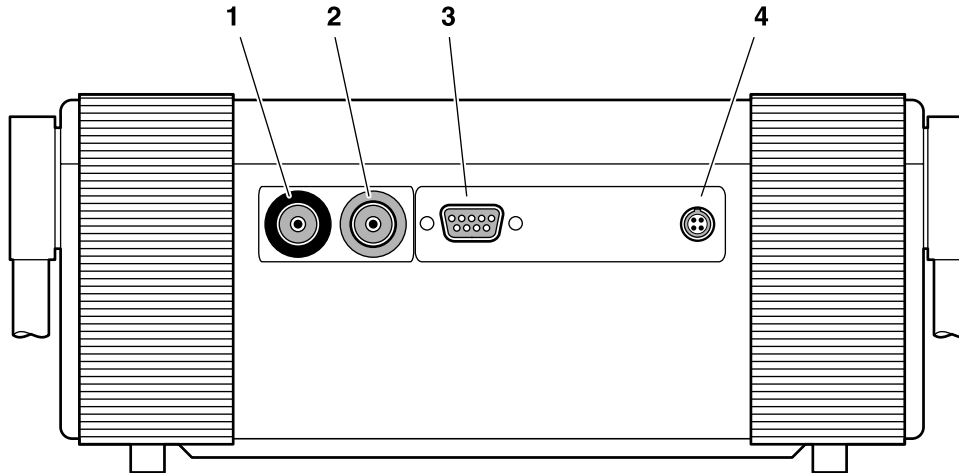
* Materials/components, which cannot be separated into mono materials by destructive mechanical processes

Interfaces and peripherals 8

8.1 Interfaces

The USM 32X presents different interfaces for the connection of probes and for the data exchange. All interfaces are located at the instrument front. The following figure gives an overview of the position of interfaces.

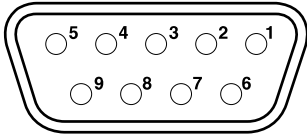
- 1 BNC or LEMO-1-TRIAX socket for the connection of the transmitter probe (black ring)
- 2 BNC or LEMO-1-TRIAX socket for the connection of the receiver probe (red ring)
- 3 **RS 232**
serial interface, 9-way Sub-D socket
- 4 **12V DC**
Mains connection socket, 4-way LEMO-0-B socket



8.2 RS 232 interface

The USM 32X has a RS 232 interface for remote control and documentation (report printout).

View of the 9-way Sub-D socket



Contact assignment of the Sub-D socket

Contact	Designation	Signal direction	Level
1	unassigned	–	–
2	RXD	input	RS 232
3	TXD	output	RS 232
4	DTR	output	RS 232
5	ground	–	RS 232
6	DSR	input	RS 232
7	RTS	output	RS 232
8	CTS	input	RS 232
9	unassigned	–	–

Note:

Switch off the instrument before connecting a cable to the RS 232 socket or before withdrawing any plugs.

Data exchange

When you connect the instrument with a PC you can:

- remote control the instrument via the PC,
- transfer A-scans for documentation,
- transfer instrument settings in ASCII format,
- transfer reports from stored datasets,
- transfers Datalogger jobs in ASCII format (only in USM 32X F),
- read and write datasets in binary format.

Connecting a printer or a PC

You can connect the USM 32X to a printer or a PC using the special Krautkramer cables:

PC: UD 20 (25-way) or UD 31 (9-way)
Printer: UD 31 (Seiko DPU) or UD 32 (Epson)

Please refer to chapter 2.

Activation of serial communication

After connecting the instrument to the PC you must run a software that opens the serial port. This can either be a commercial terminal program (e.g. Microsoft Hyper Terminal) or a customised program like UltraDOC. Make sure that the serial communication parameters on the PC are identical to those of the instrument.


The data transmission parameters are fixed in the USM 32X and cannot be changed:

Baud rate: 9600
Word length: 8 data bits
Stop bits: 2
Parity: none

The settings on the USM 32X apply to most of the printers and PCs. To ensure a perfect communication, please check the settings of the connected peripherals and adjust them to the parameters of the USM 32X.

Printing data

The USM 32X enables a direct printout of data, for example a report including the A-scan and the instrument settings.

To do this, select the printer driver in the function **PRINTER** (function group **CFG**) and just press the  key after having initialized and activated the printer. The data selected by you in the function **COPYMO** (function group **CFG**) are printed.

For more details on this, please refer to chapter 6 *Documentation*.

8.3 Remote control

You can use a connected PC for the remote control of the USM 32X.

The data transfer is carried out by means of a remote control program and the corresponding remote control commands. These commands represent instructions referring to the individual functions of the USM 32X.

The program Crosstalk can for example be used as remote control program under DOS. In Windows based systems it is possible to use e.g. the Terminal program.

After the remote control program has been started and the program interface has been configured, the commands are input via the keyboard of the computer. In this connection, please observe the following differentiation:

- **Interrogation** of a value or state of a USM 32X function using the command structure:

`<ESC> <COMMAND> <RETURN>`

The USM 32X transmits the value of the current setting.

- **Entry** of a new value or state of a function using the command structure:

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

All values are entered or transmitted by the USM 32X without a comma or a point. The resolution of the function should therefore be observed with all values. The resolution of a function applies to the entire value range of that function.

A **resolution of 0.01** means:

The USM 32X transmits the value of a function multiplied by the factor of 100. The entry of a value must be done 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 USM 32X transmits the value of a function multiplied by the factor of 10. The entry of a value must be done 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 USM 32X transmits the value of a function without multiplication. The entry of a value must be done without any multiplication.

Example:

- Setting the response threshold of gate a to 41 %:
<ESC>at 41 <RETURN>

Syntax and timing

The syntax and timing of the communication with the instrument is as follows:

PC	ESC		A		B		CR					
USM		*	A		B		_	n Bytes	ETX	CR	LF	

With:

ESC = escape (ASCII CHR 27)

* = star (ASCII CHR 42)

AB = remote code of an instrument function

CR = carriage return (ASCII CHR 13)

|_ | = Space (ASCII CHR 32)

n Bytes = function value of function AB

ETX = end of text (ASCII CHR 3)

LF = line feed (ASCII CHR 10)

Transmission timing

- As soon as the instrument has received the **ESC** command, it will return the * which then will be displayed on PC screen.
- Then you key in the wanted remote code according to the given table. The instrument echoes your entries.
- Finally you hit the [**CR**]-key on your keyboard or send the CR-command (closing the remote command).
- The instrument will now return a **blank**, then the related **function value** which may consist of several Bytes, then the “**end of text**” character, and finally the **carriage return** and the **line feed** character.

Example:

Request **RANGE** value from the USM 32X

PC	ESC		D		W		CR					
USM		*	D		W		_	5000	ETX	CR	LF	

Remote code of the **RANGE** function is **DW** (display width). Please note that numerical function values are always returned as integer values with the given maximum resolution, here DW = 5000 means 50.00 mm.

Example:

Request reading at position 2 in the measurement line

PC	ESC		E		2		CR					
USM		*	E		2		_	10.81	ETX	CR	LF	

Remote code of measurement position 2 is **E2** (evaluation 2). E2 = 10.81 means 10.81 mm (here sound path of the echo in gate A had been displayed). Please note that all readings from the 5 possible reading locations are shown in that applicable decimal format where the decimal separator is a dot.

Changing a function value (Adjusting functions)

Key in **[ESC] DW [Space] 2000 [CR]** in order to set the range to 20.00 mm:

ESC		D		W		_		2		0		0		0		CR			
	*		D		W		_		2		0		0		0		ETX	CR	LF

Please note that you must key in the function value as an integer with the maximum given resolution, here 2000 for the range of 20 mm.

Transfer of datasets

A total of 100 datasets (complete instrument setup including A-scan) can be stored in the instrument. The stored datasets including the actual setting (SET-# = 0) can be transferred to the PC in compressed binary format for archiving purposes.

If required, the datasets may be downloaded back to the instrument for re-use or echo comparison. This bi-directional dataset transfer is part of the software UltraDOC.

Actual dataset (SET-# 0) from the instrument to the PC
(upload):

E		U		D		_		0		C											
S										R											
C	*		U		D		_		0		_	v ₁	...	v _n	C	LF	b ₁	...	b _n	E	C
															R					T	R
																				X	LF

v₁ ... v_n describes the software version of the USM,
bytes b₁ ... b_n contain the instrument setting including
A-scan. In order to store this information you must
write the transferred bytes v₁ ... v_n, CR, LF, b₁ ... b_n into
a file.

Dataset file from the PC to the instrument's dataset #1
(download):

E		U		R		_		1		C				v_1	...	v_n	C	L	b_1	...	b_n	E	C	L
S										R							R	F				T	R	F
C	*		U		R		_		1		E	C	L									X		
										X	R	F	*)											

*) at this time the instruments waits for the reception of the bytes $v_1 \dots v_n$ CR LF $b_1 \dots b_n$. The instrument now checks whether received dataset is compatible with the current software version of the instrument, and whether the dataset is valid (correct checksum).

Functions and remote control codes

Presettings are in bold-face type. You will find a brief description of all functions in chapter 9.1 *Function directory*.

If not otherwise stated, all values refer to steel,
C = 5920 m/s.

Function	Code	Range/Default	Resolution
aLOGIC	AM	0 = off 1 = pos 2 = neg	1
aSTART	AD	USM 32X B: 0 - 1420 mm / 35 USM 32X L: 0 - 9999 mm / 35 USM 32X F: 0 - 1420 mm / 35	0.01
aTHRSH	AT	10 - 90 % / 40	1
aWIDTH	AW	USM 32X B: 0.2 - 1420 mm / 40 USM 32X L: 0.2 - 9999 mm / 40 USM 32X F: 0.2 - 1420 mm / 40	0.01
bLOGIC	2L	0 = off 1 = pos 2 = neg	1

Function	Code	Range/Default	Resolution
bSTART	2D	USM 32X B: 0 - 1420 mm / 35 USM 32X L: 0 - 9999 mm / 35 USM 32X F: 0 - 1420 mm / 35	0.01
bTHRSH	2T	10 - 90 % / 30	1
bWIDTH	2W	USM 32X B: 0.2 - 1420 mm / 40 USM 32X L: 0.2 - 9999 mm / 40 USM 32X F: 0.2 - 1420 mm / 40	0.01
CLEAR (only USM 32X F)	...	0 = off 1 = on	1
COPYMO	CM	0 = hardcpy 1 = report 2 = meas P5 3 = pardump 4 = PCX 5 = sto SET 6 = special 7 = sto LOC (only in USM 32X F) 8 = datalog (only in USM 32X F)	1
DAMPING	PG	0 = low 1 = high	1
D-DELAY	DD	-10 - 1024 mm / 0	0.01

Function	Code	Range/Default	Resolution
DELETE	EA	0 = off 1 = on	1
DIALOG	DG	0 = German 1 = English 2 = French 3 = Italian 4 = Spanish 5 = Portuguese 6 = Dutch 7 = Swedish 8 = Slovenian 9 = Romanian 10 = Finnish 11 = Czech 12 = Danish 13 = Hungarian 14 = Croatian 15 = Russian 16 = Slovakian 17 = Norwegian 18 = Polish 19 = Japanese	1
DUAL	DM	0 = off 1 = on	1

Function	Code	Range/Default	Resolution
FILLED	FI	0 = off 1 = on	1
FREQU	FR	0 = 0.5 - 4 MHz 1 = 2 - 18 MHz 3 = 0.1 - 1 MHz	1
LIGHT	LT	0 = off 1 = on	1
LOC-#	F#	0 - 999 / 0 (only USM 32X F)	
MTLVEL	SV	1000 - 15000 m/s / 5920	1
P-DELAY	PD	0 - 100 ms / 0	0.01
POWER	PI	0 = low 1 = high	1

Interfaces and peripherals

Remote control





Function	Code	Range/Default	Resolution	Function	Code	Range/Default	Resolution
PRF-MOD (only USM 32X L)	PF	10 steps: 0 = 1 1 = 2 2 = 3 3 = 4 4 = 5 5 = 6 6 = 7 7 = 8 8 = 9 9 = 10	1	SCHEME	CS	0 = green/black 1 = orange/black 2 = black/white 3 = black/yellow	
PRINTER	PR	0 = Epson 1 = HP Laserjet 2 = HP Deskjet 3 = DPU-41x	1	S-DISP	VS	0 = off 1 = Sa 2 = Sb 6 = Sc-a 7 = Ha% 8 = Hb% 13 = R-start 14 = R-end 29 = alarm 43 = Set-#	1
RANGE	DW	USM 23B: 2.5 - 1420 mm USM 23L: 2.5 - 9999 mm USM 23F: 0.7 - 355 mm (with c=1480 m/s)	0.01	SET-#	ND	1 - 100 / 1	1
RECALL	RD	0 = off 1 = on	1	STORE	SD	0 = off 1 = on	1
REJECT	RJ	0 - 80 % / 0	1	UNIT	UN	0 = mm 1 = inch	1






Other remote control codes





Code	Function/description
DA	A-scan amplitudes transferred as binary data
E1	Read value form measurement line (position 1)
E2	Read value form measurement line (position 2)
E3	Read value form measurement line (position 3)
E4	Read value form measurement line (position 4)
E5	Read value displayed in the A-scan
E6	Read second value (muscle thickness) displayed in the A-scan (only USM 32X F)
EL	Send the contents of the screen as binary data stream
EV	Read alarm LED status: 0 = no alarm 1 = alarm in A 2 = alarm in B 3 = alarm in A+B
HD	Editable header data from report transferred as ASCII-format data
I1	Set information line 1 in the startup screen
I2	Set information line 2 in the startup screen (up to 39 characters each)

Code	Function/description
ID	Read instrument software version
SL	“Scroll home”: selection of the first function in every function group and of the left function group in every function group line.
TF	Freeze on/off: 0 = off 1 = on
TZ	Zoom on/off: 0 = off 1 = on
UD	Send data set as binary data
UR	Read data set as binary data

**Control codes for the rotary knobs/
function keys**

Function	Key	Code	Range
Left-hand rotary knob/ gain		G+	increment
		G-	decrement
Right-hand rotary knob		K+	increment
		K-	decrement
dB-STEP		P	0 = 0.0
			1 = 0.5
			2 = 1.0
			3 = 2.0
			4 = 6.0
			5 = 12.0
FREEZE		F	off / on
ZOOM		Z	off / on
COPY		C	off / on

Function	Key	Code
BASE		5
P/R		6
GATE		7
MEM		8
CFG		9

Function	Key	Code
first		1
second		2
third		3
fourth		4

**Attention:**

In rare cases concerning remote control sequences, reading measurement values directly after changing a function value in the USM 32X, there could be errors as long as the instrument has not ended setting the value. In such cases, additional commands must be inserted into the remote control sequence before the measurement values are read.

Example:

If you create a remote control sequence, by which the sound path of an echo is read after freezing the A-scan, the command chain would be as follows:

Command	Answer	Description
<ESC>F<RETURN>		“A-scan freeze”
<ESC>E3<RETURN>	50,74	“Read sound path”
<ESC>F<RETURN>		“Disable A-scan freeze”
...		

In the interests of security, insert additional read commands before reading the sound path, e.g.:


Command	Answer	Description
...		
<ESC>F<RETURN>		“A-scan freeze”
<ESC>DB<RETURN>	580	“Read dB setting”
<ESC>DB<RETURN>	580	“Read dB setting”
<ESC>DB<RETURN>	580	“Read dB setting”
<ESC>DB<RETURN>	580	“Read dB setting”
<ESC>E3<RETURN>	50,74	“Read sound path”
<ESC>F<RETURN>		“Disable A-scan freeze”
...		

With these measures you ensure that sufficient time has passed in order to completely execute the previous command (display freeze) before transferring the sound path. Finally, check your remote control sequence to see that the measurement values can be correctly read, and add further read commands if necessary.

Appendix 9

9.1 Function directory

The functions marked with * are only available on the USM 32X L, those marked with ** are exclusively available on the USM 32X F.

Function	Function group	Description
aLOGIC	GATE	Evaluation logic of the gate A
aSTART	GATE	Starting point of the gate A
aTHRSH	GATE	Threshold of the gate A
aWIDTH	GATE	Width of the gate A
bLOGIC	GATE	Evaluation logic in the gate B
bSTART	GATE	Starting point of the gate B
bTHRSH	GATE	Starting point of the gate B
bWIDTH	GATE	Width of the gate B
COPYMO	CFG	Assignment of the  key
CLEAR **	MEM	Clearing the Data Logger memory

Function	Function group	Description
DAMPING	P/R	Damping of the probe's oscillating circuit
D-DELAY	BASE	Setting of the display start
DELETE	MEM	Deleting a stored data set
DIALOG	CFG	Selecting the language
DUAL	P/R	Separation of pulser and receiver
FILLED	CFG	Selecting the echo display mode (filled or normal)
FREQU *	P/R	Selecting the frequency range for the connected probe
GAIN	left-hand rotary knob	Setting of the gain
LIGHT	CFG	Choice of lightning for the display
LOC-# **	MEM	Number of the memory location for the pair of readings fat/muscle thickness

Function	Function group	Description
MTLVEL	BASE	Setting of the material sound velocity
P-DELAY	BASE	Compensating for the probe delay line
POWER	P/R	Setting the power of the initial pulse
PRF-MOD *	P/R	Setting the pulse repetition frequency
PRINTER	CFG	Selecting the printer for the test report
RANGE	BASE	Setting of the range in which the measurement is made.
RECALL	MEM	Retrieving a stored data set
REJECT	P/R	Suppression of unwanted or spurious echo indications
SCHEME	CFG	Choice of a color scheme for the screen display

Function	Function group	Description
S-DISP	CFG	Zoomed display of a selected parameter
SET-#	MEM	Number of the data set
STORE	MEM	Saving the data set
UNIT	CFG	Selecting the unit of measurement (mm or inch)

9.2 EC declaration of conformity

We declare that the USM 32X conforms to the following European directives:

- 89/336EEC (Electromagnetic compatibility)

The conformity of the above-mentioned product with the regulations of the directive 89/336EEC is proven by the observance of the standard specifications

- EN 55011: 1998 Class A, Group 2 and
- EN 61000-6-2: 1997
- EN 61000-6-4: 1997

The conformity of the above-mentioned product with the regulations of the directive 73/23/EEC, amended by the directive 93/68/EEC, is proven by the observance of the standard specification

- EN 61010-1: 2001

9.3 Manufacturer/ Service addresses

The ultrasonic testing kit USM 32X is manufactured by:

GE Inspection Technologies GmbH

Robert-Bosch-Str. 3
D – 50354 Hürth

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

The USM 32X is manufactured according to state-of-the-art methods using high-quality components. Thorough in-process inspections or intermediate tests and a quality management system certified to DIN EN ISO 9001 ensure an optimum quality of conformance of the instrument.

Should you nevertheless detect an error on your instrument, switch the instrument off and remove the batteries. Inform your local service of GE Inspection Technologies indicating the error and describing it.

Keep the shipping container for any repairs possibly required which cannot be made on the spot.

If there is anything special that you would like to know about the use, handling, operation and specifications of the instruments, please contact your nearest representative of GE Inspection Technologies or directly:

GE Inspection Technologies GmbH

Service-Center
Robert-Bosch-Str. 3
D – 50354 Hürth

or:

Postfach 1363
D – 50330 Hürth

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

France

GE Inspection Technologies Scs
SAC Sans Souci
68, Chemin des Ormeaux
F – 69760 Limonest

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

Great Britain

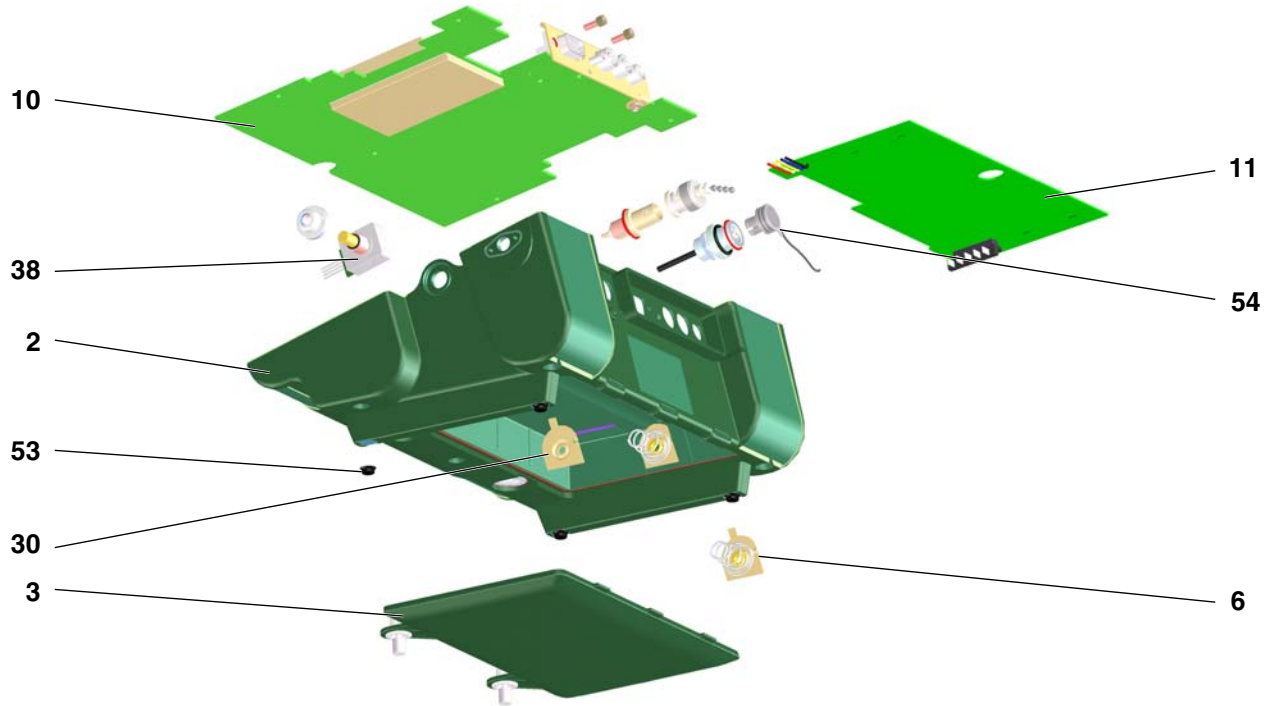
GE Inspection Technologies
892 Charter Avenue
Canley
GB – Coventry CV4 8AF

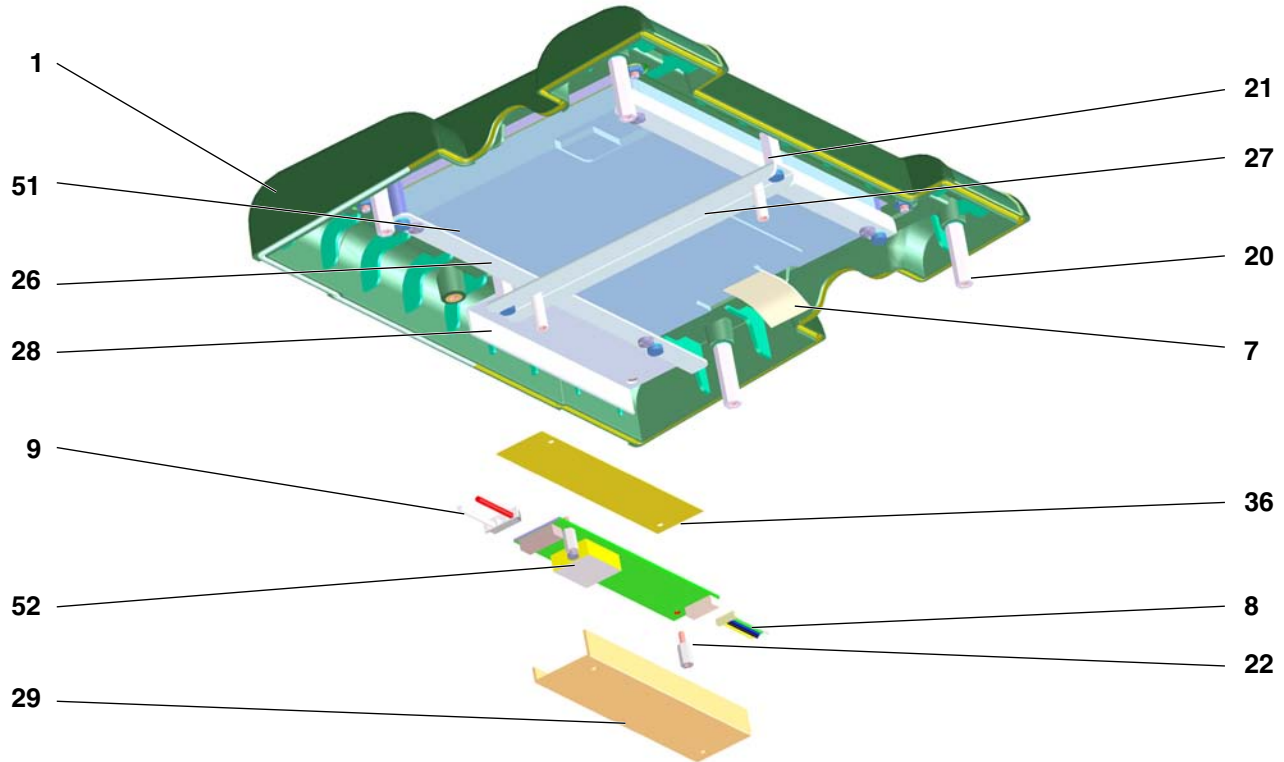
Phone +44 845 - 130 - 3925
Fax +44 845 - 130 - 5775

USA

GE Inspection Technologies, LP
50 Industrial Park Road
P.O. Box 350
USA – Lewistown, PA 17044

Phone +1 717 - 242 03 27
Fax +1 717 - 242 26 06





Pos. #	Description	Id.-No.	Remark
1	Housing upper part, with sealing	36163-3.130	
2	Housing lower part, partly mounted (contains Pos. 11, 6 and 30)	36164-3.130	
3	Battery cover, complete	36165-3.190	
4	Connector-Cover, complete	36166-3.110	
5	Membrane keypad	35593-3.120	
6	Contact spring, complete	35632-3.160	
7	Flexible cable LCD	35635-3.180	
8	Cable 5 pin inverter	35451-3.180	
9	Cable 2 pin LCD	35636-3.180	
10	PCB assembly USM 35 X	36160-3.220	
-	PCB assembly USM 32 X B+F	36161-3.220	
-	PCB assembly USM 32 X L	36162-3.220	
11	PCB assembly USM 35 X Bat	36128-3.220	
12	Cable Lemo - MicroCoax	36070-3.180	
-	BNC-Connector	06650-7.130	
20	Spacer (23 mm)	103138-6.020	
21	Spacer (14 mm)	102043-6.020	
22	Spacer (8 mm)	102044-6.020	
23	Spacer sleeve	34809-6.020	
24	Rotatable knob	36059-6.630	
25	Handle	35253-6.540	
26	Mounting bracket	35612-6.600	
27	Mounting bracket LCD	35621-6.600	
28	Mounting bracket LCD inverter	35622-6.600	
29	Cover	35631-6.600	
30	Contact plate	35633-6.600	
31	Ratchet disk	34796-6.600	
32	Holder for handle	35301-6.640	
-	Pressure devices	18672-7.820	
33	Sealing (Key pad)	34994-6.640	
34	Clamp, lower	34882-6.640	
35	Clamp, upper	35629-6.640	
36	Isolation foil	35634-6.650	
37	Sealing screw	36071-6.070	
38	Rotary position transducer	36056-6.530	
50	Locking screw	12326-7.139	
51	LCD-Display	100874-7.232	
52	Converter	101067-7.232	
53	Rubber foot	14520-7.820	
54	Blanking cap , Lemo	103120-7.137	
-	Blanking cap , BNC	18906-7.139	
	Handle (Modification-Set complete)	35258-2.380	
	08.March.05 / Ant		

Special measurements using the USM 32X F **10**

10.1 Calibration

Calibrating the display range

Before using the USM 32X F, you have to calibrate the instrument.

To be able to use the USM 32X F safely and effectively, adequate training in the ultrasonic testing technique is required.

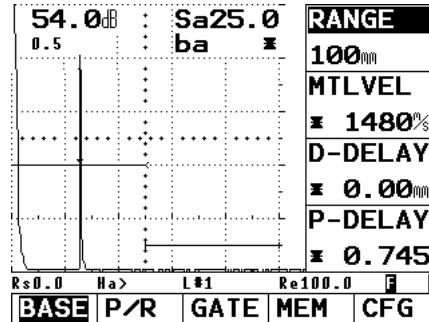
 **Note:**

General calibration methods for the USM 32X are described in chapter 5.6 *Calibrating the USM 32X*.

Calibration process

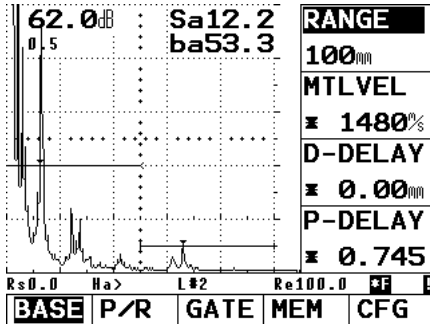
Carry out the calibration on the calibration block VF1 in the flat (thickness 25 mm) for the calibration range of 100 mm.

- Set the **RANGE** to 100 mm.
- Set the sound velocity in **MTLVEL** to 1480 m/s.
- Couple the probe to the calibration block.
- Use the function **P-DELAY** to set the probe delay so that Sa = 25 mm is displayed.



Adjusting the sensitivity

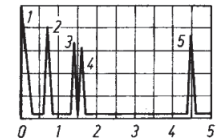
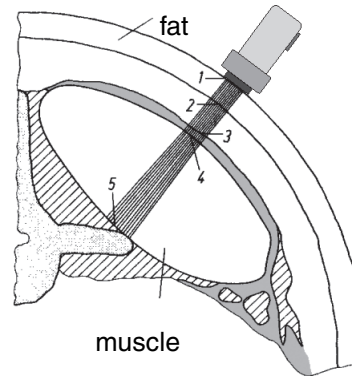
- Couple the probe to the test object.
- Set the gain so that the muscle echo (in gate B) exceeds the gate threshold.



10.2 Measurement

Measurement on a live pig

When coupling the probe to a live pig, up to four echoes appear on the display of the USM 32X F:

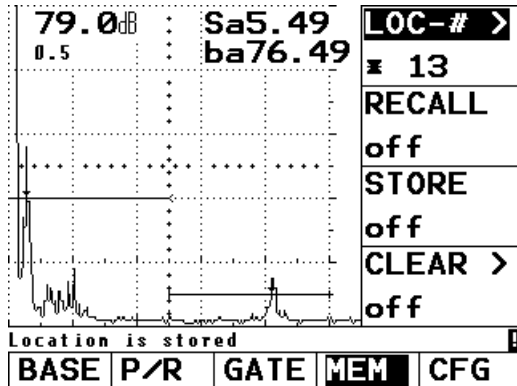


1. initial pulse
2. fascia (upper layer of fat)

3. fascia (lower layer of fat)
4. back muscle, above
5. back muscle, below

At the intersection point of the last echo flank of the echo within the gate, the sound path from the skin surface is now determined and displayed.

Example:



Gate A

The gate A covers the range from 0 to 50 mm, the threshold is at = 40% (default setting). The measurement refers to the fat thickness (reading **Sa**) at the flank of the last echo in the gate.

Gate B

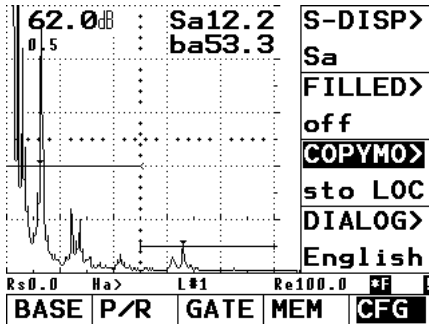
The gate B covers the range from 50 to 100 mm, the threshold is at = 10% (default setting). The measurement refers to the muscle thickness (reading **ba**) between the first echo in gate B and the last echo in gate A.


The two readings are displayed in the top right corner of the A-scan. You can only vary the value **Sa** using the function **S-DISP** (function group **CFG**), the value **ba** has a fixed setting.

Preparing a measurement series

The USM 32X F has a data logger for storing 1000 pairs of readings together with the test location number. An A-scan is not stored.


- Use the function **COPYMO** to select the setting **sto LOC**.



If you now press the key , the pair of values **Sa** (fat) and **ba** (muscle) is stored in the data logger together with the test location number .

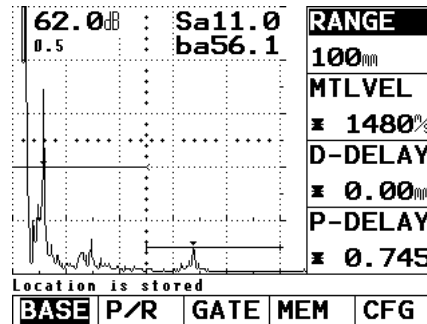
The current memory location is displayed at position 3 of the measurement line (**O**).

Saving readings

After the key  has been pressed, the pair of values **Sa** (fat) and **ba** (muscle) is stored in the data logger together with the test location number.

You can select the required memory location using the function **LOC-#** (function group **MEM**).

The saving is briefly confirmed in the measurement line, the location number is automatically increased.



The USM 32X F is now ready to save the next pair of readings.

Clearing the data logger

You can clear the complete data memory in order to subsequently record and store new readings.

- Set the function **CLEAR** (function group **MEM**) to **on**. A safety prompt appears in the measurement line.
- Press the key of the function **CLEAR** another time. The data logger memory is cleared.


10.3 Documentation

You can print out the list of saved locations and pairs of readings using a connected printer or transfer the data to a connected computer.

Note:

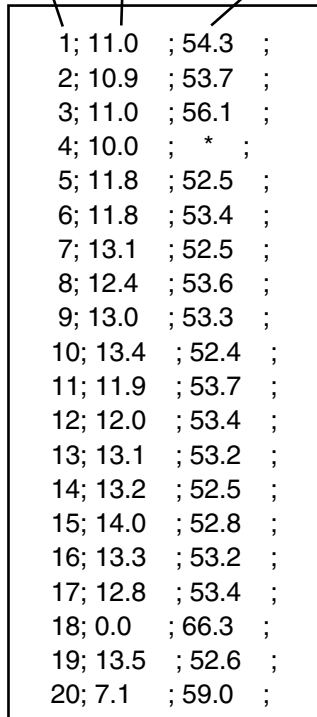
General information on the function **COPYMO** and on the data transfer is also given in chapter 6 *Documentation*.

- Set the function **COPYMO** (function group **CFG**) to **datalog**.

If you now press the key , the list of the pairs of readings **Sa** (fat) and **ba** (muscle) is transferred to the connected computer or printer together with the location number.

The list can be received e.g. using the program Hyperterminal. Thanks to the separator (;), the list can be immediately read in an Excel file.

Loc-# Fat thickness Muscle thickness



1;	11.0	;	54.3	;
2;	10.9	;	53.7	;
3;	11.0	;	56.1	;
4;	10.0	;	*	;
5;	11.8	;	52.5	;
6;	11.8	;	53.4	;
7;	13.1	;	52.5	;
8;	12.4	;	53.6	;
9;	13.0	;	53.3	;
10;	13.4	;	52.4	;
11;	11.9	;	53.7	;
12;	12.0	;	53.4	;
13;	13.1	;	53.2	;
14;	13.2	;	52.5	;
15;	14.0	;	52.8	;
16;	13.3	;	53.2	;
17;	12.8	;	53.4	;
18;	0.0	;	66.3	;
19;	13.5	;	52.6	;
20;	7.1	;	59.0	;

Changes **11**

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.

Index **12**

Index

- A**
- Accessories 2-6
 - Adjustment
 - Coarse and fine 4-8
 - Alkaline batteries 7-4
 - aLOGIC (Evaluation logic gate A) 5-12
 - Anticoincidence 5-12
 - Assignment of COPY key 5-28
 - aSTART (Starting point of gate A) 5-13
 - aTHRSH (Threshold of gate A) 5-13
 - aWIDTH (Width of gate A) 5-13
- B**
- Backlight 4-11, 5-30
 - BASE (function group) 5-4
 - Basic settings
 - Display 4-11
 - Batteries 1-2
 - Care 7-3
 - Charging 7-3
 - Checking charge 3-4
 - Exhausted 7-3
 - Inserting 3-3
 - Internal charging 3-5
 - Partially discharged 7-3
 - Battery charge indicator 3-5
 - bLOGIC (Evaluation logic gate B) 5-12
 - bSTART (Starting point of gate B) 5-13
 - bTHRSH (Threshold of gate B) 5-13
 - bWIDTH (Width of gate B) 5-13
- C**
- Calibration 5-14
 - Dual-element (TR) probes 5-18
 - Straight-beam probes 5-14
 - Calibration USM 32X F 10-2

Care 7-2

CFG (function group) 5-27

Changes 10-1

Changing a function value 8-11

Checking battery charge 3-4

Coarse and fine adjustment 4-8

Codes
 Function codes 8-14

Coincidence 5-12

Color scheme 4-11

Configuration 5-27

Connecting a probe 3-7

Controls 4-2

COPY key 6-2

COPYMOD 6-3

COPYMOD (Assignment of the COPY key) 5-28

D

D-DELAY (Display starting point) 5-6

DAMPING (Probe matching) 5-7

Data exchange
 Printer or PC 8-4

Data logger 10-5

Data saving 5-24

Data set 5-24
 Deleting 5-25
 Recalling 5-26

Data transmission parameters 8-4

Deleting 5-25

DIALOG (Selecting the language) 4-9, 5-29

Display 4-3
 Color Scheme 4-11

Display range 5-4

Display starting point 5-6

Index

- Documentation USM 32X F 10-6
- Double assignment 4-8
- Double assignment of functions 5-27
- DUAL (Pulser-receiver separation) 5-9
- E**
- EC declaration 9-4
- Echo display 5-28
- Enlarged echo display 5-32
- Enlarged display
- Measurement value 4-5
- Evaluation logic of the gates 5-12
- F**
- Fat measurement 10-3
- FILLED (Echo display mode) 5-28
- Fine and coarse adjustment 4-8
- Freeze function 5-32
- FREQU (Frequency range) 5-10
- Function directory 9-2
- Function groups 5-2
- Function keys 4-6
- Functions
- Special keys 5-32
- Functions on display 4-4
- G**
- Gain 4-7, 5-3
- GATE (function group) 5-11
- Gate setting 5-11
- Gate width 5-13
- Gates
- Starting point 5-13

I	Lithium-Ion batteries	3-4
Indicator		
Battery charge	3-5	
Instrument versions	1-8	
Intensity	5-8	
Interfaces		
Settings	8-4	
K		
Keys	4-6	
Special	5-32	
L		
Language	4-9, 5-29	
LEDs	5-33	
LIGHT	5-30	
Lighting	4-11	
Line	4-5	
	Mains connection	3-2
	Maintenance	7-5
	Manufacturer	9-4
	Measurement line	4-5, 5-27
	Measuring	5-22
	Measuring point	5-20
	MEM (function group)	5-24
	MTLVEL (Sound velocity)	5-5
	O	
	On/Off key	4-6
	Operational concept	4-8
	Operator training	1-4
	Operator's controls	4-2

Index

P	
P-DELAY (Probe delay)	5-6
P/R (function group)	5-7
Parity	6-3
PC connection	8-4
POWER (Intensity)	5-8
Power supply	3-2
Power supply unit	3-2
PRF-MOD (Pulse repetition frequency)	5-9
Printer	
Preparing	6-3
PRINTER (Printer for test report)	5-28, 5-31
Printer connection	8-4
Printing data	6-2, 8-5
Probe connection	3-7
Probe delay	5-6
Probe matching	5-7
Pulse repetition frequency	5-9
Pulser adjustment	5-7
Pulser-receiver separation	5-9
R	
RANGE (Display range)	5-4
Recycling	7-6
REJECT	5-8
Remote control	8-6
Reset	3-8
Rotary knobs	4-6, 4-7
RS 232 interface	8-3

S

S-DISP 4-5

S-DISP (Zoomed display of reading) 5-27

Safety information 1-2

Saving in USM 32X F 10-5

SCHEME 5-30

Screen 4-3

Selecting units 4-9

Serial communication activation 8-4

Service addresses 9-4

Sound velocity 5-5

 Coarse and fine adjustment 5-4

Spare parts list 9-6

Special keys 4-6

Standard package 2-3

Start-up 3-8

Status symbols 5-33

Storing a data set 5-25

Suppression

 Setting 5-8

SVEL1 (Fixed sound velocity) 5-27

Switching on/off 3-8

Syntax 8-8

T

Temperature variations

 Important information 1-6

Test material

 Important information 1-5

Threshold of the gates 5-13

Timing 8-8

Transfer of datasets 8-11

Transfer parameter 6-3

Index

U

Ultrasonic testing	
Important information	1-3
UNIT (Selecting units of measurement)	4-9, 5-31
Units	5-2
USM 32X (versions)	1-8

W

Wall thickness measurement	
Important Information	1-5
Waste disposal	7-6
Width of the gates	5-13

Z

Zoom mode	4-3
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Technical specifications according to EN 12668-1

USM 32X B
USM 32X F

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
			-	-	-	Spike pulse
» Spectrum						Picture: 1
» Spectrum						Picture: 2
» Spectrum						Picture: 3
» Spectrum						Picture: 4
» Damping		Ω	-	342 45	-	DUAL = off DAMPING = low DAMPING = high
				1000 50		DUAL = on DAMPING = low DAMPING = high
» Capacity		pF	-	220 1000	-	POWER = low POWER = high
» Pulse Repetition Frequency		Hz	20%	1000	20%	firm
» Operating Modes			-	-	-	Single-, dual mode
» Characteristics of Transmitter Pulse			-	-	-	
»» Pulse voltage	V_{50}	V	-346	-315	-283	1000 Hz DAMPING = low POWER = high
»» Pulse rise time	t_r	ns	8,19	9,64	11,08	
»» Pulse duration	t_d	ns	120,4	133,7	147,1	
»» Effective output impedance	Z_0	Ω	23	29	35	

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
»» Pulse voltage	V_{50}	V	-238	-216	-195	1000 Hz DAMPING = high POWER = high
»» Pulse rise time	t_r	ns	11,18	13,15	15,12	
»» Pulse duration	t_d	ns	81,4	90,5	99,5	
»» Effective output impedance	Z_0	Ω	21	26	31	
»» Pulse voltage	V_{50}	V	-246	-224	-202	1000 Hz DAMPING = low POWER = low
»» Pulse rise time	t_r	ns	5,33	6,27	7,21	
»» Pulse duration	t_d	ns	34,3	38,1	41,9	
»» Effective output impedance	Z_0	Ω	38	48	58	
»» Pulse voltage	V_{50}	V	-153	-139	-125	1000 Hz DAMPING = high POWER = low
»» Pulse rise time	t_r	ns	6,21	7,31	8,40	
»» Pulse duration	t_d	ns	25,1	27,9	30,7	
»» Effective output impedance	Z_0	Ω	24	31	36	

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
Receiver						
» Amplifier			-	-	-	
» Setting Range		dB	-	110	-	
»» Increments		dB	-	0,5 1 2 6 12	-	
»» Accuracy of calibrated attenuator		dB	-2	0	2	
» Amplifier Frequency			-	-	-	
»» Frequency spectrum (-3dB)		MHz	-	0,2 - 18	-	(-3dB)
»» Frequency ranges		MHz	-	-	-	0,5 - 4 MHz Filter 1
»» Lower frequency range	f_l	MHz	0,352	0,391	0,430	
»» Upper frequency range	f_u	MHz	3,903	4,337	4,770	
»» Center frequency	f_0	MHz	1,237	1,302	1,367	
»» Bandwidth	Δf	MHz	3,551	3,946	4,340	
»» Maximum frequency	f_{max}	MHz	1,055	1,407	1,759	
»» Gain for 80% SH		dB	23,5	24,5	25,5	
»» Minimum input voltage	V_{min}	μV_{pp}	90	110	120	
»» Maximum input voltage	V_{max}	V_{pp}	-	-	40	
»» Dynamic range		dB	-	>110	-	
»» Noise level	n_{in}	$nV\sqrt{Hz}$	1	-	80	
»» Frequency ranges		MHz	-	-	-	2 - 20 MHz Filter 2

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
»» Lower frequency range	f_l	MHz	1,875	2,083	2,291	
»» Upper frequency range	f_u	MHz	18,528	20,587	22,645	
»» Center frequency	f_0	MHz	6,220	6,548	6,875	
»» Bandwidth	Δf	MHz	16,653	18,504	20,354	
»» Maximum frequency	f_{max}	MHz	9,072	12,096	15,120	
»» Gain for 80% SH		dB	24,5	25,5	26,5	
»» Minimum input voltage	V_{min}	μV_{pp}	200	260	320	
»» Maximum input voltage	V_{max}	V_{pp}	-	-	40	
»» Dynamic range		dB	-	>100	-	
»» Noise level	n_{in}	$nV\sqrt{Hz}$	1	-	80	
»» Deadtime after transmitter pulse		μs	-	<5 us	-	1nF, 125 Ohm, 0,5-4MHz
»» Receiver input impedance						
»»» Single probe (combined transmitter and receiver)						Single mode
»»» Rmax	R_{max}	Ω	-	338	-	Rmax
»»» Rmin	R_{min}	Ω	-	338	-	Rmin
»»» Cmax	C_{max}	pf	-	52	-	Cmax
»»» Cmin	C_{min}	pf	-	52	-	Cmin
»»» Dual-probe (separate transmitter and receiver)						Dual mode
	R_{max}	Ω	-	511	-	
	R_{min}	Ω	-	511	-	
	C_{max}	pf	-	33	-	
	C_{min}	pf	-	33	-	

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
» Signal Mode			-	-	-	
»» Full Wave			-	yes		
» Suppression			-	yes	-	
»» Adjustable		%	-	1 - 80	-	

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
Monitor						
» Number of Gates			-	2	-	
» Alarm logic			-	off, pos, neg	-	
» Start		mm	-	0 to 1420	-	
» Width		mm	-	0,2 to 9999	-	
» Threshold		%	-	10 - 90	-	
» Measurement points			-	flank, peak	-	
» Alarm			-	LED, horn	-	

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
Display						
» Type			-	active color-LCD	-	
» Dimensions of the Display		mm	-	86 x 115	-	(HxW)
» Resolution			-	240 x 320		Number of pixels
» Backlight			-	yes	-	2 steps
» A-scan display						
»» Linearity of time base		%	-0,5		0,5	
»» Sampling error		%	-2	0	2	bei 2 MHz
»» Display jitter			-	-	-	
»»» Amplitude		%	-2	0	2	Amplitude
»»» Position		%	-1	0	1	Position
» Measurement resolution			-	-	-	
»» Sound path		mm	0,01	-	1	0,01: 0 to 99 mm 0,1: 100 mm to 999 mm 1: ab 1000 mm
»» Amplitude		%	-	0,5	-	
		t_{A1}, t_{A2}				
»»» t_{A1}		ns	-	100	-	t_{A1}
»»» t_{A2}		ns	-	250	-	Following an interface echo

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
» Display width		mm	-	0,5 to 1420	-	
»» Display start		mm	-	37 -10 to 1420	-	Display start
»» Probe delay		µs	-	0 to 199,99	-	
» Material velocity		m/s	-	1000 to 15000	-	Resulation 1m/s
» Unit of measurement			-	mm, inch	-	
» Linearity of time base		%	0,5	0	0,5	
» Image processing			-	-	-	
»» Readings to be displayed			-	3	-	4 for USM 32F
»»» Time of flight			-	yes	-	For Gate A, B
»»» Sound path difference			-	B-A	-	For Gate A, B
»»» Amplitude in %			-	yes	-	For Gate A, B
»»» Alarm			-	yes	-	For Gate A,B
» Signal display mode			-	standard,- filled	-	
» Signal processing			-	-	-	

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
»» Screen freeze			-	yes	-	Freeze
» Zoom			-	yes	-	A-scan on full screen width
» Status information			-	yes	-	
» Dialog languages			-	19	-	
» Function lock			-	yes	-	In zoom mode

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
Data processing						
» Analog-to-Digital Conversion						
»» Sample frequency		MHz	30	-	240	
» Storage of data						
»» Number of datasets			-	200	-	
»» Contents of datasets			-	-	-	A-scan + instrument setup
»» Dataset description			-	-	-	Numerical and alpha-numerical
»» Fat and muscle thickness readings			0		1000	
» Measurement results						
»» Sound path (TOF)			-	yes	-	For Gate A and B
»» Amplitude			-	selectable		For Gate A and B
»» Hardcopy			-	yes	-	Format PCX
»» Function list			-	yes	-	
»» Test Report			-	yes	-	
»» Sound path difference				Yes		For USM 32F

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
Interfaces						
» Digital interface						
»» Types						
»»» RS-232			-	yes	-	RS-232
»» Printer						
»»» Output/type			-	-	-	RS 232
»»» Driver			-	-	-	Epson HP Seiko
»» Data						
»»» Time of flight			-	yes	-	Time of flight
»»» Amplitude			-	yes	-	Amplitude
»»» Alarms			-	yes	-	Alarms
»»» A-Scan				yes		A-Scan
» Remote control						
			-	-	-	RS 232

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
General						
» Instrument						
»» Size (HxWxD)		mm	-	176 x 255 x 105	-	
»» Weight		kg	-	2,2	-	incl. batteries
»» Storage temperature		°C	-20		+60	
»» Temperate range for mains operation		°C	0		40	
»» Temperature range for battery operation		°C	0		60	
»» Warm-up period		h	-	-	-	10 minutes at 25° C
»» Possible power supplies			-	-	-	Battery, mains (external power supply)
»» Voltage range for battery operation		V=	8,6 5,4		13 8	Li Ionen Battery 6 NiCD, NiMH Cells
»» Voltage range with power supply		V=	9,5		13	
»» Power consumption		VA	5,5	-	8	Min (ECO) Max (FULL)
»» Low battery warning			-	yes	-	Status display
»» Environmental Protection			-	IP 54	--	
»» Shock resistivity			-	-	-	Shock resistance according to DIN IEC 68, 6 ms, 60g shocks per axis
»» Vibration						Vibration resistance according to DIN IEC 68, 1-150 Hz, 2g, 20 cycles per axis

Technical specifications according to EN 12668-1

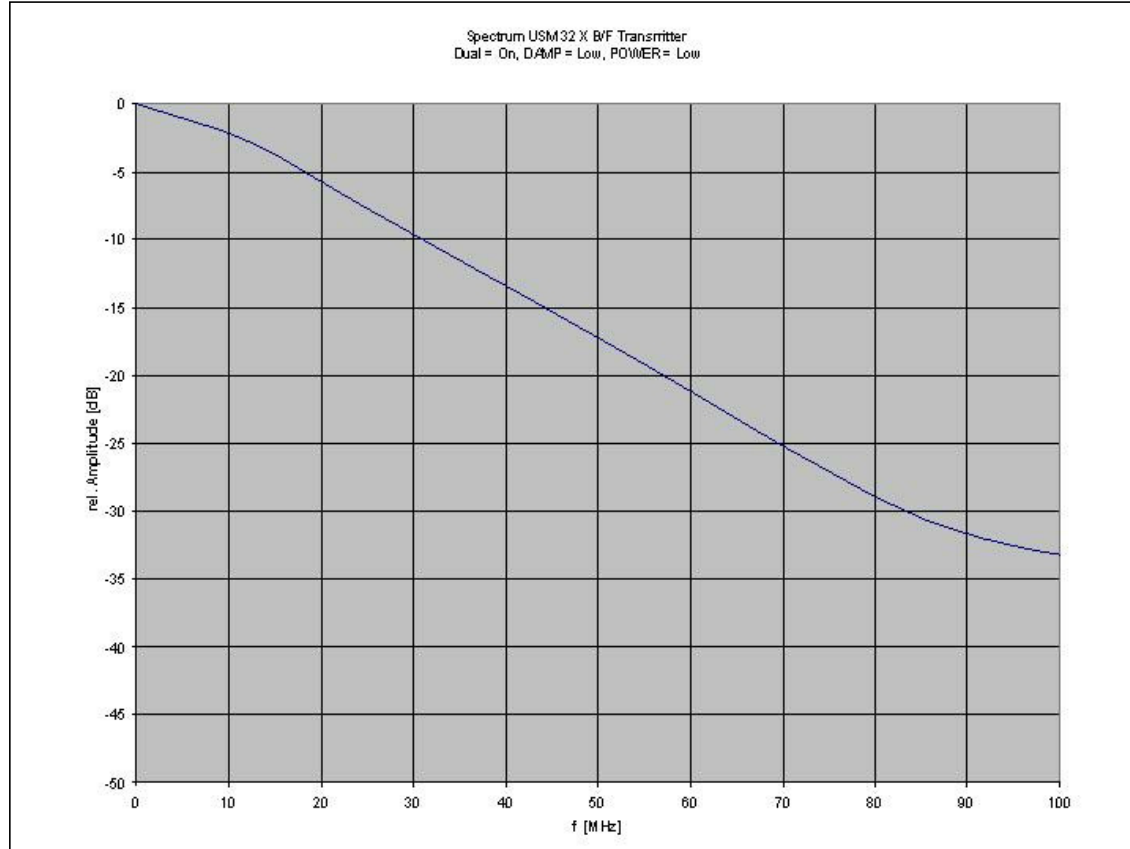
Description	Symbol	Dimension	Min	Average	Max	Comment
» Stability against temperature change			-	-	-	
»» Amplitude		%/10° C	-5	0	5	
»» Echo position		%/10° C	-1	0	1	
» Stability against voltage change			-	-	-	
»» Amplitude		%	-2	0	2	
»» Time of flight		%	-1	0	1	
» Power supply			-	-	-	Li Ion Battery 6 NiMH cells
»» Battery operation time		h	-	10 3	-	Li Ion Battery 6 NiMH cells
» Stability after warm-up time			-	-	-	After 30 minutes
»» Low battery display			-	-	-	Statussymbol
»» Amplitude		%/10° C	-2	0	2	+/-0,5%
»» Time of flight		%	-1	0	1	+/- 0,5mm
»» Change in amplitude over time base position with battery c		%	-	-	-	
» Types of Sockets						
»» Probe connection			-	Lemo, BNC	-	On order
»» RS-232			-	DSUB	-	9-pin
»» External power supply			-	Lemo	-	4-pin
» Case			-	Plastic		
» Documentation			-	-	-	Technical reference manual

Technical specifications according to EN 12668-1

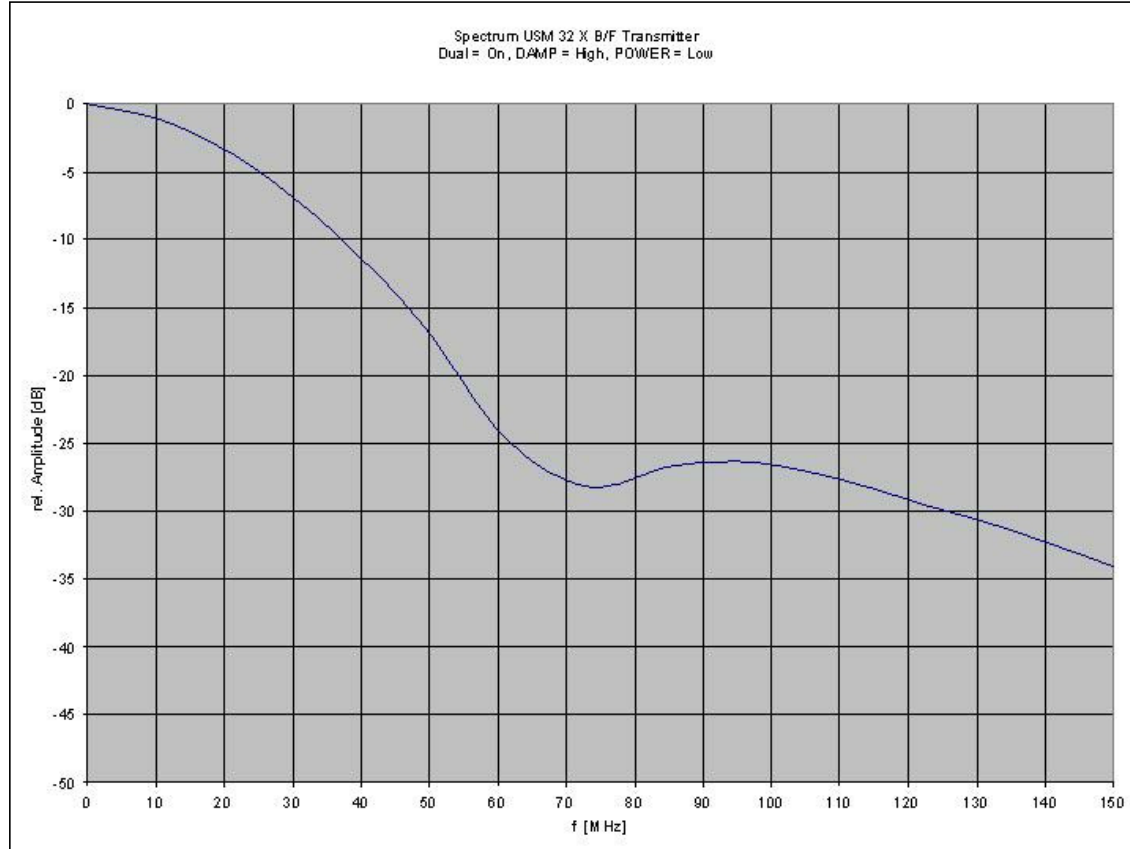
Description	Symbol	Dimension	Min	Average	Max	Comment
Other						
» Software update procedure			-	-	-	Download via RS 232

Technical specifications according to EN 12668-1

Picture: 1

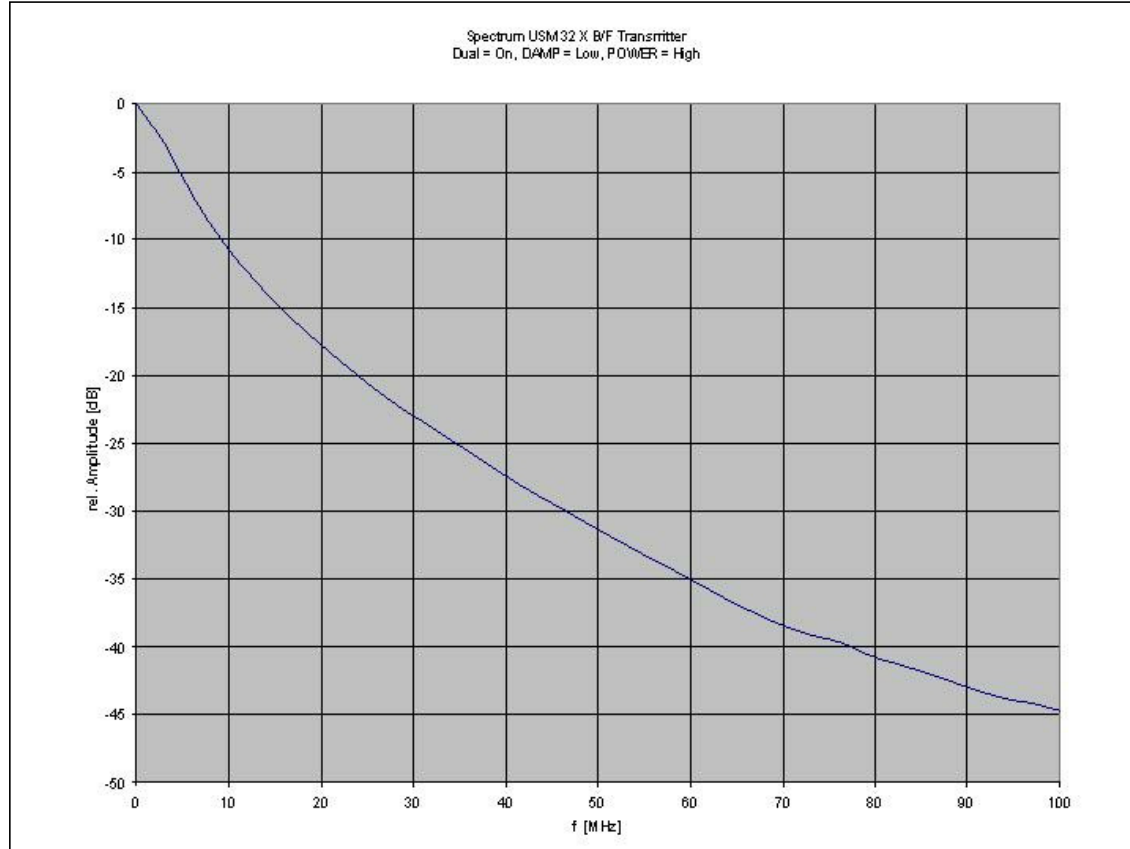


Picture: 2

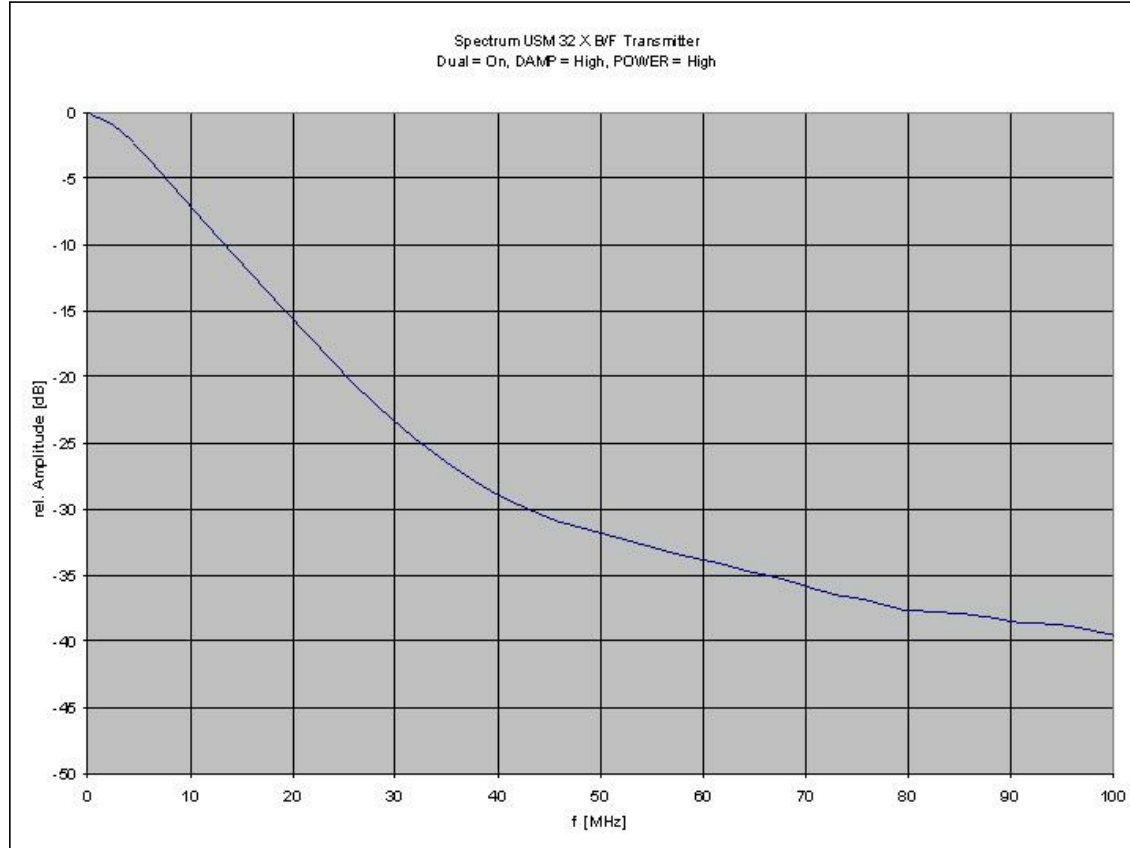


Technical specifications according to EN 12668-1

Picture: 3



Picture: 4



Technical specifications according to EN 12668-1

USM 32X L

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
			-	-	-	Spike pulse
» Spectrum						Picture: 1
» Spectrum						Picture: 2
» Spectrum						Picture: 3
» Spectrum						Picture: 4
» Damping		Ω	-	342 45	-	DUAL = off DAMPING = low DAMPING = high
				1000 50		DUAL = on DAMPING = low DAMPING = high
» Capacity		pF	-	220 1000	-	POWER = low POWER = high
» Pulse Repetition Frequency		Hz	20%	4-1000	20%	
»» PRF Mode			-	-	-	Manual, automatically linked to range in 10 steps
»» PRF step		Hz	-	4 100	-	>1,5m <1,5m
» Operating Modes			-	-	-	Single-, dual mode
» Characteristics of Transmitter Pulse			-	-	-	
»» Pulse voltage	V ₅₀	V	-376	-342	-307	1000 Hz DAMPING = low POWER = high
»» Pulse rise time	t _r	ns	10,38	12,21	14,04	

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
»» Pulse duration	t_d	ns	229	254,5	280	
»» Effective output impedance	Z_0	Ω	16	20	24	
»» Pulse voltage	V_{50}	V	-266	-242	-217	1000 Hz DAMPING = high POWER = high
»» Pulse rise time	t_r	ns	13,71	16,13	18,55	
»» Pulse duration	t_d	ns	151	167,5	184	
»» Effective output impedance	Z_0	Ω	19,2	24	28,8	
»» Pulse voltage	V_{50}	V	-342	-311	-280	1000 Hz DAMPING = low POWER = low
»» Pulse rise time	t_r	ns	9,07	10,67	12,27	
»» Pulse duration	t_d	ns	124	137,5	151	
»» Effective output impedance	Z_0	Ω	17,6	22	26,4	
»» Pulse voltage	V_{50}	V	-240	-218	-196	1000 Hz DAMPING = high POWER = low
»» Pulse rise time	t_r	ns	11,57	13,61	15,65	
»» Pulse duration	t_d	ns	82	91,5	101	
»» Effective output impedance	Z_0	Ω	19,2	23	28,8	

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
Receiver						
» Amplifier			-	-	-	
» Setting Range		dB	-	110	-	
»» Increments		dB	-	0,5 1 2 6 12	-	
»» Attenuator uncal. range		dB	-	4	-	
»» Accuracy of calibrated attenuator		dB	-2	0	2	
»» Uncalibrated increments		dB	-	~0,1	-	
» Amplifier Frequency			-	-	-	
»» Frequency spectrum (-3dB)		MHz	-	0,1 - 20	-	(-3dB)
»» Frequency ranges		MHz	-	-	-	0,1 - 1 MHz Filter 4
»» Lower frequency range	f_l	MHz	0,083	0,092	0,101	
»» Upper frequency range	f_u	MHz	0,915	1,017	1,119	
»» Center frequency	f_0	MHz	0,291	0,306	0,321	
»» Bandwidth	Δf	MHz	0,833	0,926	1,018	
»» Maximum frequency	f_{max}	MHz	0,241	0,322	0,402	
»» Dynamic range		dB	-	>110	-	
»» Noise level	n_{in}	nV \sqrt{Hz}	1	-	80	
»» Minimum input voltage	V_{min}	μV_{pp}			120	
»» Maximum input voltage	V_{max}	V_{pp}	-	-	40	

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
»» Frequency ranges		MHz	-	-	-	0,5 - 4 MHz Filter 1
»» Lower frequency range	f_l	MHz	0,257	0,286	0,314	
»» Upper frequency range	f_u	MHz	3,774	4,193	4,612	
»» Center frequency	f_0	MHz	1,039	1,094	1,149	
»» Bandwidth	Δf	MHz	3,517	3,908	4,298	
»» Maximum frequency	f_{max}	MHz	0,941	1,255	1,568	
»» Minimum input voltage	V_{min}	μV_{pp}			120	
»» Maximum input voltage	V_{max}	V_{pp}	-	-	40	
»» Dynamic range		dB	-	>110	-	
»» Noise level	n_{in}	$nV\sqrt{Hz}$	1	-	80	
»» Frequency ranges		MHz	-	-	-	2 - 20 MHz Filter 2
»» Lower frequency range	f_l	MHz	1,874	2,083	2,291	
»» Upper frequency range	f_u	MHz	18,474	20,527	22,580	
»» Center frequency	f_0	MHz	6,211	6,538	6,864	
»» Bandwidth	Δf	MHz	16,600	18,445	20,289	
»» Maximum frequency	f_{max}	MHz	8,918	11,891	14,863	
»» Minimum input voltage	V_{min}	μV_{pp}			320	
»» Maximum input voltage	V_{max}	V_{pp}	-	-	40	
»» Dynamic range		dB	-	>100	-	
»» Noise level	n_{in}	$nV\sqrt{Hz}$	1	-	80	
»» Deadtime after transmitter pulse		μs	-	<7 us	-	Power high, Damping low, 0,1-1MHz

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
»» Receiver input impedance						
»»» Single probe (combined transmitter and receiver)						Single mode
»»» Rmax	R _{max}	Ω	-	340	-	Rmax
»»» Rmin	R _{min}	Ω	-	340	-	Rmin
»»» Cmax	C _{max}	pf	-	52	-	Cmax
»»» Cmin	C _{min}	pf	-	52	-	Cmin
»»» Dual-probe (separate transmitter and receiver)						Dual mode
	R _{max}	Ω	-	513	-	
	R _{min}	Ω	-	513	-	
	C _{max}	pf	-	34	-	
	C _{min}	pf	-	34	-	
» Signal Mode			-	-	-	
»» Full Wave			-	yes		
»» Negative Halfwave			-	yes	-	
»» Positive Halfwave			-	yes	-	
»» RF				yes		To 50 mm steel
» Suppression			-	yes	-	
»» Adjustable		%	-	1 - 80	-	

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
Monitor						
» Number of Gates			-	2	-	
» Alarm logic			-	off, pos, neg	-	
» Start		mm	-	0 to 9999	-	
» Width		mm	-	0,2 to 9999	-	
» Threshold		%	-	10 - 90	-	
» Measurement points			-	flank	-	
» Alarm				LED		

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
Display						
» Type			-	active color-LCD	-	
» Dimensions of the Display		mm	-	86 x 115	-	(HxW)
» Resolution			-	240 x 320		Number of pixels
» Backlight			-	yes	-	2 steps
» A-scan display						
»» Linearity of time base		%	-0,5		0,5	
»» Sampling error		%	-2	0	2	bei 2 MHz
»» Display jitter			-	-	-	
»»» Amplitude		%	-2	0	2	Amplitude
»»» Position		%	-1	0	1	Position
» Measurement resolution			-	-	-	
»» Sound path		mm	0,01	-	1	0,01: 0 to 99 mm 0,1: 100 mm to 999 mm 1: ab 1000 mm
»» Amplitude		%	-	0,5	-	
		t_{A1}, t_{A2}				
»»» t_{A1}		ns	-	100	-	t_{A1}
»»» t_{A2}		ns	-	250	-	Following an interface echo

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
» Display width		mm	-	0,5 to 9999	-	
»» Fixed ranges		mm	-	55	-	
»» Display start		mm	-	-10 to 900	-	Display start
»» Probe delay		µs	-	0 to 199,99	-	
»» Automatic Calibration			-	yes	-	2 step calibration
» Material velocity		m/s	-	1000 to 15000	-	Resulation 1m/s
» Unit of measurement			-	mm, inch	-	
» Linearity of time base		%	0,5	0	0,5	
» Image processing			-	-	-	
»» Readings to be displayed			-	3	-	
»»» Time of flight			-	yes	-	For Gate A, B
»»» Sound path difference			-	B-A	-	For Gate A, B
»»» Amplitude in %			-	yes	-	For Gate A, B
» Signal display mode			-	standard,- filled		

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
» Signal processing			-	-	-	
»» Screen freeze			-	yes	-	Freeze
» Zoom			-	yes	-	A-scan on full screen width
» Status information			-	yes	-	
» Dialog languages			-	20	-	
» Function lock			-	yes	-	In zoom mode

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
Data processing						
» Analog-to-Digital Conversion						
»» Sample frequency		MHz	30	-	240	
» Storage of data						
»» Number of datasets			-	100	-	
»» Contents of datasets			-	-	-	A-scan + instrument setup
»» Dataset description			-	-	-	Numerical and alpha-numerical
» Measurement results						
»» Sound path (TOF)			-	yes	-	For Gate A and B
»» Amplitude			-	selectable		
»» Hardcopy			-	yes	-	Format PCX
»» Function list			-	yes	-	
»» Test Report			-	yes	-	

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
Interfaces						
» Outputs			-	-	-	
»» Horn			-	yes	-	
» Digital interface						
»» Types						
»»» RS-232			-	yes	-	RS-232
»» Printer						
»»» Output/type			-	-	-	RS 232
»»» Driver			-	-	-	Epson HP Seiko HP DeskJet 1200 HP LaserJet 1200
»» Data						Redable about RS232
»»» Time of flight			-	yes	-	Time of flight
»»» Amplitude			-	yes	-	Amplitude
»»» Alarms			-	yes	-	Alarms
»»» A-Scan				yes		A-Scan
» Remote control			-	-	-	RS 232

Technical specifications according to EN 12668-1

Description	Symbol	Dimension	Min	Average	Max	Comment
General						
» Instrument						
»» Size (HxWxD)		mm	-	176 x 255 x 105	-	
»» Weight		kg	-	2,2	-	incl. Batterien
»» Storage temperature		°C	-20		+60	
»» Temperate range for mains operation		°C	0		40	
»» Temperature range for battery operation		°C	0		60	
»» Warm-up period		h	-	-	-	10 minutes at 25° C
»» Possible power supplies			-	-	-	Battery, mains (external power supply)
»» Voltage range for battery operation		V=	8,6 5,4		13 8	Li Ionen Battery 6 NiCD, NiMH Cells
»» Voltage range with power supply		V=	9,5		13	
»» Power consumption		VA	5,5	-	8	Min (ECO) Max (FULL)
»» Low battery warning			-	yes	-	Status display
»» Environmental Protection			-	IP 66	--	
»» Shock resistivity			-	-	-	Shock resistance according to DIN IEC 68, 6 ms, 60g shocks per axis
»» Vibration						Vibration resistance according to DIN IEC 68, 1-150 Hz, 2g, 20 cycles per axis

Technical specifications according to EN 12668-1

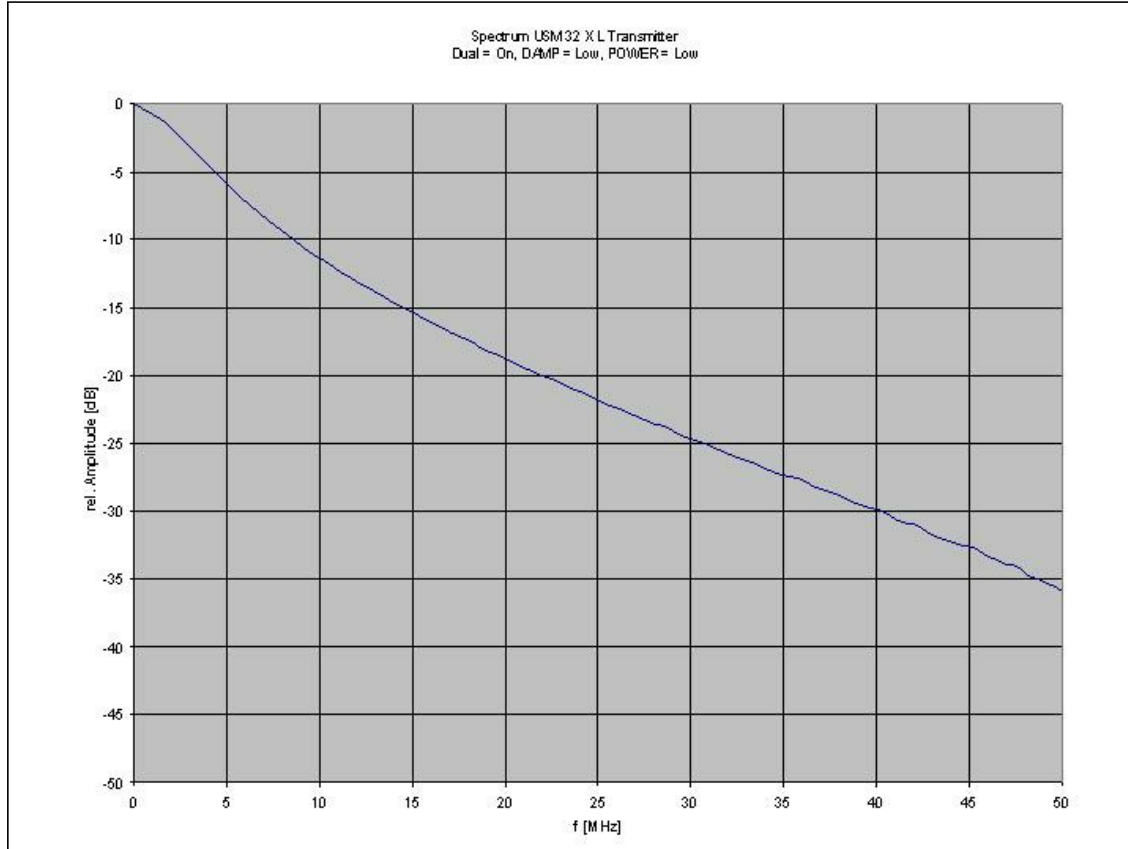
Description	Symbol	Dimension	Min	Average	Max	Comment
» Stability against temperature change			-	-	-	
»» Amplitude		%/10° C	-5	0	5	
»» Echo position		%/10° C	-1	0	1	
» Stability against voltage change			-	-	-	
»» Amplitude		%	-2	0	2	
»» Time of flight		%	-1	0	1	
» Power supply			-	-	-	Li Ion Battery 6 NiMH cells
»» Battery operation time		h	-	14 3	-	Li Ion Battery 6 NiMH cells
» Stability after warm-up time			-	-	-	After 30 minutes
»» Low battery display			-	-	-	Statussymbol
»» Amplitude		%/10° C	-2	0	2	+/-0,5%
»» Time of flight		%	-1	0	1	+/- 0,5mm
»» Change in amplitude over time base position with battery c		%	-	-	-	
» Types of Sockets						
»» Probe connection			-	Lemo, BNC	-	On order
»» RS-232			-	DSUB	-	9-pin
»» External power supply			-	Lemo	-	4-pin
» Case			-	Plastic		
» Documentation			-	-	-	Technical reference manual

Technical specifications according to EN 12668-1

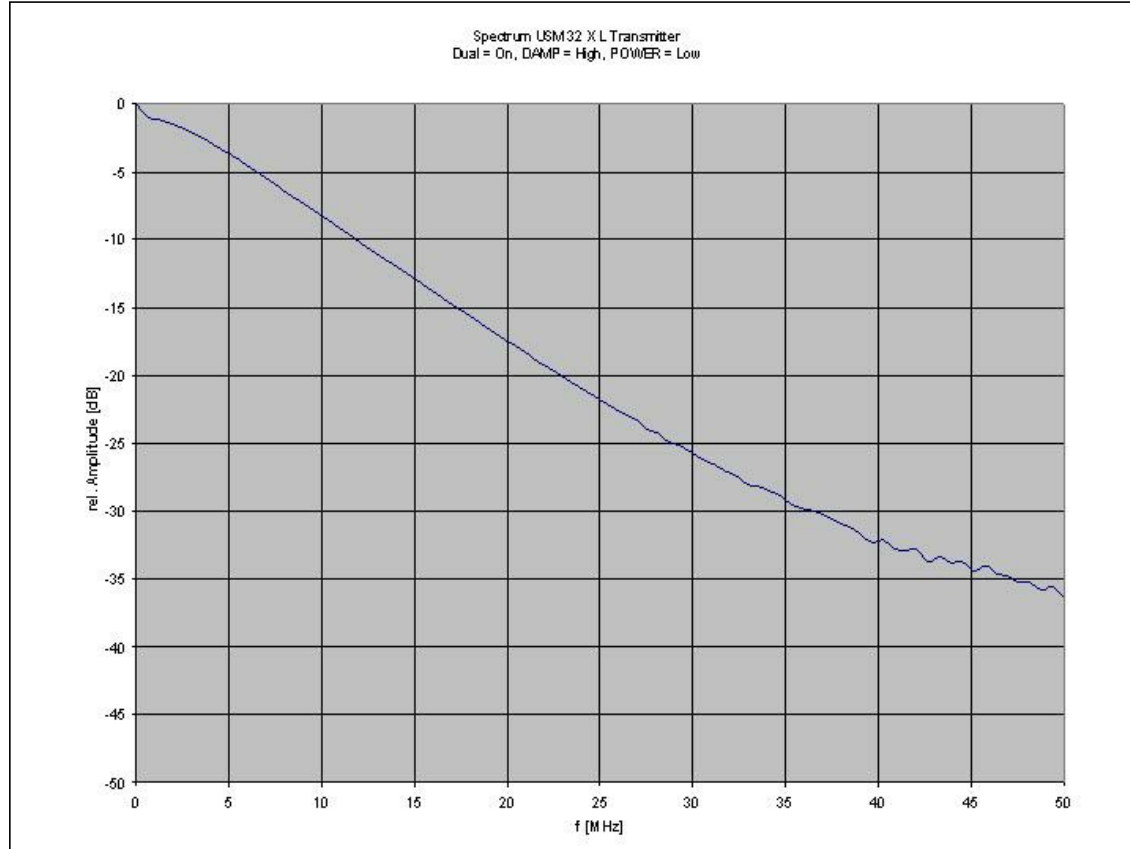
Description	Symbol	Dimension	Min	Average	Max	Comment
Other						
» Software update procedure			-	-	-	Download via RS 232
» Options			-	-	-	Data logger

Technical specifications according to EN 12668-1

Picture: 1

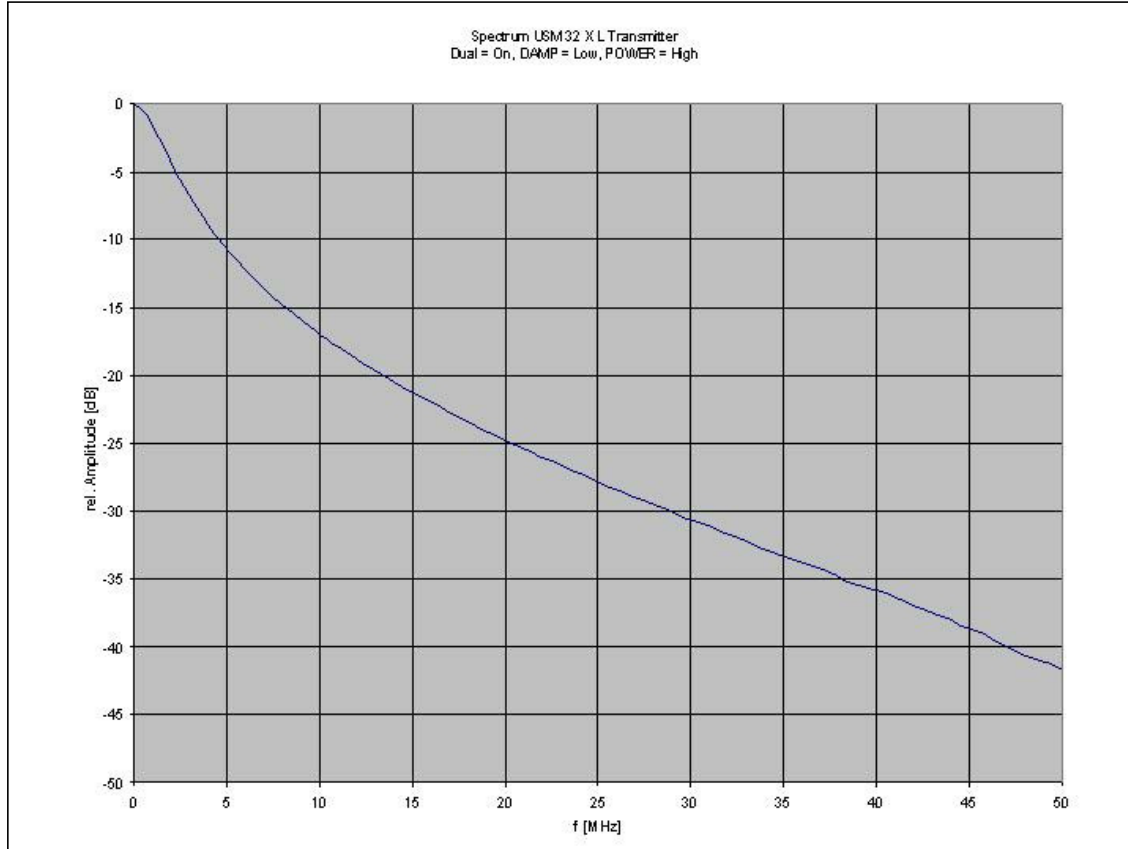


Picture: 2



Technical specifications according to EN 12668-1

Picture: 3



Picture: 4

